

BULLETIN *of* THE UNIVERSITY OF KANSAS

STATE GEOLOGICAL SURVEY *of* KANSAS

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

DEVELOPMENT OF THE OIL AND GAS RESOURCES OF KANSAS



By
EDWARD A. KOESTER



Mineral Resources Circular 3

*Published Semimonthly from January to June
and Monthly from July to December*

Publications of the State Geological Survey are distributed from Lawrence, Kansas

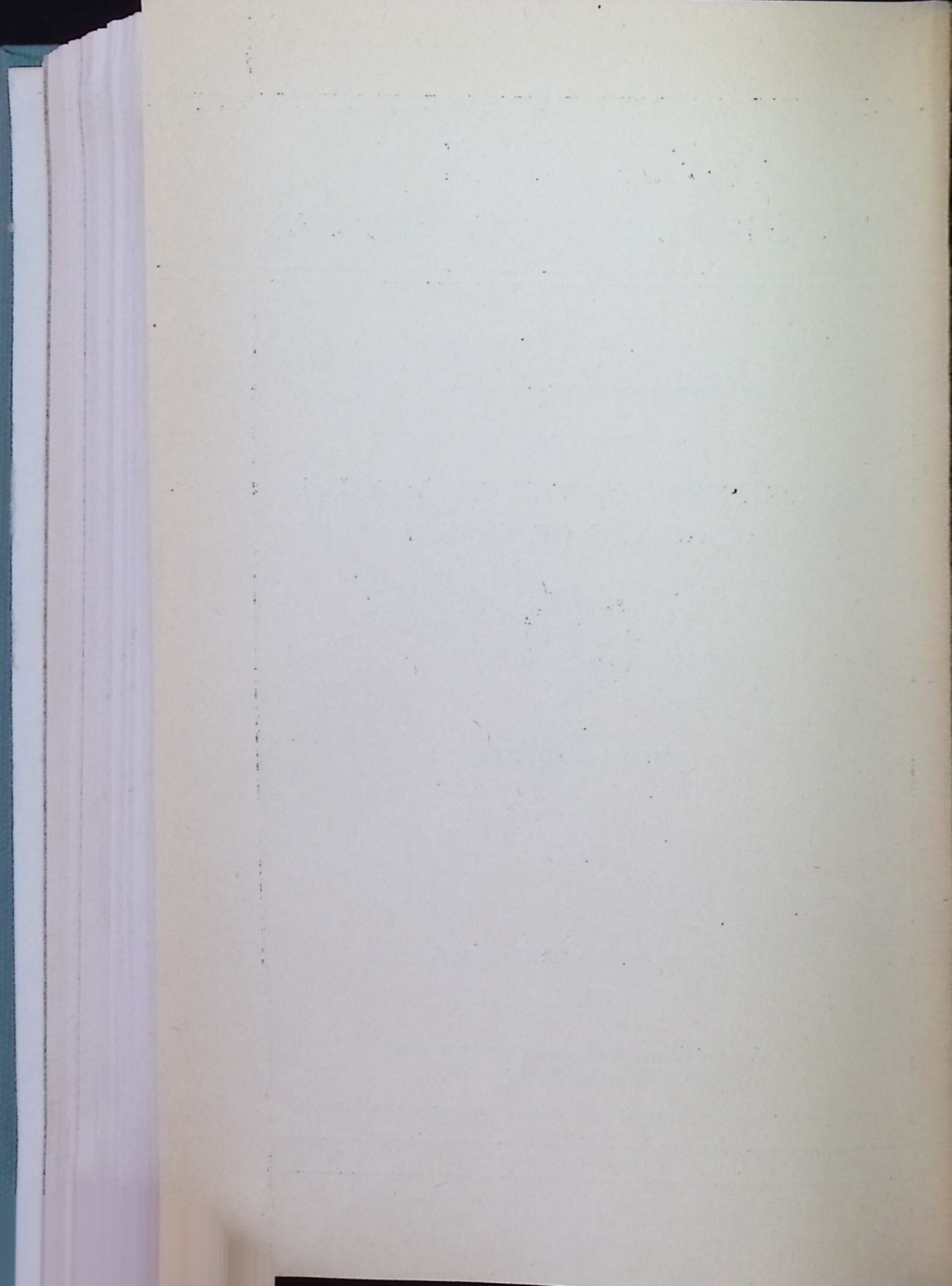
VOL. 35

AUGUST 1, 1934

No. 14

Entered as second-class matter December 29, 1910, at the post office at
Lawrence, Kan., under act of July 16, 1894.

15-4984



STATE GEOLOGICAL SURVEY OF KANSAS

RAYMOND C. MOORE
State Geologist

KENNETH K. LANDES
Assistant State Geologist

MINERAL RESOURCES CIRCULAR 3



Development of the Oil and Gas Resources
of Kansas in 1931 and 1932

EDWARD A. KOESTER

Printed by authority of the State of Kansas

STATE OF KANSAS

ALF M. LANDON, *Governor*

STATE BOARD OF REGENTS

C. M. HARGER, *Chairman*

DUDLEY DOOLITTLE.

RALPH T. O'NEIL.

W. D. FERGUSON.

O. S. STAUFFER.

FRED M. HARRIS.

LESLIE E. WALLACE.

DREW McLAUGHLIN.

BALIE P. WAGGENER.

STATE GEOLOGICAL SURVEY OF KANSAS

ERNEST H. LINDLEY, Ph. D.,
Chancellor of the University of Kansas, and
ex officio Director of the Survey.

RAYMOND C. MOORE, Ph. D.,
State Geologist.

KENNETH K. LANDES, Ph. D.,
Assistant State Geologist.

CONTENTS

	PAGE
INTRODUCTION.....	7
Acknowledgments.....	9
Economic conditions.....	9
Important results.....	11
Proration.....	15
Gas developments.....	16
Production.....	16
EASTERN KANSAS.....	18
Butler county.....	19
Cowley county.....	20
Greenwood county.....	22
Seeley-Wick pool.....	22
Edwards extension.....	22
Carson pool.....	23
Hamilton pool.....	23
Johnson pool.....	23
Lamont (Norton pool).....	24
Virgil pool.....	24
Quincy pool.....	24
Miscellaneous.....	24
Woodson county.....	25
Quincy district.....	25
Virgil district.....	25
WESTERN KANSAS.....	25
Barber county.....	29
Barton county.....	30
Ellis county.....	31
Ellsworth county.....	31
Finney county.....	34
Harvey county.....	34
Haskell county.....	37
Kingman county.....	38
McPherson county.....	39
McPherson oil and gas field.....	39
Ritz-Canton oil and gas field.....	40
Voshell field.....	42
Johnson field.....	42
Reno county.....	43
Rice county.....	46
Rooks county.....	54
Rush county.....	55
Russell county.....	57
Saline county.....	61

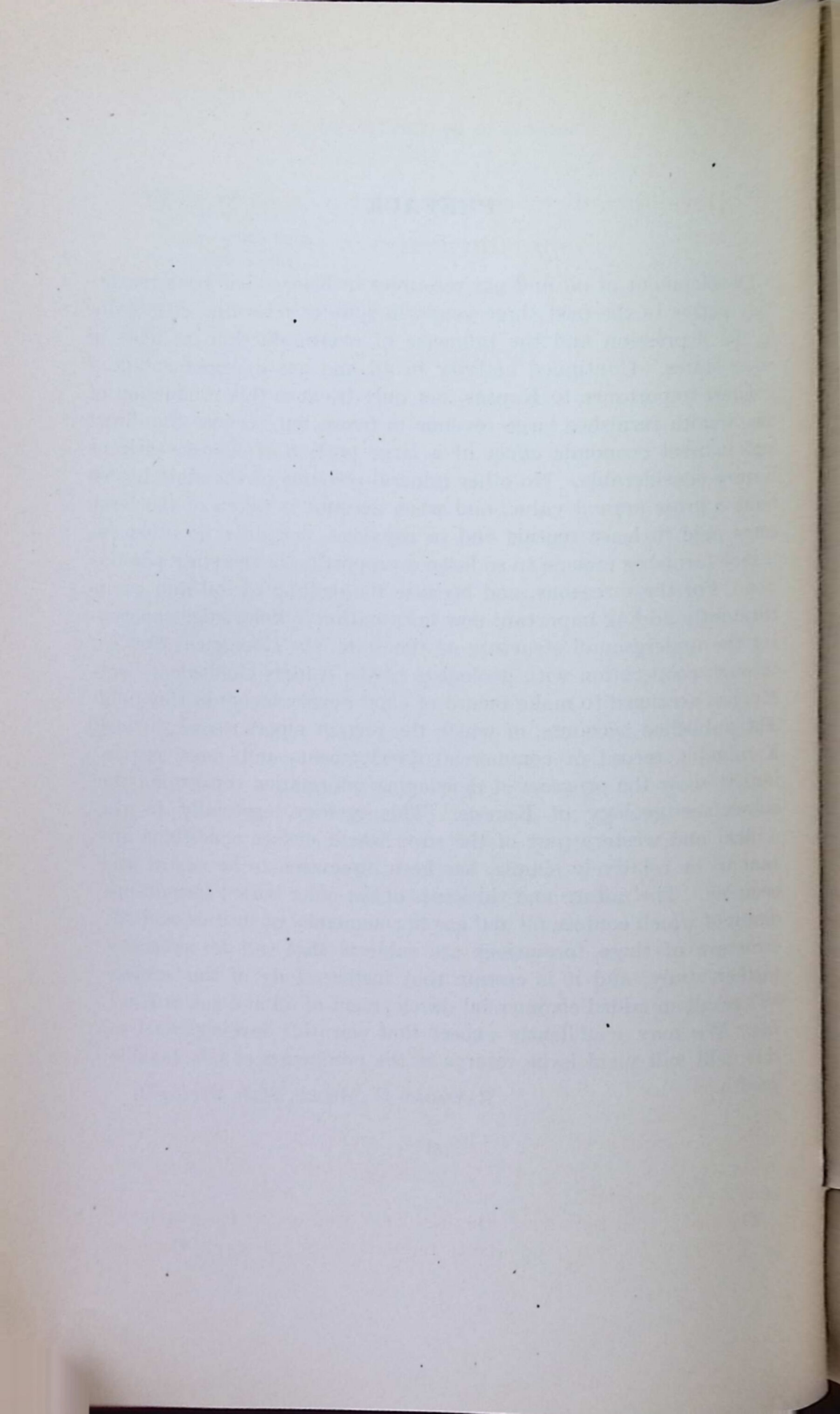
Geological Survey of Kansas

	PAGE
Sedgwick county.....	62
Goodrich field.....	63
Eastborough field..	67
Greenwich field.....	68
Valley Center field.....	70
Stevens, Morton and Grant counties.....	71
Sumner county.....	71
Stafford county.....	73
Developments in other counties.....	74

PREFACE

Development of oil and gas resources in Kansas has been reasonably active in the past three years, in spite of retarding effects due to the depression and the influence of overproduction in fields of other states. Continued activity in oil and gas development is of greatest importance to Kansas, not only because this production of new wealth furnishes large revenue in taxes, but because the direct and indirect economic effect of a large portion of Kansas citizens is very considerable. No other mineral resource of the state has so large a gross annual value, and when account is taken of the large sums paid in lease rentals and in royalties, certainly no other resource furnishes income to so large a proportion of the state population. For these reasons, and because the drilling for oil and gas is constantly adding important new information to knowledge concerning the underground structure of the state, the Geological Survey, through coöperation with geologists of the Kansas Geological Society, has arranged to make record of chief developments in this field. The published accounts, of which the present report is one, furnish a valuable record of commercial developments and, more importantly, show the progress of developing information concerning the subsurface geology of Kansas. This geology, especially in the central and western part of the state where surface conditions appear to be relatively simple, has been discovered to be varied and complex. The nature and thickness of the older buried formations, many of which contain oil and gas in commercial quantities, and the structure of these formations are subjects that call for extended further study, and it is certain that further study of this subject will result in added commercial development of oil and gas in Kansas. We may confidently expect that scientific investigations in this field will yield large returns in the production of new taxable wealth.

RAYMOND C. MOORE, *State Geologist.*



Development of the Oil and Gas Resources of Kansas in 1931 and 1932

EDWARD A. KOESTER

INTRODUCTION

The first of a series of reports concerning the development of the oil and gas resources of Kansas, sponsored by the Kansas Geological Society and published by the State Geological Survey of Kansas, was prepared for the year 1927. Subsequently reports have been published for the years 1928-1929, and for 1930. This report covers the two-year period 1931-1932.

It is the purpose of the author in preparing this résumé to model it after the previous reports of this series, in so far as possible. However, of necessity, less attention is given in this report to the details of production of different fields or producing horizons, as production figures on each field are not available to the author. More space, however, is devoted to a discussion of the structural features of the various producing areas, especially those in western Kansas. This is possible in the present report because more information concerning the subsurface stratigraphy and structure is known than at the time the previous reports were published.

The author has attempted to describe the various fields as of January 1, 1933. Inasmuch as the main body of this report has been written some months after that date, it is only natural that developments since that time have colored the writer's viewpoint.

Some students of Kansas subsurface stratigraphy will take issue with the author's use of subsurface terms, such as "Oswald lime," "Viola lime," and "Hunton lime." A word of explanation at this time is advisable. Though our knowledge of subsurface stratigraphy in Kansas has grown remarkably in the past six or eight years, there are still too many problems that remain unsolved for any one geologist to definitely state the producing horizon in every field in central and western Kansas. Indeed there are very few fields in which the age of the producing horizon would be agreed upon by all geologists.

The producing horizon in the discovery well of the Hollow field, in T. 22 S., R. 3 W., has been referred to as Misener, Hunton

"lime," and Siluro-Devonian limestone. The field term for this pay is "Hunton lime," and is used in this report, although the author recognizes that some Misener sand is found in some of the wells.

The term "Oswald lime" has been used for many years for the limestone beds so successfully developed in some Russell county fields. This is a field term, but there is growing evidence leading to the adoption of this term as a truly scientific name. It has been correlated as equivalent to the Oread limestone, the Lansing formation, the Kansas City, and even the Marmaton. Most geologists who have studied the problem refer to it as Lansing-Kansas City in age. The writer prefers to use the term "Oswald lime" for this series of oil-producing rocks and to extend the use of the term beyond Russell, Rooks and Ellis counties in which it has previously been applied.

"Viola lime" is a field term denoting to some almost any limestone found overlying the "Wilcox" sand in Kansas. While it is recognized that there is a white, crystalline limestone in Kansas wells to which the term "Kansas Viola" may be more accurately restricted, in a report such as this the term "Viola lime" is best used to describe the Ordovician limestones and dolomites occurring between the Sylvan or Maquoketa shale and the "Wilcox series." However, in those instances in which it has been definitely proved that the "Viola lime" was not the producing horizon under discussion, the more scientifically accurate term is used. For example, the deep pay in the Goodrich field, T. 25 S., R. 1 E., Sedgwick county, has been considered in the press as "Viola lime." Actually, the pay is a porous dolomite of Misener (Lower Mississippian) age and is so called in this report.

The term "Arbuckle lime" has been used to describe the thick series of dolomites and thin green shales which lie at the lowest part of the section in nearly all parts of Kansas. While the author recognizes that the correlation may be correct, he prefers to call this group the "Siliceous lime," the term most commonly used in the field. Some geologists consider part of the "Siliceous lime" to be of Chazyan age in certain areas in Kansas, and thus definitely above the Arbuckle.

Acknowledgments

The author acknowledges the assistance of the various geologists, land men, oil and gas companies and individual operators who have so generously contributed to the publication of this information. To certain individuals special acknowledgment is due.

Granville Tierney, of the Amerada Petroleum Corporation, has supplied almost all the production information on western Kansas fields. Production data on eastern Kansas fields have been taken from the reports of the *Oil and Gas Journal*.

George F. Berry and B. S. Ridgeway have supplied most of the manuscript concerning the developments in Cowley, Butler, Greenwood, Woodson and Chase counties. Much of the information concerning developments in McPherson county was prepared with the assistance of Gail Carpenter. The manuscript covering the developments in Morton, Stevens, Seward, Grant and Haskell counties is almost wholly the work of Lourin A. Crum, consulting geologist.

Marvin Lee, consulting geologist, has contributed most of the information concerning proration in Kansas during the period covered by this report.

The writer is indebted also to Thomas H. Allan, R. A. Whortan, Harvel E. White, Anthony Folger, H. S. Bryant, and E. A. Wyman for assistance in preparing this report.

Economic Conditions

The oil and gas industry in Kansas, as well as in other states, cannot be said to have enjoyed prosperity in the years 1931 and 1932. Disturbing factors, both within and without the industry, were such as to prevent the profitable operation of most companies. The general slackening in the use of raw materials of all sorts, which began in 1930, did not seriously affect the oil industry in these two years, but overproduction in Texas and Oklahoma had the effect of depressing the industry throughout the United States. As this overproduction fluctuated, so the price of crude oil at the well likewise varied in the two-year period. Prices for Kansas oil were not controlled by Kansas overproduction or underproduction, but were controlled largely by the unstable conditions in the states to the south.

A study of the price changes of 40° oil gives a fair picture of the economic situation of the Kansas oil and gas industry. The price at the beginning of 1931 for this grade of oil was \$1.07 per barrel. The

posted price as set by most of the crude purchasers was changed as follows:

Kansas crude oil prices per barrel in 1931 and 1932

1931—March 5	\$0.67
June 1	0.37
July 8	0.22
July 24	0.42
August 22	0.70
November 2	0.85
1932—April 1	1.00
October 5	1.12
December 16	0.77
1933—January 18	0.52

One of the unfavorable permanent results of the unprofitable condition of the oil and gas industry in these times was the premature abandonment of small wells whose operation was unprofitable under existing conditions or impossible because of lack of pipeline outlet. One of the largest purchasers in the state ceased purchasing oil January 1, 1931, from thousands of eastern Kansas wells, and this situation was only partially corrected by the joint action of certain purchasing companies, who, at the request of the governor, agreed to buy a limited amount of this production. Moreover, many newly discovered fields in the western portion of the state remained shut in, in whole or in part, because of the inability of their owners to sell their output. The result of the latter condition, however, was beneficial to the industry as a whole, as it kept this oil out of competition with the production from older fields and tended to retard development.

Another result of the economic conditions was the fact that only those wells were drilled whose chances for success were believed to be most favorable. For this reason the percentage of dry holes to total wells drilled was unusually low, being only 29.8 per cent in 1931 and 29.2 per cent in 1932.

Naturally the drilling of wildcat wells showed a marked decrease. Whereas thirty western Kansas counties were prospected in 1929, the year of most active wildcatting in that part of the state, only twenty-six counties received tests in 1931, and twenty-two in 1932. Although fewer tests were drilled during the past two years, the results were more successful. Important reserves have been proved in a number of undeveloped areas, and several new counties have been added to the list of oil producers. Moreover, nearly all the wells drilled in 1931 and 1932 were well financed and able to reach all known oil-producing beds.

Important Results

The outstanding developments in Kansas during 1931 may be listed in order of importance as follows:

(1) Discovery of several "Siliceous lime" producing fields on the Ellsworth anticline and Central Kansas uplift in Ellsworth, Rice, Barton and Rush counties.

(2) Development of large gas reserves in southwestern Kansas, and the construction of large gas pipe lines to carry away its gas.

(3) Extension and development of the Ritz-Canton field and other fields in McPherson county.

(4) Discovery of oil in commercial quantities in the Hunton "lime" in Kansas.

(5) Discovery of Lansing "lime" production in the Cunningham field of Kingman county.

(6) "Siliceous lime" development in the Winfield pool, Cowley county.

(7) Sustained development in Sedgwick county fields.

(8) Decline in activity in older fields of eastern Kansas.

In 1932 several features stood out in the oil industry in Kansas, as follows:

(1) The unusual success, on a percentage basis, in the discovery of new producing areas in western Kansas.

(2) The development of prolific production from several producing horizons along the McPherson anticline in McPherson, Harvey and Reno counties.

(3) The proving of the Hunton "lime" as an important producing horizon.

(4) Continued activity in the Winfield townsite field, Cowley county, and in Sedgwick county.

(5) A mild revival of interest in Bartlesville sand fields of Greenwood and Woodson counties.

(6) The unsuccessful completion of several wildcat tests in far western Kansas, which added much valuable geological data.

(7) The growth of proration throughout the state.

A statistical summary of oil and gas developments in Kansas in 1931 and 1932 is given in Tables 1 and 2. These figures bring out the concentration of activity in the central counties of the state and in Greenwood county. The great activity in the Ritz-Canton field accounts for most of the operations listed in McPherson county, which led all other counties in total operations for both years.

Greenwood county, which ranked below Sedgwick and Cowley counties in 1931, had a revival of activity in 1932 and placed second. Steady development in the fields near Wichita and the revival of interest at Winfield as the result of the discovery of "Siliceous lime" production there account for the showing of Sedgwick and Cowley counties.

The more important newcomers to the list of active counties are Rice, Ellsworth, Harvey, Reno and Barton counties. The decline in activity in the old fields of eastern and southeastern Kansas is due, of course, to the unfavorable economic conditions prevailing throughout the nation as well as the lack of pipe-line outlet for many of the old fields. The latter handicap also explains the relative inactivity in Trego, Rooks, Rush, Ness and Edwards counties, as the undeveloped pools of these counties were without pipe-line connection on January 1, 1933.

Attention has been called to the low percentage of dry holes to total completions in 1931 and 1932, the figures being 29.8 per cent and 29.2 per cent, respectively. These compare with 42.8 per cent in 1929, and 40.8 per cent in 1930. The lowering of this percentage is due, in part, to more successful use of geological methods in locating and developing oil reserves, as well as the tendency of major companies and independent operators alike to drill only inside locations unless forced to do otherwise due to expiring leases.

However, the trend toward a wider spacing of wells in recent years has tended to counteract this apparent improvement in procedure. Whereas ten to twelve years ago it was not at all uncommon to drill nine wells on each forty-acre lease, the customary procedure in most Kansas fields to-day is to drill not more than four wells on each forty acres, and the development of some fields has been commenced with the anticipation of drilling but one well to the forty acres. In a few instances wide spacing of wells has met with considerable opposition from landowners and royalty owners, and it is quite unlikely that the forty-acre spacing of wells will ever become common in most Kansas fields.

An interesting bit of information included in Tables 1 and 2 that has heretofore been omitted in such tables, chiefly because of its unimportance, is the number of old wells drilled to deeper horizons. This column in the table lists the number of wells drilled in previous years that were deepened to some lower producing level during the years under discussion and completed as producers or abandoned as dry holes. Most of the deepening in 1931 took place in the Sedg-

TABLE 1.—Oil and gas operations in Kansas for 1931

COUNTY.	Wells.	Oil.	Gas.	Dry.	Old wells drilled deeper.
Barber.....	2	0	1	1	0
Barton.....	1	1	0	0	0
Bourbon.....	1	0	0	1	0
Butler.....	15	6	6	3	2
Chase.....	4	0	2	2	0
Chautauqua.....	2	0	1	1	0
Clark.....	1	0	0	1	0
Clay.....	1	0	0	1	0
Coffey.....	3	1	0	2	0
Cowley.....	46	14	13	19	9
Elk.....	3	2	0	1	0
Ellis.....	4	2	0	2	2
Ellsworth.....	8	2	0	6	0
Ford.....	1	0	0	1	0
Franklin.....	3	0	0	3	0
Gove.....	2	0	0	2	0
Graham.....	1	0	0	1	0
Greenwood.....	36	16	2	18	0
Harper.....	1	0	0	1	0
Harvey.....	7	1	0	6	0
Haskell.....	1	0	1	0	0
Kingman.....	2	1	0	1	0
Leavenworth.....	3	0	0	3	0
Linn.....	9	0	7	2	0
Lyon.....	2	0	0	2	0
McPherson.....	160	95	51	14	8
Marion.....	4	2	0	2	0
Miami.....	10	0	4	6	0
Morris.....	5	0	3	2	0
Morton.....	2	0	1	1	0
Ness.....	1	0	0	1	0
Pawnee.....	1	0	0	1	0
Pratt.....	1	0	0	1	0
Reno.....	8	6	1	1	1
Rice.....	21	9	3	9	0
Rooks.....	2	0	0	2	0
Rush.....	3	1	2	0	0
Russell.....	18	12	0	5	7
Saline.....	2	0	0	2	0
Sedgwick.....	48	37	0	11	21
Stevens.....	25	0	25	0	0
Sumner.....	5	2	0	3	0
Woodson.....	1	0	0	1	0
Totals.....	476	211	123	142	50

TABLE 2.—Oil and gas operations in Kansas for 1932

COUNTY.	Wells.	Oil.	Gas.	Dry.	Old wells drilled deeper.
Allen.....	1	0	0	1	0
Anderson.....	1	0	0	1	0
Barber.....	1	0	0	1	0
Barton.....	6	2	0	4	1
Butler.....	13	5	2	6	4
Chase.....	4	2	1	1	0
Chautauqua.....	14	12	2	0	0
Coffey.....	6	2	0	4	0
Cowley.....	70	52	6	12	5
Dickinson.....	1	0	0	1	0
Douglas.....	3	0	0	3	0
Edwards.....	1	0	0	1	0
Elk.....	7	1	3	3	0
Ellis.....	3	3	0	0	3
Ellsworth.....	29	17	1	11	1
Finney.....	2	0	1	1	0
Ford.....	1	0	0	1	0
Greenwood.....	104	62	0	42	1
Harvey.....	20	17	0	3	1
Kingman.....	5	4	1	0	1
Leavenworth.....	1	0	0	1	0
Linn.....	3	0	0	3	0
McPherson.....	152	125	7	20	37
Marion.....	6	0	0	6	0
Miami.....	6	0	5	1	0
Morris.....	6	0	2	4	0
Osage.....	1	0	0	1	0
Phillips.....	1	0	0	1	0
Rawlins.....	1	0	0	1	0
Reuo.....	20	15	3	2	2
Rice.....	16	11	0	5	1
Rooks.....	1	0	0	1	1
Rush.....	3	0	2	11	0
Russell.....	4	2	0	2	1
Saline.....	1	0	0	1	0
Sedgwick.....	50	33	1	16	16
Sheridan.....	1	0	0	1	0
Stafford.....	4	3	0	1	0
Sumner.....	6	1	0	5	1
Washington.....	1	0	0	1	0
Woodson.....	16	13	0	3	0
Totals.....	592	382	37	173	78

wick county fields, whereas a large share of the deepened wells in 1932 were in McPherson, Sedgwick, and Rice counties. This column does not include wells completed in one horizon and deepened to another horizon in the same year. However, a well completed in 1931, or in previous years, and deepened in 1932 would be included in the 1932 column. It can be seen, therefore, that there were only 426 new holes drilled in Kansas in 1931, and only 514 new wells in 1932, after deducting from the total completions for these years 50 and 78 older wells drilled deeper.

Proration

Kansas production is under regulation as specified in House bill No. 387, passed by the legislature in 1931, which became effective when published May 28, 1931. The principal features of the law are: the prohibition of waste, including gas energy; the regulation and prevention of discrimination of purchasers; and the marketing of oil ratably from wells in each field when the daily production is above fifteen barrels per well. This act gives the enforcing powers to the Public Service Commission. The commission, having many other regulatory duties, appointed an oil advisory committee, which, with the aid of the state umpire, keeps records and makes recommendations for orders as to specific regulation of fields and conditions in each field.

At the time that the commission was given authority to regulate production and marketing in flush fields, several of these had already been under voluntary proration and marketing restrictions by agreement of the operators. These gradually came under the control of the commission by mutual consent. It has been the policy of the Public Service Commission to permit freedom of action to operators as long as it does not conflict with the law. The cost of administration of this law is assessed against the operators according to the amount of oil taken from the fields in which ratable taking is necessary. There is a growing feeling that the whole state should share this small expense, since it is beneficial to the older fields by assuring them 100 per cent market for their output by restricting the flush fields.

At present three men are in charge of field work in connection with the commission's regulation and conservation measures, and the state umpire gives full time to this work. Most of the time of the chairman of the oil advisory committee is devoted to this work. The cost of proration to producers in Kansas has been lower than

in any other state and the employees are fewer in proportion to the amount of oil handled.

At the close of 1932 eight separate producing areas, six of which consisted of but one well, were completely shut in for lack of pipeline outlet. These eight areas had a potential production of 10,115 barrels per day.

Gas Developments

Drilling for gas was concentrated in two areas in 1931, the Hugoton field in southwestern Kansas, and McPherson county. The former field had been extensively drilled in 1930, and by the close of 1931 development had about ceased. The field is located in Stevens, Morton and Grant counties, but gas wells found in Haskell county in 1931, Finney county in 1932, and Seward county in 1922 may be considered as belonging to the same general producing area. Gas pipe lines built into this field in 1931 and 1932 are able to deliver natural gas by one system to Chicago, Ill., by another to Indianapolis, Ind., from whence lines already lead practically to the Atlantic seaboard, and to cities in Nebraska, Iowa, Minnesota and Wisconsin. A 6-inch pipe line was completed from the Hugoton field to Lamar, La Junta, and other southeastern Colorado towns in 1930, and lines also run to Dodge City and Garden City, Kan.

Drilling in the Galva portion of the Ritz-Canton field (T. 19 S., R. 2 W.) and the Canton part (T. 19 S., R. 1 W.) had established a greater production than the market could absorb by the spring of 1931, so there was little incentive to drill wells for gas in this area in the following months. However, a number of wells were drilled and completed as gas wells in the Ritz-Canton field in the latter half of 1931 and in 1932, but some of these were later drilled either into the underlying oil-bearing portion of the Mississippian chat or deepened still farther to the "Viola lime" pay and completed as oil wells. Some gas tests were drilled to hold expiring leases and shut in after completion or allowed to produce a very small share of their capacity. Many of the wells drilled in the Ritz-Canton field in the two-year period under discussion are tabulated as oil wells, though they were profitable gas wells when first drilled into the chat.

Production

The production figures given in Table 3 have been compiled from three sources. Data on the eastern Kansas counties have been taken from the reports published in the *Oil and Gas Journal*. The figures used for the western Kansas counties have been very gener-

ously supplied by Mr. Granville Tierney, of the Amerada Petroleum Corporation, who has carefully compiled this information for several years. In a few cases in which the author believed he had more accurate data at hand than those of Mr. Tierney, these have been substituted. The total figures for the two years represent within one or two per cent the actual amount of oil produced in the state for the period.

TABLE 3.—*Kansas oil production for 1931 and 1932 in barrels, by counties*

COUNTY.	1931.	1932.
Allen	174,324	161,601
Anderson	450,993	335,403
Barton	19,018	52,381
Bourbon	14,392	11,019
Butler	7,769,344	6,683,785
Chautauqua	682,854	540,184
Cowley	1,885,135	2,743,002
Douglas	4,152	1,785
Edwards	16,621	8,030
Elk	756,809	556,853
Ellis	198,251	192,145
Ellsworth	28,251	597,505
Franklin	102,809	100,086
Greenwood, Chase, Coffey	5,560,320	4,863,996
Harvey	57,443	352,206
Kingman	10,436	51,384
Labette	2,863	0
Linn	58,873	59,847
Lyon	155,273	113,307
Marion	874,410	662,826
Miami	388,624	432,670
Montgomery	312,274	424,200
McPherson	9,377,343	7,672,522
Neosho	176,310	173,392
Ness	1,163	1,045
Reno	78,834	342,268
Rice	486,047	971,078
Rooks	42,809	30,106
Rush	600	3,428
Russell	1,217,315	1,090,713
Saline	235	0
Sedgwick	5,840,234	4,538,283
Stafford	44,039	19,464
Sumner	2,348,371	1,622,813
Trego	4,290	180
Wilson	57,848	51,097
Woodson	88,125	25,175
Totals	39,286,932	35,485,779

An analysis of Table 3 discloses several interesting features. The gradual decline in production of the older fields in eastern Kansas counties continued, and was hastened by the lack of pipe-line outlets in certain areas which were left without a market after January 1, 1931, when one of the leading purchasers of crude oil in the state ceased buying the product in these areas.

Although Butler led all counties in production in 1930, rapid developments in McPherson county in 1931 pushed that county ahead, and it produced more oil than any other county in both 1931 and 1932. Butler clung to second place for both years, and Greenwood, which ranked fourth in 1931, exchanged places with Sedgwick county in 1932, which ranked third in 1931. Cowley came up from sixth place to fifth in 1932, as Sumner county fell back from fifth to sixth, and Russell county ranked seventh in both years.

There was no oil production of significance in Barton, Ellsworth, Harvey or Reno counties prior to 1931, yet these four counties had a total production of 183,546 barrels in 1931, and 1,344,360 barrels in 1932. Kingman and Stafford counties are also growing as oil-producing areas. Just as the center of drilling activity has shifted westward in recent years, so the output of petroleum has followed the drill. Moreover, a better grade of oil is being taken from the ground in the central and western counties, in general, than is found in the older parts of the Kansas oil country.

Kansas retained its position as the fourth largest oil-producing state in the nation in 1931 and 1932, and will probably remain in that position for some time to come.

EASTERN KANSAS

Oil and gas developments in the old eastern Kansas fields were practically at a standstill in 1931 and 1932. The stripper wells in many fields were without a pipe-line outlet for some time and the price of oil was discouragingly low so that exploration for new production was at a minimum. A little activity was under way in search of new gas reserves, but this led to no outstanding success. Information on the stripper field counties of eastern Kansas is difficult to assemble as company scouts pay no attention to these relatively insignificant operations.

Allen, Anderson and Linn counties reported only nine completions in 1931, and only five in 1932, all of the latter being failures. Miami was the scene of more activity, sixteen wells, of which nine were small gassers, being completed during the two-year period.

No new production was found in either Franklin or Douglas counties during these years, but there was one important Ordovician test in the latter county. This was the Pure Oil Company No. 1 Leuf, in sec. 31, T. 14 S., R. 19 E., which found sulphur water in the "Wilcox" sand at 1,922 feet, and was abandoned in the "Siliceous lime" at 2,110 feet.

Two dry holes were drilled in Lyon county in 1931. A little activity continued in the shallow gas areas of Chase and Morris counties, with unimportant results near Wilsey.

A few scattered wells were completed in more wildcat territory. In Clay county a well in sec. 19, T. 8 S., R. 3 E. was abandoned, probably in the Ordovician, at 2,860 feet. The Dickinson county test of Sever and others in sec. 13, T. 13 S., R. 3 E., quit at 4,900 feet after penetrating the pre-Cambrian over 1,500 feet. In Osage county Briggs and Smith No. 1 Woods, sec. 21, T. 14 S., R. 15 E., was dry at 2,627 feet. A Bourbon county granite well was No. 1 Stephenson, in sec. 16, T. 26 S., R. 24 E., which found the pre-Cambrian at 1,809 feet and was plugged at 2,403 feet.

In 1931 two small chat wells and two chat dry holes were completed in the Lost Springs field of Marion county, but all six tests of 1932 were failures. Three of these were attempts to extend the Ritz-Canton district of McPherson county into Marion county.

Chautauqua county was the only southeastern Kansas county to report any amount of development in the two-year period, and that consisted in the drilling of proved locations. For the first time in many years there was practically no drilling done in Wilson, Montgomery and Elk counties. A new pool was opened in 1931 in sec. 30, T. 30 S., R. 22 E., Crawford county, from the Bartlesville sand at 200 feet.

Activity in the eastern ranges of Harvey, Sedgwick and Sumner counties is described in the county reports for the western part of the state. The only other eastern counties to warrant special discussion are Butler, Cowley, Greenwood and Woodson.

Butler County

Butler county has definitely surrendered its position as the leading oil-producing county in the state and will probably never regain it. Activity during 1931 was confined to a few old fields, and there was less activity in the following year. By the close of 1930 drilling in the old El Dorado field had practically ceased, but in the summer of 1931 the Magnolia Petroleum Company began a develop-

ment program of its Koogler property in secs. 21 and 30, T. 26 S., R. 5 E. Five new wells were drilled to the "Viola lime" and "Wilcox" sand at depths of 2,500 to 2,700 feet, and two old wells were deepened. The net result was two dry holes and five producers with an average initial production of 50 barrels per well.

A northeast edge well was added to the Gelwicks pool in sec. 6, T. 27 S., R. 4 E., with an initial production of 280 barrels. This "Viola lime" producing area appears to be drilled up and some of the wells were abandoned in 1932.

Four gas wells, with initial capacities ranging from 100,000 to 1,250,000 cubic feet per day, were completed by the Flint Hills Oil and Gas Company in sec. 27, T. 28 S., R. 4 E., south of Augusta. The gas is found in lime at a depth of about 1,475 feet. Rock pressure is 300 to 325 pounds.

No new fields were discovered, but the Haverhill pool was extended two locations southward by a Bartlesville sand producer at a depth of about 2,700 feet. This field was discovered by the Empire Oil and Refining Company in 1927, who owns virtually all the productive area.

Cowley County

Oil production in Cowley county has been from the Shawnee group at a depth of 1,400 to 1,500 feet; the Kansas City group, which ranges from 1,900 feet in the eastern part of the county to 2,500 feet near Winfield; the Bartlesville sand; and the Ordovician "Siliceous lime." Gas has been produced from a shallow sand in the Admire shale, which ranges from 600 to 750 feet, the Shawnee group, and the Bartlesville sand.

During 1931, 46 wells were completed in Cowley county, 9 of which were old wells drilled deeper. There were 19 dry holes, 14 oil wells and 13 gas wells.

The most noteworthy feature of the two-year period occurred in October, 1931, when Roth and Faurot and Wakefield deepened their No. 1 well, located in lot 1, block 41, Musgrove's addition to the city of Winfield, from an old total depth of 2,975 feet to the "Siliceous lime," at a total depth of 3,296 feet, where it was completed with an initial production of 527 barrels of 40° Bé. oil 10 feet below the top of the "Siliceous lime." This well extended the "Siliceous lime" producing area about three-fourths of a mile south from the old "Siliceous lime" producing area in sec. 15, T. 32 S., R. 4 E. Nine old wells were deepened to this pay for an average

initial production of 348 barrels. This development within the city limits of Winfield continued through the early part of 1932. Oil is also produced there from the uppermost part of the Kansas City "lime" group, which is locally a sand, sandy "lime," or almost true limestone. This "pay" is known as the 2,300-foot sand, and there appears to be some relation between production and the sandy character of the producing horizon, the best production being found in wells having the most sand. Eighteen Kansas City "lime" wells were completed in 1932 with an average initial production of 160 barrels.

Twenty-eight wells, with an average initial production of 342 barrels, were completed during 1932 from the Ordovician. The average penetration, when the wells were originally drilled, was about 10 feet, but since then some of the wells have been drilled 35 feet into the formation. There have been some cases in which wells have been benefited by deepening while in others there has been no increase in production, probably due to lack of porous streaks in the formation.

Two small gas wells were completed in the Winfield district in the Bartlesville sand in 1932. Eight dry holes were likewise drilled, nearly all of which reached the Ordovician. All of the above operations for 1932 were in the Town Lot pool, except one Kansas City "lime" well, two dry holes, and an Ordovician producer in the Biddle pool, three miles northeast of the Town Lot pool.

Three oil wells were completed in sec. 12, T. 32 S., R. 4 E. in the Kansas City "lime" for an average initial production of 400 barrels. The pay comes at an average interval of 100 feet below the top of the Kansas City group and is a soft, porous zone in the "lime."

In 1931 twenty-three wells were drilled to the shallow gas horizon, which ranges in depth from approximately 620 to 750 feet. Twelve of these produced gas with an initial production ranging from 150,000 cubic feet to 750,000 cubic feet per day. Eleven of these shallow wells were failures. Six of them were in T. 32 S., R. 5 E., six in T. 33 S., R. 4 E., and eleven in T. 35 S., R. 5 E.

Other operations of 1931 were the completion of a small well in sec. 1, T. 33 S., R. 4 E. in sand at 1,434 to 1,437 feet, a gas well in sec. 19, T. 34 S., R. 3 E., which made 1,500,000 cubic feet from sand at 1,474 to 1,477 feet, and seven dry holes scattered throughout the county, one of which, in sec. 29, T. 30 S., R. 6 E., reached the Ordovician.

Two tests were completed in the Burden pool in secs. 19, 20, 29, 30, and 31, T. 31 S., R. 6 E. in 1931, one of which made 100 barrels from the Bartlesville sand, while the other was abandoned in the top of the Mississippian. Four producers were added in 1932, with an average initial production of 110 barrels. Twenty-seven Bartlesville sand wells have been drilled to the 2,900-foot pay in this field to date. White Eagle pipe-line is the outlet for the oil, which averages 38° Bé.

In 1932 Sooby and Moffit completed a small gas well at a shallow depth south of New Salem in sec. 10, T. 32 S., R. 5 E. In sec. 31, T. 31 S., R. 5 E., A. D. Crow completed two small, shallow gas wells. Trees Oil Company found a small gasser in the Kansas City group in sec. 1, T. 32 S., R. 6 E. No new pools were discovered, and three scattered dry holes were drilled, one of which went to the Mississippian.

Greenwood County

Although total completions for Greenwood county fell to 36 in 1931, there was a revival of interest in the Bartlesville sand fields in 1932 and 106 wells were drilled. The fairly good production at shallow depths (1,500 to 1,900 feet) made the area attractive to independent operators, who were able to test out acreage of the larger companies on an overriding royalty basis. Much of the drilling in this county is done by machines, and the wells can be drilled cheaply and quickly.

SEELEY-WICK POOL. This pool is situated in townships 22 and 23 south, range 11 east. Production is from Bartlesville sand, encountered at a depth of around 1,800 to 1,900 feet. One well was completed for 10 barrels during 1931. No dry holes were drilled during the year. During 1932 four wells were completed for an average initial production of around 50 barrels each. One small producer was abandoned due to a bad fishing job and one dry hole was drilled. Empire, Independent, Sinclair, Prairie, and White Eagle pipe lines serve the area.

EDWARDS EXTENSION. In 1929 the Edwards pool was extended southeast in secs. 21, 22, 27, and 28, T. 23 S., R. 11 E. Production is from Bartlesville sand, at an average depth of 1,900 feet. During 1931 seven wells were completed for an average initial production of 225 barrels each. Two dry holes were drilled at the east edge, neither of which tested the "Mississippi lime." In 1932 two producers were completed for 102 barrels and 75 barrels, respectively.

Four dry holes were drilled, two of which tested the "Mississippi lime." All of the latter were chiefly edge wells. Recovery in this area should be around 7,000 barrels per acre. The oil is 42° Bé. gravity.

CARSON POOL. This pool, in secs. 28 and 33, T. 23 S., R. 11 E., is southwest of the Edwards pool. The discovery well, the No. 1 Carson, NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 33, was drilled by Harwood and Smith February 11, 1932. Sand was encountered at 1,975 to 1,991 feet, with total depth at 1,996 feet. Initial production was 226 barrels. Since discovery, six additional producers have been completed for an average initial production of 200 barrels per well. Seven dry holes were drilled, five of which tested the "Mississippi lime." Empire and Independent pipe lines are connected.

HAMILTON POOL. The Hamilton pool is situated in secs. 26, 35 and 36, T. 23 S., R. 11 E., sec. 1, T. 24 S., R. 11 E., and sec. 6, T. 24 S., R. 12 E. It was discovered by Empire Oil and Refining Company at No. 1-A Patterson, completed May 19, 1929, for 392 barrels from Bartlesville sand, encountered from 1,765 to 1,837. In 1931 four producers were completed for average initial productions of 115 barrels each, one of these, Gore et al. No. 1 Smith, extending the pool one-half mile southeast. Six dry holes, five of which went to the "Mississippi lime," were drilled. Seven producers, with initial productions averaging 45 barrels, and one dry hole were completed in 1932. Estimated recovery per acre is 6,000 to 7,000 barrels. Gravity of the oil is 41° Bé.

In March, 1932, a southeast extension to the Hamilton pool was made by the discovery of Empire Oil and Refining Company and Matthews and Rex No. 1 Wilson, SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T. 24 S., R. 12 E., which was completed in Bartlesville sand, encountered from 1,709 to 1,717 feet, for an initial production of 120 barrels. Since that date fifteen Bartlesville sand producers have been completed for an average initial production of 160 barrels each. Two "Mississippi lime" wells were completed for 15 barrels and 20 barrels. Four dry holes were drilled, three of which tested the "Mississippi lime," encountered at a depth of around 1,800 feet. This pool now extends over parts of secs. 5, 6, 7, 8 and 17. The oil is around 40° Bé. gravity. Empire, Skelly and Sinclair Prairie pipe lines run the oil.

JOHNSON POOL. This pool is situated in sec. 16, T. 24 S., R. 12 E., and was discovered by Shull Drilling Company's No. 1 Mary Johnson NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$, completed October 12, 1930, for an initial

production of 150 barrels from Bartlesville sand, encountered at 1,556 feet. Seven wells have been completed to date, four of which were drilled in 1932 for average initial productions of 35 barrels.

LAMONT (NORTON POOL). This pool is located in secs. 15 and 22, T. 22 S., R. 12 E., and is situated on the "Lamont" Bartlesville sand trend. Discovery was by Empire Oil and Refining Company and D. M. Rhodes on April 23, 1929, at No. 1-A Norton in the NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 15. Initial production was 365 barrels from sand encountered from 1,724 to 1,747 feet. Eighteen wells are now producing, five of which were completed in 1932 for average initial productions of 50 barrels each. No dry holes were drilled. Oil is around 41° Bé. Empire pipe line runs the oil.

VIRGIL POOL. This pool lies in Ts. 22, 23 and 24 S., Rs. 12, 13 and 14 E. One Bartlesville sand well was completed for 25 barrels in 1931. Two "Mississippi lime" dry holes were drilled, one of which was an attempt to extend the "Lamont" Bartlesville sand trend to the southeast. During 1932 five wells were completed as producers, four of which encountered production in the "Mississippi lime" at around 1,700 to 1,800 feet, and one in Burgess sand, immediately above. Average initial production was 30 barrels. Three Mississippi "lime" dry holes were drilled. Skelly and Sinclair Prairie pipe lines run the oil.

QUINCY POOL. The "Quincy" Bartlesville sand trend pool extends northwest-southeast through T. 25 S., R. 13 E. One well was completed for 17 barrels in 1931. No dry holes were drilled. One well was completed in 1932 for 50 barrels. Approximately 1 $\frac{1}{2}$ miles west of the pool Hatfield completed No. 1 Lindemoor for 75 barrels from "Mississippi lime," encountered at 1,602 feet. This well is a wildcat and may open a small pool. Three dry holes were completed in the district, all testing the "Mississippi lime."

MISCELLANEOUS. Approximately 4 miles west of Fall River, D. J. Wilson completed No. 1 Sharpe, sec. 16, T. 28 S., R. 12 E., for 750,000 cubic feet of gas, at a depth of around 1,030 feet, during 1931. In the Beaumont field Thomas and Henderson completed No. 1 Lewis, center SW $\frac{1}{4}$ sec. 25, T. 27 S., R. 8 E., for around 350,000 cubic feet of gas, from a depth of 1,139 feet. Eight scattered dry holes were drilled, three of which tested the "Mississippi lime."

Woodson County

QUINCY DISTRICT. In July and August, 1932, two wells were completed near the center of the west line of sec. 14, T. 25 S., R. 13 E., of the "Quincy" Bartlesville sand trend for 100 barrels and 75 barrels, from sand encountered at around 1,500 feet. Sinclair Prairie pipe line is connected. About two miles southeast of these operations, Sheedy completed No. 1 Akins, NW $\frac{1}{4}$ SW $\frac{1}{4}$, sec. 19, T. 25 S., R. 14 E., the latter part of December, 1932, for around 400 barrels from Bartlesville sand, encountered at 1,420 feet. This well extended production on the trend about 1 $\frac{1}{4}$ miles southeast.

VIRGIL DISTRICT. During 1931 one "Mississippi lime" dry hole was drilled about four miles northeast of the town of Virgil. In the Winterschied pool, sec. 31, T. 23 S., R. 14 E., and sec. 6, T. 24 S., R. 14 E., nine Bartlesville sand producers were completed for an average initial production of 160 barrels each during 1932. A number of these wells produced up to 15 million cubic feet of gas initially, with the oil. Two "Mississippi lime" dry holes were drilled in the pool. About four miles northeast of the town of Virgil two small "Mississippi lime" producers were completed. One wildcat was completed for a dry hole in the same horizon.

WESTERN KANSAS

The term "Western Kansas" is generally used to denote that part of the state west of the Sixth Principal Meridian, including all west ranges from 1 to 43 West, and all townships from 1 to 35 South, inclusive. Actually the area thus defined includes about two-thirds of the area of the state, "Eastern Kansas" occupying only about the eastern third. To date oil production has been found in only the eastern half of the area commonly known as "Western Kansas," that is, those townships between R. 1 W. and R. 21 W., except for one well in Ness county.

It is interesting to note at this point that there has been very little exploration for oil in the western one-third of the state, the great area west of range 21 W. Very few tests in this area have reached Ordovician rocks, and few, indeed, have gone into the pre-Pennsylvanian. Although drilling has been carried on since the discovery of the Fairport field in Russell county late in 1923, not much more is known about this "far-western third" in the way of subsurface geological conditions and oil possibilities than was known eleven years ago. As discussed later under "Miscellaneous Develop-

ments," much significant information concerning this portion of the state was uncovered in 1931 and 1932, but the question as to how great the oil reserve is may be unanswered for many years.

Oil and gas are produced, or have been produced, in only 18 of the 62 counties in western Kansas. Gas is produced in eight counties, which are at present without oil production. Drilling was carried on in more than half of the western Kansas counties in 1931 and 1932, and wells were completed in 32 counties. However, in each of 11 of these counties only one well was completed in the two-year period. McPherson was the only county in which more than 37 wells were finished, and there were only six other counties in which more than ten wells were drilled.

It can readily be seen that the oil and gas possibilities of this area of approximately 54,180 square miles cannot be appreciated at this time. Moreover, the fact that in 1931 and 1932 there was a greater degree of success in developing new reserves in this area than in any previous two-year period is indicative of future success. Out of 554 tests completed in the two years, only 122 (22.0 per cent) were failures. This splendid showing was due, in part, to the reduction of wildcat drilling, but the discovery of seventeen distinct oil and gas fields and two gas fields cannot be minimized.

At the close of 1930, 1,377 wells had been drilled in western Kansas, of which 720 were dry holes. By the close of 1932, 1,931 completions were reported for western Kansas, of which 842, or 43.6 per cent, were failures. The total number of oil wells had risen from 482 to 814, and gas wells numbered 275 compared to 175 at the close of 1930.

Table 4 summarizes oil and gas operations in western Kansas for 1931 and 1932. For Harvey, Sedgwick and Sumner counties only wells in the western ranges are included.

Western Kansas produced a total of 56,745,712 barrels of crude oil between the discovery of the Fairport field in November, 1923, and January 1, 1933. Table 5, showing the production of oil by counties, includes that production of the Valley Center field in secs. 6 and 7, T. 27 S., R. 1E., which is inseparable from the production of the field as a whole.

First gas production in two counties, Finney and Haskell, was found in the 1931-1932 period. Rush county, which prior to 1931 had produced only gas, was added to the list of oil-producing counties in September, 1931.

TABLE 4.—Oil and gas operations in western Kansas for 1931-1932

COUNTY.	Com- pletions.	Oil.	Gas.	Dry.
Barber.....	3	0	1	2
Barton.....	7	3	0	4
Clark.....	1	0	0	1
Edwards.....	1	0	0	1
Ellis.....	7	5	0	2
Ellsworth.....	37	19	1	17
Finney.....	2	0	1	1
Ford.....	2	0	0	2
Gove.....	2	0	0	2
Graham.....	1	0	0	1
Harper.....	1	0	0	1
Harvey.....	24	18	0	6
Haskell.....	1	0	1	0
Kingman.....	7	5	1	1
McPherson.....	312	220	58	34
Morton.....	2	0	1	1
Ness.....	1	0	0	1
Pawnee.....	1	0	0	1
Phillips.....	1	0	0	1
Pratt.....	1	0	0	1
Rawlins.....	1	0	0	1
Reno.....	28	21	4	3
Rice.....	37	20	3	14
Rooks.....	3	0	0	3
Rush.....	6	1	4	1
Russell.....	22	15	0	7
Saline.....	3	0	0	3
Sedgwick.....	5	2	0	3
Sherman.....	1	0	0	1
Stafford.....	4	3	0	1
Stevens.....	25	0	25	0
Sumner.....	5	0	0	5
Totals.....	554	332	100	122

Eleven of the seventeen new fields discovered in 1931-1932 found their production in the "Siliceous lime," although one or two of these produces partially from the overlying Pennsylvanian basal conglomerate also. Two fields produce from the Mississippian chat, one from the Hunton "lime," one from Hunton "lime" and Mississippian chat, and one each from the "Oswald lime" and the Lansing limestone group. The southwestern Kansas gas discoveries were made in the Big Blue dolomite series of the Permian.

Western Kansas development and exploration continued to be most active in two areas. The Central Kansas uplift area of Rice, Ellsworth, Barton, Russell and Rush counties yielded twelve new pools, most of which produced from the "Siliceous lime." Three of these, however, are located along the Ellsworth anticline, which is

TABLE 5.—Cumulative oil recovery of western Kansas by counties to January 1, 1933

COUNTY.	Production.	Number of wells.
Barton.....	73,399	4
Edwards.....	71,762	2
Ellis.....	615,359	13
Ellsworth.....	625,756	20
Harvey.....	432,820	16
Kingman.....	88,820	3
McPherson.....	22,984,904	314
Ness.....	6,306	1
Reno.....	464,108	24
Rice.....	3,337,843	44
Rooks.....	151,339	2
Rush.....	3,428	1
Russell.....	10,617,994	169
Saline.....	1,640	0
Sedgwick.....	15,951,502	70
Stafford.....	63,503	4
Sumner.....	1,242,939	15
Trego.....	12,290	1
Totals.....	56,745,712	703

considered by some geologists to be apart from the Central Kansas uplift. It is not known at this time just what relation the structure at Cunningham, T. 27 S., R. 10 W., bears to the Ellsworth anticline.

Two new producing areas were developed in McPherson county. East of the town of McPherson, in the central part of the county, lies a subsurface anticline, extending in a north-south direction, for which the name McPherson anticline has been used. This anticline is known to extend from the old McPherson gas and oil field in T. 18 S., R. 2 W., southward through the Johnson, Voshell and Nikkel fields of McPherson county, the Hollow field of Harvey county, and the Haury and Burrton fields of Reno county. The southern and northern limits of this anticline are undefined at the present writing, but probably extend some distance beyond the limits here given. This "high" or series of "highs" has been referred to as the Voshell axis, but that is altogether a local name. It has also been considered by some as a southward continuation of the Abilene anticline, but the writer believes there is insufficient proof for this. Development was quite active along this line of folding in 1932 and will continue throughout 1933. The development of excellent pro-

duction from the Hunton "lime" in the Nikkel and Hollow fields was one of the features of the year.

Important data concerning new discoveries are given in Table 6.

TABLE 6.—Oil and gas discoveries in western Kansas, 1931-1932

COUNTY.	Field.	Location.	Date.	Producing horizon.
Barton.....	Isern.....	12-20 S.-11 W.	11- 4-31	"Siliceous lime"
Barton.....	Ellinwood.....	9-20 S.-11 W.	7-17-32	"Siliceous lime"
Ellsworth.....	Stratman.....	1-17 S.-10 W.	4- 9-31	"Siliceous lime"
Ellsworth.....	Stoltenberg.....	22-16 S.-10 W.	7- 5-31	"Siliceous lime"
Ellsworth.....	Breford.....	7-17 S.-10 W.	9-10-32	"Siliceous lime"
Finney.....	Holcomb.....	16-25 S.-34 W.	12-15-32	Big Blue group
Harvey.....	Hollow.....	20-22 S.- 3 W.	12-17-31	Hunton "lime"
Haskell.....	Satanta.....	29-30 S.-34 W.	9-27-31	Big Blue group
Kingman.....	Cunningham.....	30-27 S.-10 W.	1- 6-31	Lansing "lime"
McPherson.....	Johnson.....	35-19 S.- 3 W.	2- 4-32	"Mississippi lime"
McPherson.....	Nikkel.....	33-21 S.- 3 W.	10- 9-32	Hunton "lime"
Reno.....	Burrtton.....	23-23 S.- 4 W.	4-25-31	"Mississippi lime"
Rice.....	Beyer.....	21-19 S.- 9 W.	2- 8-31	"Siliceous lime"
Rice.....	Sharpe.....	13-20 S.-10 W.	3-26-31	"Siliceous lime"
Rice.....	Steckel.....	31-19 S.-10 W.	2-23-32	"Siliceous lime"
Rice.....	Orth.....	27-18 S.-10 W.	7-17-32	"Siliceous lime"
Rice.....	Chase.....	32-19 S.- 9 W.	12-15-32	"Siliceous lime"
Rush.....	Greenawalt.....	17-19 S.-16 W.	8- 5-31	"Siliceous lime"
Russell.....	Miller.....	30-14 S.-13 W.	5-12-31	"Oswald lime"

Barber County

No new production was developed in Barber county in 1932, but in January, 1931, Barbara Oil Company completed No. 2 Lytle in sec. 13, T. 33 S., R. 13 W., Medicine Lodge gas field, for 5,000,000 feet of gas from chat at 4,479 to 4,484 feet. Total depth of the hole was 4,580 feet. In February, 1932, the Barbara Oil Company's No. 4 Carter, in the NE cor. SW $\frac{1}{4}$ sec. 11, T. 33 S., R. 13 W., was abandoned after finding a hole full of water in the "Wilcox sand" at 4,920 to 4,927 feet, total depth. This well further dimmed prospects of developing Ordovician production in this field.

The only other completion was Allison-Fitzwilliams Petroleum Corporation's No. 1 Kumberg, sec. 2, T. 30 S., R. 12 W., abandoned February 13, 1931, at a total depth of 4,825 feet. A show of gas at 2,230 feet, oil at 3,005 to 3,015 feet, 4,370 feet, and at 4,575 feet, the last in the top of an Ordovician limestone, lent encouragement, but the top of the "Wilcox sand" was found at 4,680 feet with only a small show of gas at 4,700 feet, and a hole full of water was found at 4,799 feet in the "Siliceous lime," which was topped at 4,790 feet.

Barton County

The only well to be completed in 1931 in Barton county resulted in the discovery of the second oil-producing area for this county, which had undergone oil and gas exploration for many years with every assurance that eventually important reserves would be uncovered. At the close of 1932 another pool had been discovered, and considerable attention was being paid to the county by major oil companies, though little drilling was underway.

In October, 1931, Hilligoss and others' No. 1 Isern, SW cor. SE $\frac{1}{4}$ NE $\frac{1}{4}$, sec. 12 T. 20 S., R. 11 W., reached the top of the "Siliceous lime" at 3,309 feet with a show of oil, and when drilled in to 3,315 feet filled with 1,000 feet of oil in ten minutes. It later was deepened to 3,328 feet and completed with a potential of 1,023 barrels. In 1932, four tests were drilled within one-half mile of this well, to the east, south, and southwest, all of which were dry except the south offset. The well east of the discovery well was in Rice county. Derby Oil Company drilled the south offset, No. 1 Berscheit. It found the top of the "Siliceous lime" at 3,292 feet, with "pay" at 3,292 to 3,307 feet. Some water was found with the oil, so this test was drilled to 3,352 feet, finding more water and no more oil at 3,348 to 3,352 feet. It was completed as a 60-barrel well after being plugged back to 3,320 feet and shot with 15 quarts at 3,295 to 3,320 feet.

The third pool for Barton county was discovered in July, 1932, by the Midwest Refining Company (now Stanolind Oil and Gas Company). Their No. 1 Schueffler, center SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 9, T. 20 S., R. 11 W., found shows of gas and oil at several places in the "Oswald lime," after reaching its top at 3,049 feet. The top of the "Siliceous lime" was cored at 3,304 feet and after being drilled to 3,334 feet, produced 265 barrels in 9 $\frac{1}{2}$ hours on the swab.

The two other completions were wildcats that penetrated the "Siliceous lime" a greater distance than is customary. Syndicate Oil and Gas Company's No. 1 Boertz, in sec. 13, T. 18 S., R. 12 W., was abandoned at 3,750 feet, February 3, 1932, after reaching the "Siliceous lime" at 3,405 feet. It found no shows of oil or gas, but a hole full of water at 3,458-3,464 feet. Smith and Ash and Elwell abandoned No. 1 Wilson, in sec. 13, T. 18 S., R. 14 W., November 30, 1932, at 3,576 feet. This well, which is located on a surface structure, found water in the top of the "Siliceous lime" at 3,415 feet.

Ellis County

There were only two important completions in Ellis county in 1931-1932. Both were unsuccessful. One of these was the Deeprock Oil Corporation No. 1 Peavey, NE cor. SE $\frac{1}{4}$, sec. 19, T. 11 S., R. 17 W., a west offset to the Hadley well of the same company, which had produced since August, 1929, from the conglomerate at 3,408 to 3,420 feet. No. 1 Peavey found the top of the Pennsylvanian basal conglomerate at 3,445 feet with a show of oil, and was drilled to 3,496 feet. The abandonment of this well in February, 1931, without reaching the "Siliceous lime" was unfortunate and leaves a considerable area untested. The Hadley well has been a small but steady producer about 3 miles northwest of the Shutts pool, in which the only activity during 1931-1932 was the deepening of No. 1 Kessler of the Phillips Petroleum Company, SE cor. sec. 32, T. 11 S., R. 17 W., from 3,285 feet to 3,302 feet, where it produced 160 barrels per day 57 feet in the "Oswald lime."

Southeastern Ellis county received a set-back in March, 1931, when Brown et al. No. 1 Wedle was abandoned in the "Siliceous lime" at 3,605 feet. It was in sec. 13, T. 15 S., R. 16 W.

There was no activity in the Yocomento field in either 1931 or 1932, but in the Ellis county portion of the South Fairport field, in secs. 24 and 36, T. 12 S., R. 16 W. and sec. 1, T. 13 S., R. 16 W., four wells were deepened to lower pays in the prolific "Oswald lime" with moderate success.

Ellsworth County

As early as 1904 several shallow wells, drilled near the town of Ellsworth, found showings of gas at depths of less than 1,000 feet and this was used in at least one farm house for many years. However, the discovery of the Heiken pool by Slick, Pryor, and Lockhart in the NW cor. sec. 25, T. 17 S., R. 10 W., in October, 1930, was the first commercial production of oil in the county. This well found the top of the "Siliceous lime" at 3,222 feet, and when drilled in to 3,243 feet filled rapidly with oil. Later it swabbed 146 barrels in two hours, but produced only 1,150 barrels the remainder of the year. It had a total production of 8,467 barrels in 1931, but was shut in most of the year. The west offset to this well, No. 1 C Heiken, in sec. 26, was completed in June, 1932, after finding "Siliceous lime" pay at 3,243 to 3,266 feet, with an estimated production of 800 barrels. The pool was shut in from May 23 to December, 1932, and produced 27,797 barrels for the year.

In April, 1931, J. A. Aylward's No. 1 Stratmann, SE cor. NW $\frac{1}{4}$

SE $\frac{1}{4}$ sec. 1, T. 17 S., R. 10 W., reached the top of the "Siliceous lime" at 3,255 feet and filled rapidly with oil. When drilled to 3,271 feet in December, 1931, it pumped 10,991 barrels in a five-day test, establishing the area as one of large production. By the close of 1932 a total of ten producers had been completed in the field, and the productive area had been extended into section 12. A dry hole in the SE cor. sec. 2, one in the NE cor. NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 12, T. 17 S., R. 10 W., and two in sec. 6, T. 17 S., R. 9 W. appear to have defined this pool to the east, southeast and southwest. Drilling has outlined a somewhat symmetrical dome-shaped structure with a northwest-southeast alignment. All of the production is found in the "Siliceous lime," but good shows of oil and gas are also found in the "Oswald lime." The field had a potential of 10,432 barrels for the month of December, 1932. Water was encroaching in some of the wells at an alarming rate.

The third pool for the county, and second for 1931, was discovered in July, when Tom Palmer and Gypsy Oil Company's No. 1 Stoltenberg, center SW $\frac{1}{4}$ sec. 22, T. 16 S., R. 10 W., reached the top of the "Siliceous lime" at 3,333 feet, and was drilled to 3,347 feet. It tested on the swab at the rate of about 2,400 barrels per day, but produced only 4,187 barrels in 1931. As the year 1933 opened, the Stoltenberg pool was represented by one producing well in each of sections 16, 21, 23 and 27, and there were three producers in sec. 22. All of the production was from the "Siliceous lime" and the total potential of the seven wells was 5,326 barrels per day. Dry holes in sections 3, 10, 22 and 25 served to delimit the field. The wells had the customary large initial production peculiar to the "Siliceous lime," and there was some evidence of water intrusion.

On September 10, 1932, Slick, Pryor, and Lockhart and others discovered another "Siliceous lime" productive area with the completion of No. 1 Breford, SW cor. NW $\frac{1}{4}$ sec. 7, T. 17 S., R. 10 W. "Siliceous lime" was topped at 3,369 feet, with first oil at 3,385 feet. More pay was found at 3,392 to 3,395 feet, which made 30 barrels per hour. Pre-Cambrian was drilled to 3,407 feet, total depth. About 2,500 barrels of oil were produced and run to storage from this well in the latter part of 1932, but in 1933 a connection was made and three offsets were being drilled. It appears that a pool similar to the Stratmann, Stoltenberg, and Heiken pools has been discovered here.

While the above three fields were being discovered in the two-year period, a number of other wildcats and semiwildcats were being drilled in other parts of Ellsworth county, which supplied much

pertinent information concerning the subsurface stratigraphy and structure of the county. These wells showed that there was a large, structurally high area in the vicinity of the town of Ellsworth, which thus far has failed to produce any oil. They also established the general outline of the Stoltenberg-Stratmann-Heiken alignment of pools and structures and proved that there was a deep and somewhat narrow syncline directly east of these fields. The existence of a thick section of pre-Pennsylvanian rocks between the base of the Pennsylvanian and the top of the "Siliceous lime" in some parts of the county was also proved, whereas, in all of the producing fields the conglomerate lies directly on the "Siliceous lime" or on green shale of Decorah age. It was also to be shown that the northern fourth of Ellsworth county is distinctly lower than the area near Ellsworth. The following table gives information on these important tests:

TABLE 7.—Data on important test wells in Ellsworth county

LOCATION.	Total depth.	Remarks.
SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 23, T. 14 S., R. 7 W....	3,610	Base Pennsylvanian 3,418; Mississippian chert and lime to 3,492; top Ordovician at 3,556.
Cen. NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 5, T. 14 S., R. 9 W.....	1,385	100,000 feet of gas at 1,285-1,290 feet in Herington limestone.
Cen. NE $\frac{1}{4}$ Sec. 9, T. 14, S., R. 8 W.....	3,468	Mississippian chert 3,405-3,468.
SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 6, T. 14, S., R. 9 W.....	3,710	Base Pennsylvanian conglomerate 3,257; "Viola lime" 3,450-3,503; Decorah sand and shale to 3,567; "Siliceous lime" to T. D.
Cen. SE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 31, T. 15 S., R. 10 W....	3,373	Show oil in conglomerate at 3,319 and 3,362 feet; "Siliceous lime" at 3,364 feet.
NE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 17, T. 16 S., R. 7 W....	3,065	"Siliceous lime" at 3,059 feet.
SW cor. Sec. 23, T. 16, S., R. 9 W.....	3,600	"Siliceous lime" at 3,595 feet.
Cen. SW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 29, T. 16, S., R. 9 W....	3,511	"Viola lime" at 3,405; Decorah at 3,470; "Siliceous lime" at 3,507 feet.
NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 3, T. 16, S., R. 10 W...	3,392	Pennsylvanian conglomerate 3,250; Decorah 3,297; "Siliceous lime" 3,349; show oil and water 3,344 to 3,349 feet.
Cen. SE $\frac{1}{4}$ Sec. 10, T. 16 S., R. 10 W.....	3,380	Pennsylvanian conglomerate 3,302; Decorah 3,345; "Siliceous lime" 3,375 feet.
SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 25, T. 16 S., R. 10 W....	3,387	Pennsylvanian conglomerate 3,325; Decorah 3,342; "Siliceous lime" 3,363 feet.
NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 3, T. 17, S., R. 8 W.....	3,400	Oil shows 2,825, 3,100, 3,110 feet; "Viola lime" 3,293; Decorah 3,350; "Siliceous lime" 3,398 feet.
NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 31, T. 17, S., R. 9 W.....	3,295	Pennsylvanian conglomerate 3,198; "Siliceous lime" 3,243 feet, with oil show.

Finney County

The first recorded oil and gas development in this far western county was a test by the Garden City Oil and Gas Company, known as No. 1 Wrightsman, in sec. 35, T. 21 S., R. 30 W. This well was completed October 29, 1924, at a total depth of 2,842 feet, but the log is too sketchy to give any information of value concerning the section penetrated.

Though considerable geologic work has been done in Finney county since 1923, no further drilling was done until late in 1931, when National Refining Company spudded in No. 1 Wells, in sec. 13, T. 23 S., R. 30 W. This well was abandoned in the "Siliceous lime" at 5,872 feet, September 3, 1932, after finding a showing of gas and oil at 3,245 feet, and small shows of oil at 3,820 feet, 4,485 feet and 4,750 feet. The well was located after considerable magnetometer work had been done in the area and more than a score of core-drill holes put down.

Gas production was found in the test of Denham and Myers at No. 1 Brown, in the center of the SW $\frac{1}{4}$ sec. 16, T. 25 S., R. 34 W., about 12 miles southwest of the town of Holcomb. Some gas occurred at 2,525 to 2,540 feet, more at 2,580 feet, but the best "pay" was found at 2,635 to 2,665 feet. The total yield was estimated at 5,000,000 cubic feet after the well had been drilled to 2,744 feet, and completed December 28, 1932. The gas probably occurs in the same porous Permian dolomites that are productive in the Hugoton field.

Harvey County

Oil has been produced intermittently since the summer of 1919 in Harvey county in a small pool known as the Walton pool in sec. 4, T. 23 S., R. 2 E. Production is found in the Kansas City "lime" at a depth of 2,430 feet to 2,450 feet in a number of wells, but only one of these was productive during 1931 and 1932. The field has produced over 100,000 barrels, but since it never amounted to much in the way of production or area it has been almost forgotten.

The second productive area is known as the Halstead pool, which produces both oil and gas. Gas first was found in 1928 by a well in sec. 11, T. 23 S., R. 2 W. and a small amount of oil was also produced later from a near-by well. In 1930 wells were drilled some two miles northeast in secs. 35 and 36, T. 22 S., R. 2 W., and unimportant production resulted. One well and one dry hole were drilled in sec. 36 in 1931, the producer making 642 barrels in 11

hours, but falling rapidly in production thereafter. In 1932 another well was completed in sec. 35 for 150 barrels per day, but the pool will apparently never be a large one. A deep, dry hole in sec. 23, T. 23 S., R. 2 W. limits production to the south.

Harvey county came into prominence as an oil county for the first time in December, 1931, when Frank Hollow and associates, now known as the Acre Oil Company, found the top of pay at 3,507 feet corrected, and the hole filled with oil when drilled to 3,509 feet. It was not known at the time with what this producing horizon correlated, but it is now known that the Hunton limestone carries most of the oil, though a small amount of Misener sand is found almost directly overlying the Hunton. The well was swabbed at the rate of 16 barrels per hour at a total depth of 3,509 feet, but when deepened 3 feet in July, 1932, made 1,456 barrels initially per day. This production did not hold and in the following month the well was deepened to 3,514½ feet, at which depth it was completed for 520 barrels per day on the pump. It was the discovery well of the Hollow pool and the first well in Kansas to produce oil commercially from the Hunton "lime." It had been drilled on a one-acre lease in the midst of an area that had been carefully core-drilled by the Shell Petroleum Company and leased intensively by many major companies. As soon as the discovery well proved the existence of a prolific area many near-by tests were started, and thirteen additional wells had been completed by the end of the year. The data on these are shown in Table 8.

The discovery of chat production in this pool was a surprise and was made by the Frost Drilling Company et al. No. 1 Martens, which flowed wildly at an estimated rate of 5,000 barrels daily from a total depth of 3,308 feet, after the top of the chat of Mississippian age was reached at 3,295 feet. The completion of this well added further interest to the area and caused the commencement of several more wells so that the Hollow pool, in the early part of 1933, was the most active area in Kansas.

The Hollow field is situated in alignment with the Voshell and Nikkel fields of McPherson county on the north and the Burrton and North Burrton areas to the south. It was only natural that there should be exploration along this "trend" in 1931 and 1932. Early in 1933 a well one mile northeast of the nearest producer of the Hollow field extended that pool and there were possibilities that other extensions would be made in a short time. Three wells in

TABLE 8.—Data on wells in Hollow field, T. 22 S., R. 8 W., to close of 1932

COMPANY.	Lease.	Well.	Completed.	Sec.	Spot.	Remarks.
Schule Oil.....	Martens.....	1	9-28-32	19	NE NE SE	Hunton pay 3,481-3,490 ft. 927 bbls. in 20 hrs.
Mabee and Shell.....	Martens.....	1	8-28-32	19	NE NE SE	Hunton pay 2,460-2,475 ft. 465 bbls. in 24 hrs.
Mabee and Shell.....	Martens.....	2	11-28-32	19	SE NE SE	Chat pay 3,190-3,225 ft. Flowing estimated 100 bbls. per hr.
Mid-Kansas Oil and Gas.....	Duerksen.....	1	7- 8-32	19	SE SE NE	Hunton pay 3,474-3,488 ft. 723 bbls. in 4 hrs.
Frost Drilling.....	Martens.....	1	10-16-32	19	NE SE SE	Chat pay 3,195-3,308 ft. Estimated 5,000 bbls. daily.
Producers and Refiners.....	Martens.....	1	11-28-32	19	NE NW SE	Chat pay 3,154-3,208 ft. Estimated 5,000 bbls. daily.
Skelly Oil.....	Martens.....	1	12-18-32	19	SE SE SE	Chat pay 3,183-3,248 ft. 2,083 bbls. daily flowing.
Acre Oil.....	Fee.....	1	2-10-32	20	SW SW NW	Hunton pay 3,507-3,514½ ft. 520 bbls. daily.
W. C. McBride, Inc.....	Friesen.....	1	6-16-32	20	NW NW SW	Hunton pay 3,505-3,515 ft. Flowed 355 bbls. in 2 hrs.
W. C. McBride, Inc.....	Friesen.....	2	10- 4-32	20	NW NW SW	Hunton pay 3,489-3,505 ft. Swabbed 816 bbls. in 12 hrs.
W. C. McBride, Inc.....	Friesen.....	3	11-13-32	20	SW NW SW	Hunton pay 3,490-3,506 ft. Swabbed 65 bbls. per hour.
Phillips Petroleum.....	Workentine.....	1	10- 5-32	20	NW SW SW	Hunton pay 3,481-3,495 ft. Swabbed 1,033 bbls. in 19 hrs.
Stanlind Oil and Gas.....	Froese.....	1	6- 2-32	20	SW SW NW	Hunton pay 3,481-3,496 ft. Flowed 968 bbls. in 14 hrs.

the Burrton field were completed in 1932 on the Harvey county side of the Harvey-Reno county line, but these wells will be mentioned in the discussion of Reno county developments.

Important wildcat completions of 1931-1932 are given in the following table:

TABLE 9.—Data on wildcat wells completed in Harvey county

LOCATION.	Total depth.	Remarks.
Gen. SW $\frac{1}{4}$ Sec. 32, T. 22 S., R. 1 E.....	4,120	"Siliceous lime" 3,606.
Gen. NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 19, T. 23 S., R. 1 E.....	3,637	"Siliceous lime" 3,626.
SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 7, T. 23 S., R. 1 E.....	3,577	"Viola lime" 3,560.
NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 5, T. 22 S., R. 3 W.....	3,810	Hunton 3,547-3,620; "Viola" 3,678-3,700; Simpson 3,700-3,783; "Siliceous lime" 3,783.
NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 9, T. 22 S., R. 3 W.....	3,804	Quit in Simpson sand.
NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 31, T. 22 S., R. 3 W.....	3,875	Oil show in top of Hunton at 3,620; "Siliceous lime" at 3,838.
NW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 23, T. 23 S., R. 2 W.....	3,556	Oil show in chat at 2,995; "Siliceous lime" at 3,524.

The Hollow field, in the extreme western side of the county, is the only pool of consequence discovered to date. The failure of numerous wells to discover new sources of production in the eastern part of the county and the disappointing results in the Walton and Halstead pools have tended to shift interest away from Harvey county.

Haskell County

The first well to be drilled for oil or gas in Haskell county—Derby Oil Company, Trees Oil Company, and Kuhn No. 1, Warner, sec. 29, T. 30 S., R. 34 W.—was completed September 9, 1931, as a commercial producer of gas at a total depth of 2,608 feet. It found 270,000 feet of gas at 2,520 feet, 640,000 feet at 2,536 feet, and when drilled to 2,608 feet produced 14,200,000 feet of gas. While treated as a new discovery, this well probably represents merely an extension of the Hugoton field. The producing horizon is thought to be the Fort Riley limestone member of the Chase group. No new tests were drilled in Haskell county in 1932, and the discovery well was shut in with no market outlet.

Kingman County

The wildcat play in Kingman county of 1929-1930 died out in 1931, when only two wells were completed, but one of these was the discovery well of the Cunningham field. Four additional wells were drilled in 1932 in the Cunningham field and the discovery well was deepened. This well, Skelly Oil Company No. 1 Miles, in the NE. cor. sec. 30, T. 27 S., R. 10 W., had the following interesting record.

Show gas 1,525-1,530 feet.

Estimated 2,000,000 feet of gas 1,635-1,640 feet.

Show gas 1,775-1,780 feet.

6,016,000 feet of gas 2,005-2,020 feet.

Increase in gas to 9,250,000 feet 2,133-2,147 feet.

More gas 2,161 feet.

250,000 feet gas 2,480 feet.

100,000 feet gas 3,385-3,389 feet.

1,250,000 feet gas 3,390 feet, with show oil.

Swabbed and flowed 145 barrels oil in 12 hours at 3,393 feet.

Flowed 35 barrels oil per hour at 3,438-3,441 feet and made 3,250,000 feet gas.

This well reached the top of the Lansing limestone at 3,338 feet in January, 1931, and was drilled to a total depth of 3,441 feet and shut in. When opened December 8, 1931, it flowed 300 barrels in 24 hours through 3-inch tubing. When deepened more oil and some gas was found at 3,490 to 3,494 feet, but water came into the hole at 3,505½ feet and the hole was plugged back to 3,464 feet and the well completed January 7, 1932, for 233 barrels per day.

Skelly Oil Company drilled four other wells in this pool during 1932, as shown in the following table:

TABLE 10.—Data on wells in the Cunningham field, Kingman county

Well No.	LOCATION.	Total depth.	Production.
Miles 1.....	SE cor. sec. 19.....	3,496	Flowed 7½ barrels per hour.
Leisman 1...	Cen. SE¼ SW¼ sec. 20.....	4,195	27,024,000 feet gas.
Leisman 2...	SW cor. sec. 20.....	3,492	9,000,000 feet gas and 60 barrels oil.
Leisman 3...	NW cor. sec. 29.....	3,489	118 barrels oil.

All of the above wells were drilled only to the Lansing "lime" pay, except No. 1 Leisman, which was completed in the "Siliceous lime."

It found the top of the Lansing formation at 3,360 feet, with shows of oil and gas in it at various depths, but water was found at 3,520 feet in the last pay drilled in the discovery well. At 3,556 to 3,560 feet 4,200,000 feet of gas was found and another show of oil at 3,680 to 3,690 feet in the lower part of the Kansas City formation. The base of the Pennsylvanian was reached at 3,842½ feet and a very thin section of "Mississippi lime" was drilled to 3,857 feet. Ordovician chert and dolomite correlating with the "Viola lime" was drilled from 3,923 feet to 4,012 feet, which yielded 26,130,000 feet of gas at 3,958 feet, and the top of the "Siliceous lime" reached at 4,093 feet. More gas was found in this formation with some oil and water, and after drilling to 4,195 feet the hole was plugged back to 4,175 feet, where it gauged 27,024,000 feet of gas and was shut in.

With the exception of the discovery well, all wells have been drilled with rotary tools until the Lansing formation has been penetrated. The upper part of the Lansing is cored and then the hole standardized and completed with cable tools. For this reason the value of the showings of gas found by No. 1 Miles have not been adequately tested. The importance of this field remained to be proved on January 1, 1933, but the failure of No. 1 Leisman to find substantial showings of oil in the pre-Pennsylvanian beds was disappointing, even though it is known to be away from the higher parts of the structure.

McPherson County

During the years 1931 and 1932 oil and gas developments in McPherson county were carried on under the same adverse conditions which were evident throughout the greater part of the oil industry. General overproduction was followed by low price and proration. The Voshell pool and that portion of the Ritz-Canton pool then known as the Ritz pool, secs. 6 and 7, T. 20 S., R. 1 W., and secs. 1 and 12, T. 20 S., R. 2 W., produced under proration during a large part of 1930.

Only operations necessary to take care of offset obligations and short-term leases were carried on during 1931. Wildcatting was practically at a standstill. No new pools were discovered. The few semiwildcats drilled resulted in the extension of the producing area in both the Voshell and the Ritz-Canton fields. In 1932, however, two new pools were discovered, the Johnson in Ts. 19 and 20 S., R. 3 W., and the Nikkel in T. 21 S., R. 3 W.

THE MCPHERSON OIL AND GAS FIELD. As early as 1926 oil was found in porous limestone of the Kansas City group, but not in

commercial amounts. The first oil was produced in this field from the "Mississippi lime" in July, 1928. Commercial gas was found in this field in Merriman et al. No. 1 Anderson, center SW $\frac{1}{4}$ sec. 29, T. 18 S., R. 2 W., in September, 1926, from a porous, cherty horizon at the top of the "Mississippi lime" at 2,927 to 2,943 feet. Initial production was 7,500,000 feet per day. This well is located near the top of the subsurface structure, but oil has been found in flank wells in the same horizon. At the close of 1930, the producing area contained fourteen gas wells and nine oil wells, eight of which also produce gas. Production of oil in 1931 amounted to 33,360 barrels, and in 1932, 24,735. There was no drilling in the field in 1931 or 1932, except the deepening of two wells, both of which were dry and abandoned. One of these was Graham Brothers et al. No. 1, Rolander, SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 30, T. 18 S., R. 2 W., which was a failure at 3,278 feet after being deepened from 2,395 feet where it had produced a small amount of oil from the Kansas City "lime" pay at 2,345 to 2,365 feet.

RITZ-CANTON OIL AND GAS FIELD. Ritz-Canton is the name that has been assigned to the producing area in Ts. 19 and 20 S., Rs. 1 and 2 W. Gas in the "Mississippi lime" was discovered by the McPherson Oil and Gas Company's No. 1 Wedel, center SW $\frac{1}{4}$ sec. 12, T. 19 S., R. 2 W. By the close of 1930, the Ritz pool consisted of twenty-one oil wells and three gas wells, all producing from the cherty portion of the "Mississippi lime." It was described as including portions of secs. 1 and 2, T. 20 S., R. 2 W. and secs. 6 and 7, T. 20 S., R. 1 W. At that time it had been defined in all directions except to the north. In July, 1927, some time after the discovery of oil and gas in the Ritz pool, the McPherson Oil and Gas Company No. 1 Decker, center SE $\frac{1}{4}$ sec. 11, T. 19 S., R. 2 W., was completed as a gas well. During 1930 a gas-producing area developed which became known as the Galva or Decker gas field, located in secs. 2, 10, 11, 12, 13, 14, and 15, T. 19 S., R. 2 W. A third producing area was discovered when the McBride, Inc. No. 1 Whitright, in the NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 30, T. 19 S., R. 1 W., found gas in the "Mississippi lime" in June, 1930. In November the Mid-Kansas No. 1 Garrett, SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 19 S., R. 1 W., failed to find production in the "Mississippi lime" and was deepened to the "Viola lime," where it was completed with an initial production of 3,567 $\frac{1}{2}$ barrels. Development proceeded as rapidly as conditions within the industry would permit until at the close of 1932, the Ritz, Galva-Decker, Canton producing area

had been connected and extended to comprise the Ritz-Canton oil and gas pool.

At the close of 1932 "Mississippi lime" production, oil or gas or both, had been found in an area which included secs. 16, 17, 19, 20, 21, 28, 29, 30, 31 and 32, T. 19 S., R. 1 W., secs. 2, 3, 9, 10, 11, 12, 13, 14, 15, 23, 24, 25, 26, 27, 35 and 36, T. 19 S., R. 1 W., and secs. 1, 2 and 12, T. 20 S., R. 2 W. The "Mississippi lime" production is predominantly gas in the following areas: secs. 16, 17, 20 and 21, T. 19 S., R. 1 W., and secs. 2, 3, 10, 11, 12, 13, 14 and 15, T. 19 S., R. 2 W.

The "Viola lime" production at the close of 1932 was confined to secs. 16, 18, 19, 20, 21, 29, 30, 31 and 32, T. 19 S., R. 1 W., secs. 13, 24, 25, 26, 35 and 36, T. 19 S., R. 2 W., secs. 6 and 7, T. 20 S., R. 1 W., and sec. 1, T. 20 S., R. 2 W.

In November, 1932, the Palmer and Phillips No. 2-A Winn, located in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 7, T. 20 S., R. 1 W., was deepened to the "Wilcox" sand, where it was completed for an initial production of 996 barrels in 24 hours. The Washoma No. 2 Meeks, in the NE $\frac{1}{2}$ SW $\frac{1}{4}$ sec. 7, T. 20 S., R. 1-W., was then deepened to the Wilcox and completed with an initial production of 960 barrels of oil and 20 barrels of water. Subsequent deepening of offsets and close-in locations has been very disappointing. A number of deep failures have been drilled throughout the Ritz-Canton producing area indicating that production lower in the section than the "Viola lime" is to be confined to the tops of sharp local highs which may be found on the broad, relatively flat structure underlying the Ritz-Canton field. Drilling has shown that this structure is actually a series of more or less sinuous undulating folds, the tops of which have variable elevation.

At the beginning of 1933, the Ritz-Canton oil and gas field had been extended until it covered approximately 14,000 acres of land, in which production of oil or gas from one of the three "pays" was proved. It is second in size only to the El Dorado field of Butler county. The field has been operated under rigid proration almost since its discovery, but recent potential tests show that for the most part it is on a decline. A number of the larger chat wells completed during the year, with "potentials" of 3,000 to 14,000 barrels per day, have slumped greatly in production, and the largest of these at the beginning of 1933 was capable of producing only about 1,200 barrels. Producers from the "Viola lime" have also fallen off, but not so much.

Sixty-seven chat wells and 104 "Viola lime" and "Wilcox" sand wells had a total potential of 156,756 barrels on October 1, 1932, but the total potential of 71 chat wells and 102 "Viola lime" and "Wilcox" sand wells was only 87,183 barrels on December 1, 1932.

The deepening of many of the gas wells in secs. 20 and 21, T. 19 S., R. 1 W. near Canton to the "Viola lime" resulted in many disappointments, because several of them found unfavorable porosity conditions in the dolomitic producing portion of the "Viola lime," and were completed as relatively small producers. The completion of wells in sec. 13, T. 19 S., R. 2 W. during the latter part of 1932 from the "Viola lime" extended the productive area of the deep pay toward the higher parts of the Galva dome, but the best part of that structure remains undrilled in the Ordovician.

VOSHELL FIELD. The Voshell field was discovered in August, 1929, by the completion of Washabaugh et al. (later W. C. McBride, Inc.) No. 1 Voshell, NE cor. sec. 9, T. 21 S., R. 3 W., which produced from the "Viola lime" at a depth of 3,301 to 3,304 feet at a rate of 40 barrels per day. Production was later discovered in the Mississippian chat, the Misener sand, the "Wilcox" sand, and the "Siliceous lime." Of the five producing horizons the "Wilcox" sand has proved the most prolific and only the discovery well has produced from the "Viola lime." At the close of 1930 a total of 95 wells were producing in the Voshell field. The producing area covered secs. 27, 33 and 34, T. 20 S., R. 3 W., and secs. 3, 4, 9, 10, 15 and 16, T. 21 S., R. 6 W.

During 1931 three wells were deepened from the "Wilcox" sand to the "Siliceous lime," four producers were completed in Mississippian chat, and two wells in the "Wilcox" sand. Operations for 1932 numbered eighteen. Of these five were deepening operations. Eight wells were completed in the "Mississippi lime." One "Wilcox" sand well and four "Mississippi lime" wells were completed in sec. 21, T. 21 S., R. 3 W., and two "Mississippi lime" wells were completed in sec. 28 of the same township, thus adding sections 21 and 28 to the producing area of the Voshell field.

JOHNSON FIELD. During February, 1932, the Shell Petroleum Company No. 1 Johnson, SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 19 S., R. 3 W., was completed in the "Mississippi lime" for 13,585,000 cubic feet of gas and an estimated production of 300 to 600 barrels of oil per day. The top of the "Mississippi lime" was reached at 2,984 feet with the pay occurring 35 feet in. At the end of 1932 sixteen wells were producing from the cherty portion of the "Mississippi

lime" in the Johnson field, which now covers most of sec. 35, T. 19 S., R. 3 W., and portions of secs. 2 and 11, T. 20 S., R. 3 W. Since this field is located but a short distance from the city limits of McPherson, it is some times referred to as the Doorstep pool. Two dry holes in secs. 3 and 11 help to partially define the limits of this field, but its southern edge is unknown. It is noteworthy that this field is the only one discovered in 1932 in western Kansas that was developed to any degree.

The Johnson field is located on the McPherson anticline and is similar to other fields on that subsurface feature except that pre-Mississippian production has yet to be found on it. In this respect it is similar to the old McPherson gas and oil field, also on the McPherson anticline, which produces only from the chat and the Kansas City "lime."

Development of the Johnson field has shown the area to be characterized by large production of gas in the upper 40 feet of chat, while oil is found 50 to 70 feet in the chat. The initial production of the largest wells is 2,000 barrels per day. The allowable during December, 1932, was 29 barrels per well per day, so there is little incentive to develop this field at this time.

The second Hunton "lime" field in the state, and the first in McPherson county, was discovered October 9, 1932, when J. E. Mabee, Inc., brought in No. 1 Nikkel, NE cor. SW $\frac{1}{4}$ sec. 33, T. 21 S., R. 3 W., which flowed 830 barrels in 23 hours from the Hunton "lime" at 3,466 to 3,467 feet. This well is on a core-drilled structure on the McPherson anticline and, at the time of completion, was $1\frac{1}{2}$ miles south of the nearest production in the Voshell field. The area has been established as a separate field by the Public Service Commission. Four other wells have been completed in the Hunton "lime" in this section up to the close of 1932, and early in 1933 the producing area was extended into section 34 by a flowing well. The initial production of the first five wells drilled in the field averaged 1,500 barrels per well. It appears that an excellent producing area has been uncovered, and the Hunton "lime" is proved as a reservoir of high-grade oil. The field lies near the northern edge of a Hunton "lime" basin, and a short distance north the Hunton "lime" is missing throughout the Voshell field.

Reno County

Activity in Reno county during 1931 was less than in previous years due to the suspension of wildcat exploration work, but results were more encouraging than normal from a production standpoint.

Of the eight wells drilled, one wildcat was abandoned as a dry hole, another was completed as a gas well discovering the Burrton field, and six combination oil and gas wells were completed in the Haury or North Burrton field, including the deepening of the discovery well. Results in 1932 were equally fruitful. Out of twenty completions only two were wildcat failures, three were gas wells, and fifteen produced gas and oil. No new fields were discovered in 1932, but the Burrton field was proved for oil, and its area shown to be extensive by the completion of eighteen tests. There was no activity in the Haury field in 1932.

Madison et al. No. 1 Esau, NE cor. SE $\frac{1}{4}$ sec. 12, T. 22 S., R. 4 W., was completed as a dry hole at 3,320 feet November 16, 1931, after finding the top of the "Mississippi lime" at 3,260 feet and a hole full of water at 3,320 feet. A real disappointment was No. 1 Rainbow, of the Derby Oil Company et al. in the NW cor. SE $\frac{1}{4}$ sec. 33, T. 22 S., R. 7 W., which was abandoned in the "Siliceous lime" at 3,966 feet. This well found an encouraging show of oil in the top of the chat at 3,546 $\frac{1}{2}$ feet to 3,565 feet, which failed to yield commercial production when shot with 100 quarts after plugging back from the total depth. A small show of oil was reached at 3,864 to 3,869 feet in the "Viola lime," but only water found in the "Siliceous lime."

Another failure that attracted attention was that of Vernon Oil and Gas Company No. 1 Tonn, center NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 17, T. 25 S., R. 4 W., near Haven. This well had been completed at a total depth of 3,611 feet, with an initial production of 197 barrels of oil and 40 barrels of water July 2, 1930. The oil was found in the "Mississippi lime" at 3,606 to 3,611 feet. Only 5,877 barrels were produced from it in 1930 and 1931. In November, 1932, this well, which had been drilled by Tatlock et al., was taken over by the Vernon Company and deepened to 4,131 feet. The "Mississippi lime" was found to be unexpectedly thick and the "Viola lime" was drilled from 4,011 to 4,027 feet. Simpson sand and shale ran from that depth to 4,117 feet, the top of the "Siliceous lime." No shows of oil or gas were found below the Mississippian.

The Haury field, located altogether in sec. 1, T. 23 S., R. 4 W., consisted of six wells at the close of 1932. The discovery well was Study, Turner et al. No. 1 Haury, in the NE cor. SW $\frac{1}{4}$ of the section which was completed for 23,000,000 feet of gas from Mississippian chat and lime at 3,301 to 3,333 feet on October 1, 1930. It was deepened to 3,368 feet in cherty lime and flowed 15 barrels

per hour for four hours with 26,000,000 feet of gas on December 2, 1931, after the north offset had been completed as the first oil producer in the field. The latter was No. 1C Haury, of Frost Drilling Company et al., SW cor. NE $\frac{1}{4}$ sec. 1, which found the top of Mississippian chat and lime at 3,254 feet, first gas at 3,280 to 3,283 feet, more gas at 3,318 feet, and a total of 8,000,000 feet of gas at 3,335 feet. First oil was found at 3,342 feet, but when the hole was deepened to 3,364 feet the well flowed 337 barrels of oil with 7,000,000 feet of gas on February 16, 1931. Two offsets to these wells were drilled during the year and two wells a quarter of a mile north were also completed as combination wells in the chat.

One of the wells was Derby Oil Company et al. No. 1 Goering, SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, which was completed as a 100-barrel well in the chat pay after plugging back to 3,358 feet from a total depth of 3,890 feet. This well found a hole full of water in "Viola lime" at 3,737 feet to 3,755 feet, more water at 3,764 feet in Simpson sand, and reached the top of the "Siliceous lime" at 3,840 feet. No shows of oil were found in the Ordovician sequence, but saturated Hunton "lime" was found at 3,635 to 3,640 feet. It was not tested. Top of chat in this well was reached at 3,260 feet, and the pay was found at 3,341 to 3,346 feet.

As in the Burrton field to the south, there is no sharp line between the gas and oil pays in the Haury field. Ordinarily the maximum gas production is found about 75 to 85 feet below the top of the chat and the oil is found about 90 to 110 feet in the Mississippian.

Production in the Burrton field was developed in April, 1931, by the discovery of commercial gas production in Shell Petroleum Corporation and Continental Oil Company's No. 1 Blake, SW cor. SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 23, T. 23 S., R. 4 W., which found its production in the top of the chat at 3,266 to 3,308 $\frac{1}{2}$ feet. It later was deepened to 3,323 feet and completed for 18,000,000 feet of gas. On January 15, 1932, this well was deepened to a total depth of 3,378 $\frac{1}{2}$ feet and completed for 15,315,000 feet of gas and 283 barrels of fluid, 16 per cent of which was water. This discovery of oil started a mild drilling campaign which resulted in the completion of wells in secs. 24, 25, 26, 34 and 35, T. 23 S., R. 4 W., and sec. 2, T. 24 S., R. 4 W. Three oil wells, which are a part of this field, were completed in secs. 19 and 30, T. 23 S., R. 3 W., Harvey county.

Three gas wells were completed in the Reno county part of the field with open-flow capacities of 22, 59 and 86 million feet per day. They are in sections 26 and 35, on the higher part of the structure,

which is a rather broad, flat anticline as delineated on the upper surface of the Mississippian cherty lime. Fifteen oil wells were completed, with an average initial production of 220 barrels per well. The gas wells have penetrated an average of 92 feet of chat, whereas the oil wells have been drilled in approximately 110 feet before the maximum production was secured. It has been the custom in the later wells drilled in the field to drill through with rotary tools and shut off the gas-producing portion of the chat before testing the well for oil production. Water has been found with the oil in several wells, and the oil recovery from the chat will probably not be so high as other areas in west-central Kansas, such as the Ritz-Canton-Galva district.

An Ordovician test drilled on the east flank of this anticline is No. 2 Frantz, of Skelly and Glad Oil companies, NE cor. NW $\frac{1}{4}$, sec. 2, T. 24 S., R. 4 W. This test was drilled to a total depth of 3,844 feet, but plugged back to 3,398 feet and completed as a well flowing 137 barrels of oil per day from chat pay at 3,343 to 3,364 feet. It lent considerable stratigraphic and structural information to the area. An oil show was found in the top of the Hunton "lime" at 3,625 feet, but a hole full of water was found in the "Siliceous lime" topped at 3,835 feet. This well is located sufficiently low on the subsurface anticline to condemn only part of the Burrton field for pre-Mississippian production.

Rice County

Rice county holds the distinction of being one of the first counties in the state in which gas production was found and the second county west of the Sixth Principal Meridian in which oil was discovered. Unlike Russell county, in which the first western Kansas oil discovery was made, Rice county was prospected intermittently for many years before the first oil pool was opened up and then over five years elapsed before another productive area was uncovered. However, since that time, 1929, thanks to the core-drill and subsurface geological work, new pools have been opened up with surprising regularity, and each year since 1930 (including 1933) at least two new areas have been added.

The oil and gas development of Rice county, up to the close of 1932, may be conveniently divided into three periods. The first dates from 1888, when gas was first found, until 1924, when the discovery of the Welch pool, southeastern Rice county, inaugurated another period characterized by five years of haphazard wildcatting

without productive results. The third period dates from the discovery of the Raymond field, in the western part of the county, in the summer of 1929.

Little is known of those pioneers who formed the Kansas Natural Gas and Oil and Mineral Products Company in 1887 with the avowed intention of exploring the vicinity of Lyons, the county seat, for its mineral wealth. Sufficient to say that they proceeded to drill a well a few blocks east of the public square in Lyons at a location approximating the NE cor. SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34, 19 S., R. 8 W. The first important discovery was salt, at a depth of 780 feet, and the salt beds were found to be 275 feet thick. Drilling continued, and a strong flow of gas was found at 1,210 feet. No exact information can be found as to the volume of gas, but the rock pressure is given as 67 pounds per square inch. The well was drilled to 1,230 feet and the gas piped to the Interstate Hotel and several near-by dwellings. The well was completed in 1888, and shortly after another well was drilled somewhere in the northwest part of Lyons by a Jack Brisbane. He also found gas at about the same depth, but there is no record that this gas was ever put to use. Several months after the first well had been placed on production it was ruined by "premature explosion," according to reports, and the Rice county gas industry lay dormant for over 35 years.

Aside from showing that oil or gas might be found in this part of the state, these wells had one important effect in proving the existence of thick salt beds. The following year the first salt shaft was put down and numerous others were subsequently sunk at Hutchinson, Ellsworth, Kanopolis, Anthony, Sterling, and other towns giving birth to an industry that for many years produced several million dollars of wealth annually. However, the occurrence of gas was not widely heralded and the development of eastern Kansas fields proceeded without operators knowing of the Lyons discovery until development moved gradually westward, hastened by the discovery of oil at El Dorado and Augusta.

Although numerous attempts were made in the county to drill wells for oil and gas and much land was leased for this purpose, only two wells are definitely known to have been drilled in the 36 years following the discovery of gas at Lyons. Both of the wells were in T. 18 S., R. 6 W. One, located in section 3, was drilled to a depth of 2,200 feet in 1917. The other, in section 14, is reported to have been abandoned at about 1,740 feet, although the log of this well is not available.

The second period of oil and gas development of Rice county was inaugurated by the discovery of the Welch field in April, 1924. The well was No. 1 Welch of the Meridian Oil and Gas Company and Prairie Oil and Gas Company in the SE cor. SW $\frac{1}{4}$ NW $\frac{1}{2}$ sec. 35, T. 20 S., R. 6 W. Oil was found at 3,370 to 3,415 feet in what has since been known as the Welch chert, a cherty residual phase of the "Mississippi limestone." The well produced 115 barrels per day initially, but in two years had slumped to 25 barrels per day. Gravity of the oil is 33.5° Bé. Drilling in the immediate vicinity of the discovery well resulted in the completion of a number of small wells and a few dry holes, limiting the field to the east, west and north. In July, 1926, production in larger amounts was found in wells drilled in secs. 2 and 3, T. 21 S., R. 6 W., and the field revived. One of the wells has produced over 800,000 barrels of oil to date and is still a prolific producer. Again in 1930, the field was extended south by completion of a well flowing over 1,200 barrels per day in the SE $\frac{1}{4}$ of sec. 3, T. 21 S., R. 6 W.

The Welch pool was the second most important field in western Kansas until it was passed in total production by the Valley Center field in 1929. Until the close of 1932, it had produced slightly less than two and one-half million barrels. It is located on a southwest plunging anticline which is reflected on the top of the "chat" producing horizon, although it is recognized that the chat surface is bevelled by erosion. Two Ordovician tests have been drilled within the limits of the field and found encouraging shows of oil in the Wilcox sand. Wells located more favorably on this subsurface structure should hold possibilities for Ordovician production.

Between the discovery of the Welch pool in April, 1924, and August, 1929, nine wildcat wells were drilled in Rice county. Many of these were drilled by independent operators whose knowledge of the oil business was limited and who allowed their wells to be located by "oil-finders" or "doodlebugs." Most of them were drilled in 1924 during the excitement following the discovery of the Welch field. A number of wells were also drilled at this time in adjacent parts of McPherson and Reno counties. Their only benefit was in supplying much valuable geological information concerning the subsurface stratigraphy and structure of this area where surface geologic information is lacking due to poor exposures and the fact that much of the county is covered by dune sand.

The details of these Rice county wildcats are given in Table 11.

TABLE 11.—Rice county wildcat completions, 1924-1929

LOCATION.	Date completed.	Total depth.	Remarks.
Sec. 10, T. 18 S., R. 6 W.	2-13-26	3,511	Abandoned in what is probably the Mississippian.
Sec. 35, T. 19 S., R. 6 W.	11-15-24	3,578	Good show of oil in Mississippian chat at 3,255 to 3,310 feet. Quit in "Viola lime" at 3,570 feet.
Sec. 1, T. 19 S., R. 7 W.	3- 1-27	4,456	Show gas at 3,175 feet, in Pennsylvanian conglomerate. Abandoned in pre-Cambrian.
Sec. 7, T. 20 S., R. 6 W.	11-15-24	3,565	Mississippian chat at 3,324 to 3,384 feet. Abandoned in Sylvan shale.
Sec. 14, T. 20 S., R. 6 W.	9- 7-24	3,655	Mississippian chat at 3,290 to 3,368 feet with show of oil. "Wilcox" sand at 3,640 to 3,655 feet with oil show and water.
Sec. 21, T. 20 S., R. 6 W.	10-14-26	3,775	Mississippian chat at 3,370 to 3,435 feet with show of oil. Quit in "Wilcox" sand.
Sec. 17, T. 21 S., R. 6 W.	8-24-26	3,804	Abandoned in Mississippian or Sylvan shale. No shows of oil or gas.
Sec. 34, T. 21 S., R. 7 W.	3-24-27	4,012	Mississippian chat at 3,438 to 3,492 feet with show of oil. Show oil at 3,778 feet in "Wilcox" sand. Top of "Siliceous lime" at 3,860 feet.
Sec. 13, T. 21 S., R. 8 W.	6-21-27	4,029	Good show of oil in chat at 3,348 to 3,380 feet. "Viola lime" at 3,620 feet. "Wilcox" sand at 3,655 feet. Quit in "Siliceous lime" topped at 3,720 feet.

All of the above wells are in eastern and southeastern Rice county, and the numerous shows of oil and gas found in them, some of which might have been made into small wells, sustained interest in the county. This fact, together with a growing appreciation of the subsurface conditions in the county, caused several of the major companies to conduct core-drilling campaigns here, which largely were the cause of the later discovery. However, it was in the western part of the county that the next activity took place.

Slick, Pryor and Lockhart's (formerly Steinbuechel et al.) No. 1 Schurr, NE cor. SW $\frac{1}{4}$ sec. 21, T. 20 S., R. 10 W., was the discovery well of the Raymond field. It was completed August 5, 1929, in the Pennsylvanian basal conglomerate, which was first called the "Schurr sand," at a total depth of 3,289 feet after finding the top of the sand at 3,278 feet. Oil testing 52° Bé. was produced at the rate of 240 barrels per day. Offsets were soon started and one of these, Producers and Refiners Corporation's No. 1 Thompson, SE cor. NW $\frac{1}{4}$ sec. 21, found the top of the "Siliceous lime" at 3,330 feet with a show of oil, after finding a hole full of water in the con-

glomerate. When completely drilled in during February, 1930, it produced about 1,200 barrels per day. This completion stimulated activity not only in the Raymond vicinity but also throughout the county, and fifteen wildcat wells were completed in Rice county in 1930, more than had been drilled up to that time.

Development of the Raymond field up to January 1, 1933, has resulted in the completion of twelve oil wells located along the east-west quarter section line in sec. 21, T. 20 S., R. 10 W. They had a potential in the early part of 1932 of 11,988 barrels, or approximately 1,000 barrels per well. This potential was used throughout the year and the allowable for the field was 15 per cent. The field was never produced wide open for any length of time, so that its real value cannot be accurately estimated, but it appears to offer large recovery possibilities. Practically all the production is secured from the "Siliceous lime," which carries water.

By the end of 1932 seven dry holes in sections 14, 22, 27 and 28 had defined the east, southeast and southern limits of the pool. A large flat-topped domal type of structure (as interpreted on the eroded surface of the "Siliceous lime") had been outlined by drilling. There were possibilities of extensions to the west and northwest for some distance.

Showings of oil and gas have been found in wells in T. 20 S., R. 10 W. at many horizons in the Permian and Pennsylvanian beds. One of these is C. B. Davis et al. No. 1 Kelly, SW corner. NW $\frac{1}{4}$ sec. 22, which found 2,400,000 feet of gas in a sand lens in the Severy shale at 2,566 to 2,575 feet, total depth 2,593 feet. The Boucher Oil Company No. 1 Boy, in the SW cor. sec. 16, T. 21 S., R. 10 W., south of Raymond, found 10,000,000 feet of gas in the same lens at 2,550 to 2,553 feet total depth, in January, 1930, but was deepened unsuccessfully and abandoned in the "Siliceous lime" at 3,434 feet in September.

Shell Petroleum Company et al. No. 1 Ploog, center SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, T. 18 S., R. 9 W., in January, 1930, opened up the third oil field for the county. This well flowed and swabbed at the rate of about 3,300 barrels per day after finding the top of the "Siliceous lime" at 3,252 feet and drilling in 1 foot. Directly to the south, Shell et al. No. 1 Murphy, center NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 4, T. 19 S., R. 9 W., found only a small amount of oil in the hole in "Siliceous lime," topped at 3,296 feet; it was abandoned with a hole full of water at 3,330 $\frac{1}{2}$ feet. An important well to the northeast was No. 1 Cupp of Mid-Kansas Oil and Gas Company et al. SW cor. NE $\frac{1}{4}$

sec. 22, T. 18 S., R. 9 W., which was abandoned in the "Siliceous lime" at 3,522 feet. A sand in the lower part of the Admire shale showed 6,680,000 feet of gas at 2,020 feet, but a south offset to this well, drilled for gas in 1931, was abandoned as a dry hole at 2,096 feet.

The Ploog well is located near the center of a large block of acreage owned jointly by Shell Petroleum Corporation, Carter Oil Company, Gypsy Oil Company, J. A. Hull Company, and J. H. Tatlock. Development of this pool will probably be slow and orderly. Although the Murphy test was a distinct disappointment, the production of over 140,000 barrels from the Ploog well indicates that a reserve of importance has been discovered here.

The completion of the Ploog well in 1930 proved the contention of a number of geologists that a subsurface "trend" or line of structural highs ran in a general north-south direction from central Ellsworth county through Rice county and into Reno county. This Ellsworth anticline, as it has been called, runs through Rs. 8, 9 and 10 from the vicinity of Ellsworth to and beyond the southern limits of Rice county. An important test on this "high" was Shell Petroleum Corporation et al. No. 1 Soeken, center SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 25, T. 17 S., R. 9 W., abandoned at 3,385 feet in the "Siliceous lime." A showing of 36° oil, which bailed at the rate of 25 barrels per day, was found in the Pennsylvanian basal conglomerate at 3,260 to 3,268 feet.

More successful was Muth Brothers et al. No. 1 Beyer, NE cor. NW $\frac{1}{4}$ sec. 21, T. 19 S., R. 9 W., completed in February, 1931, as a well with an initial production of 395 barrels on the swab. The area surrounding this well has since been referred to as the Beyer pool. This well found the top of the Pennsylvanian basal conglomerate at 3,184 feet and the base of it and the top of the "Siliceous lime" at 3,212 feet. First oil was found at 3,212 to 3,215 feet, and more oil at 3,224 feet and 3,239 feet. The well was drilled to 3,244 feet without any increase in production. Due to lack of pipeline outlet the well was not produced steadily for some time.

The National Refining Company drilled a north offset to No. 1 Beyer, known as No. 1 Sherman, in the SE cor. SW $\frac{1}{4}$ sec. 16, T. 19 S., R. 9 W., and completed it September 2, 1932. It found the top of the conglomerate at 3,195 feet with a small show of oil. At 3,200 feet, 400 feet of oil rose in the hole and this increased to the 1,500 foot level at 3,214 $\frac{1}{2}$ feet. The top of the "Siliceous lime" was found at 3,218 feet with a marked increase in the amount of oil, which

filled to 2,600 feet when drilled to 3,224 feet. Six additional feet of lime were drilled without finding more oil or any water. This well averaged 164 barrels per day on a five-day pumping test in September, 1932.

The conglomerate as found in these wells consists of much variegated shale, red and white chert and sand, similar to the conglomerate as it occurs in other wells through this general region. However, it also contains what appears to be a tightly cemented, brown oil-stained sandstone, which appears to be the productive zone in the Sherman well at 3,195 to 3,206 feet. Apparently this sandstone was too tightly cemented to produce oil in the Beyer well.

At the close of the year, Lebow et al. No. 1 Callis, SW cor. SE $\frac{1}{4}$ sec. 16, was completed at a total depth of 3,239 feet. The top of the conglomerate was found at 3,204 feet, first free oil at 3,206 to 3,211 feet, and 750 feet of oil in 12 hours at 3,225 feet. The top of the "Siliceous lime" was reached at 3,235 feet and the hole filled 2,300 feet with oil over night when drilled to 3,239 feet. This well produced 114 barrels the first 24 hours on the pump.

Six miles southwest of the Beyer area and three miles northeast of the Raymond field is the Sharpe pool, discovered in 1931 by Hinkle, Cress et al. No. 1 Sharpe, in the SE cor. NE $\frac{1}{4}$ sec. 13, T. 20 S., R. 10 W. This well found the top of the "Siliceous lime" at 3,334 feet with a show of oil and when drilled in to 3,336 feet filled with oil in 24 hours. It was later deepened to 3,339 feet and shut in for most of the remainder of the year. It produced only 6,149 barrels in 1931, and was allotted an estimated potential of 450 barrels in the early part of 1932. It began showing water soon after production commenced.

In May and June, 1932, the east and southeast offsets, respectively, were completed. Werbro's Development Co. No. 1 Masemore, in the SW cor. NW $\frac{1}{4}$ sec. 18, T. 20 S., R. 19 W., had a potential of 1,104 barrels from "Siliceous lime" at 3,316 to 3,322 feet. One location directly south of it was No. 1 Heckel of the Empire Oil and Refining Company, which produced a potential of 816 barrels from "Siliceous lime" at 3,322 to 3,338 feet. An attempted northeastward extension of this pool failed when Roy Ramsey et al. abandoned No. 1 Hilton, SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 6, T. 20 S., R. 9 W., at a total depth of 3,323 feet in the "Siliceous lime."

Ramsey persisted in his attempts to develop production in this area, however, and on December 15, 1932, completed No. 1 High School, NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 32, T. 19 S., R. 9 W., as a well

swabbing 14 barrels of oil per hour at 3,245 feet to 3,284 feet. Top of weathered "Siliceous lime" was found at 3,238 feet and the hole drilled to 3,289 feet, water coming into the hole in the last four feet of drilling. The hole was plugged back to 3,284 feet and shot with 120 quarts. Only 445 barrels of 45° Bé. oil was sold from this well in 1932. This well is situated on the edge of the town of Chase and in an area that had been extensively core-drilled and blocked by the Gypsy Oil Company, to whose credit this discovery must be attributed. An active drilling campaign was under way in this field in the early part of 1933.

About six miles west of Chase and less than three miles northeast of the Isern field of Barton county, the Gypsy Oil Company, in April, 1932, opened up a new pool or an extension of the Isern field at No. 1 Steckel, center NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 31, T. 19 S., R. 10 W. Top of the "Siliceous lime" was found at 3,299 feet, an oil show at 3,305 feet, 350 feet of oil at 3,316 feet, more oil at 3,320 feet, and an increase in oil to 800 feet in one hour at 3,322 to 3,324 $\frac{1}{2}$ feet, total depth. After producing 951 barrels in several short tests, the well was shut in with an estimated potential of 145 barrels.

The third discovery in 1932 for Rice county was found by Slick, Pryor and Lockhart, Inc., Darby Petroleum Corporation, and the Western Petroleum Exploration Company at No. 1 Orth, in the SE cor. NE $\frac{1}{4}$ sec. 27, T. 18 S., R. 10 W. This well found a gas show at 2,900 feet, and 750,000 cubic feet of gas at 2,925 feet in the "Oswald lime," but when "Siliceous lime" was drilled from 3,240 to 3,243 feet, 1,600 feet of oil filled the hole in one hour. After short swabbing tests, during which 815 barrels of oil were produced and run to storage, the well was shut in with an allowed estimated potential of 1,800 barrels daily. The well is located on a large block of leases core drilled to the Cimarron anhydrite by the owners.

Rice county has shown enough potential production to warrant further exploration and development. Oil found in the Welch field tests 32° Bé. All of the other fields in the county produce oil of high gravity. "Siliceous lime" oil at Raymond tests 41°, in the Sharpe field 46°, from the Ploog well 47°, and the oil from the Beyer, Steckel, Orth and Chase Townsite pools runs 42° or better. Considerable water is found in most of the wells producing from the "Siliceous lime" within a few weeks to a few months after completion, but more care in drilling in wells in the future will doubtless tend to reduce this hazard. The relatively shallow depth necessary to test all producing horizons makes Rice county an attractive

area in which to operate. In the central and eastern portions of the county, 3,600 to 3,800 feet of drilling will reach the "Siliceous lime," whereas in the western part 3,300 to 3,500 feet is sufficient to reach that objective. Lack of pipe lines have retarded development of Rice county more than any one factor, but the building into this area in 1933 of several lines relieved this unfavorable situation.

. On January 1, 1933, there were four one-well pools in Rice county, and the Beyer and Sharpe pools were represented by but three completions each. The Welch field, nine years old, was producing almost as much oil as it ever had, with some drilling being done and the southern limits undefined. The Raymond field likewise was undefined at the end of 1932.

Rooks County

Activity in Rooks county in 1931 and 1932 was impeded by the same general conditions that hindered development throughout the Mid-Continent field, as well as the fact that the two small pools discovered and producing during the years suffered through lack of pipe-line outlet. The only well in one of these pools was abandoned in 1932 after being deepened and finding a hole full of water in the "Siliceous lime."

The Laton field, discovered in July, 1927, by the Vickers Petroleum Company, failed of an extension in 1931 by the abandonment of Stearns-Streeter Company and Billings Oil and Gas Company No. 1 Livengood, SE cor. SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 11, T. 9 S., R. 16 W., with a hole full of water at 3,600 feet. In this well, which is about one-half mile northeast of the discovery well of the field, the top of the "Oswald lime" was found at 3,215 feet and a showing of oil that tested at the rate of about 25 barrels per day was found at 3,307 feet. Under economic conditions then prevailing this was considered unprofitable and the well drilled to lower horizons. Production of the two wells in this field continued intermittently during the two-year period; 19,612 barrels were marketed in 1931, and 17,331 barrels in 1932. The Laton field has recovered 115,367 barrels up to the close of 1932.

Four miles southwest of the Laton field, Derby Oil Company's No. 1 Kruse, NW cor. NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 10 S., R. 16 W., was completed in December, 1927, for 42 barrels of 41° oil at 3,126 to 3,134 feet, 51 feet in the "Oswald lime." Up to March, 1929, it produced about 6,202 barrels of oil, but was deepened and aban-

done with a bad fishing job in May, 1929, at a total depth of 3,425 feet without reaching the Ordovician.

An attempt to find production in northwestern Rooks county met with failure when Empire Oil and Refining Company abandoned No. 1 Sample, in sec. 17, T. 7 S., R. 20 W., with a hole full of water from "Siliceous lime" at 3,688 feet.

Aylward et al. No. 1 Silvers, in the center NE $\frac{1}{4}$ sec. 21, T. 8 S., R. 19 W., was deepened and abandoned on December 21, 1932. This well had found commercial production of a low-gravity oil October 1, 1930, in the Pennsylvanian basal conglomerate at a depth of 3,442 to 3,445 feet. The well appeared to have a capacity of about 300 barrels per day, but mechanical difficulties cut its actual production far below that figure. In 1930, 985 barrels were produced and run to storage, but in 1931 a pipe line was laid to the railroad at Webster and oil was sold off and on until the well was deepened. Production during 1931 was 23,197 barrels and in 1932, 12,775 barrels. The top of the "Siliceous lime" was found at 3,442 feet, and water filled the hole at 3,475 feet. The abandonment of this well, located as it is on a well-defined surface structure mapped on beds in the Niobrara, was a distinct disappointment to many operators and companies owning leases near by. Further development of this promising area was being planned in 1933.

Rush County

Fifteen tests for oil and gas had been drilled in Rush county to the close of 1930 and three wells were added in each of the years 1931 and 1932. The first pool to be discovered was the Bison gas field, which, to date, has yielded but one commercial producer. It is No. 1 Schuerman, center NW $\frac{1}{4}$ sec. 27, T. 17 S., R. 17 W., which found the Pennsylvanian basal conglomerate at 3,573 to 3,578 feet for 18,000,000 feet of gas per day with rock pressure of 880 pounds per square inch. It was completed November 21, 1928, but four additional tests near by have failed to find production. It appears to be on a subsurface high similar to the Gorham field of Russell county, in which the basal conglomerate yields rich oil recoveries and some "Oswald lime" oil is also found. In both areas the Pennsylvanian is underlain by the pre-Cambrian.

Not unlike the Bison area is the Otis gas field, situated entirely in T. 18 S., R. 16 W. This area was discovered by Morgan and Flynn et al., at No. 1 Eitel, center NW $\frac{1}{4}$ sec. 11, which found 16,500,000 feet of gas in Pennsylvanian basal conglomerate at 3,507

to 3,509 feet in March, 1930. The rock pressure was 725 pounds per square inch. The same operators completed No. 1 Mohr, center SW $\frac{1}{4}$, sec. 2, as a dry hole in September, 1930, at a total depth of 3,762 feet after reaching pre-Cambrian rocks at 3,504 feet.

In the next two years the following four wells were added:

LOCATION.	Well.	Sand record and production.
Cen. SW $\frac{1}{4}$ sec. 11	No. 1 Tammen.....	3,497 to 3,509 feet; 34,000,000 feet.
Cen. NW $\frac{1}{4}$ sec. 14	No. 1 Mohr.....	3,488 to 3,502 feet; 35,500,000 feet.
Cen. NE $\frac{1}{4}$ sec. 16	No. 1 Buddee.....	3,468 to 3,501 feet; 45,000,000 feet.
Cen. NW $\frac{1}{4}$ sec. 23	No. 1 Koriel.....	3,496 to 3,516 feet; 38,273,000 feet.

Developments to the close of 1932 had revealed the existence of a prolific gas-producing area on a broad northwest-southeast trending subsurface structure with the lowest producing well better than 50 feet lower, structurally, than the highest, based on the data on the top of the producing horizon. It is quite likely that additional drilling will develop production over a larger area. No important showings of oil or gas have been found in the "Oswald lime" in wells drilled in this field.

The first commercial oil field in Rush county was found in August, 1931, when Dewey and Mitchell and Syndicate Oil and Gas Company found oil in No. 1 Greenawalt, center SW $\frac{1}{4}$ sec. 17, T. 19 W., R. 16 W. Top of the "Oswald lime" was found at 3,490 feet, and top of the Pennsylvanian basal conglomerate at 3,795 feet. A show of oil was found at 3,820 feet in the top of the "Siliceous lime," which immediately underlies the conglomerate, and more oil came into the hole at 3,835 feet. The well tested at the rate of about 300 barrels per day, but was deepened to 3,880 feet where a hole full of water was found. The hole was plugged back to 3,835 feet and attempts made to produce commercially. Due to lack of pipe-line outlet, very little oil was sold and the total yield up to January 1, 1933, was only 3,428 barrels. This is the most important test yet drilled in Rush county, as it demonstrates that production from the "Siliceous lime" may be expected not only in Rush county but also in adjoining counties. It is far from other "Siliceous lime" producing areas, the nearest being in southern Russell county.

No other tests were drilled near the Greenawalt well, but the Schultz test of Barnsdall Oil Company et al., SW cor. sec. 3, T. 19 S., R. 16 W., was abandoned at 3,880 feet.

Russell County

While Russell county offered no important contributions to oil and gas development in 1931-1932, this county has played such an important part in the history of western Kansas development, and has offered so much of basic value to a thorough understanding of the many geological problems of west-central Kansas, that it is altogether appropriate that a summary of developments by years be given. In the following résumé, the number of wells drilled, exclusive of old wells drilled to deeper horizons, are given, together with items of importance in a geological or production sense.

1923. Discovery of the Fairport field. The discovery well, which also was the first commercial oil well in western Kansas, found oil in the "Oswald lime" November 25, 1923, but was not actually completed until January, 1924.

1924. Twenty-three wells drilled. Development of the Fairport field and the drilling of numerous wildcats in scattered parts of Russell and adjoining counties, which furnished much needed subsurface geological information concerning this part of the state. The existence of an unconformity at the base of the Pennsylvanian was proved, but the true significance of it was probably not realized by geologists at the time. The failure of all wildcat wells to discover new productive areas was a severe blow to exploration in this part of the state and forestalled development for about five years. The correlation of the "Oswald lime" with the Lansing-Kansas City groups was first suggested, although many geologists believed the top of the "Oswald" series to be equivalent to the Oread "lime." At present almost all geologists working in Kansas correlate the "Dodge lime," found about 10 to 15 feet above the top of the "Oswald series," with the Oread limestone.

1925. Sixty-seven wells drilled. Continued development of the Fairport field, with several extensions to the north and south, and the drilling of edge wells to the east and west. Many wells were deepened to lower pays in the "Oswald lime" series. Very little wildcatting took place.

1926. Forty-two wells drilled. Discovery of South Fairport and Gorham fields, both producing from the "Oswald series." These discoveries created no great interest and wildcatting was still at a low ebb.

1927. Eighteen wells drilled. Routine development in the old fields, with a few deep wells on the flanks of the proved anticline yielding important geological information. The discovery of commercial production in the Laton field of Rooks county attracted some attention to Russell county again.

1928. Thirty-one wells drilled. Discovery of prolific production in the Pennsylvanian basal conglomerate, locally called the "Gorham sand," in a well in the Gorham field revived oil activity in all of west-central Kansas. An active wildcat drilling campaign resulted, which lasted through 1929 and 1930 and added Ellis, Trego, Ness, Rush, Edwards and Barton counties to the list of oil and gas producing counties. North Fairport field discovered.

1929. Twenty-nine wells drilled. Discovery of Sellens and Ochs fields, both producing from the "Siliceous lime," which heretofore had shown scant possibilities for production. Sustained wildcatting.

1930. Twenty-one wells drilled. Discovery of Dillner and Gideon fields. Suspension of wildcatting and inside drilling due to economic conditions.

1931. Eleven wells drilled. Discovery of Miller pool.

1932. Three wells drilled. No important developments.

Of the eighteen completions reported in Russell county in 1931, the most important was the discovery well of the Miller pool. It was No. 1 Miller of the Russell Oil Corporation et al., SW cor. SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T. 14 S., R. 13 W., which was completed June 28. This well is especially interesting in view of the large number of oil and gas shows it found before reaching commercial oil production in the "Oswald lime." First gas was found at 1,886 to 1,893 feet, some gas at 2,285 feet, and more gas at 2,306 feet. A show of oil and gas was reached at 2,385 feet, at the top of the Tarkio "lime," and oil showed in the lower part of the Howard "lime," at 2,560 to 2,567 feet. A show of oil and gas at 2,630 to 2,639 feet was in the Topeka "lime," and the show of oil found at 2,790 to 2,800 feet probably was in the Oread "lime." The top of the "Oswald series" was reached at 2,886 feet, where the 6-inch pipe was set. When porous cherty oölitic lime was drilled between 2,902 and 2,904 feet, oil rose in the hole 1,200 feet in one hour and 1,500 feet in three hours. The well was swabbed at the rate of eight barrels per hour and gradually deepened to 3,090 without finding any evident increase in production. It was plugged back to 2,996 feet and shut in, but was deepened again to 3,111 feet in October, 1931, after which it was placed on the pump. This well produced 5,192 barrels in 1931, and 18,716 barrels in 1932, so that the well has proved itself to be a small but consistent pumper. An interesting feature of this well has been the fact the quality of the oil has improved in time. The first oil marketed from this well tested 36° and 37° Bé., whereas later production has tested as high as 40° Bé., similar to most of the "Oswald lime" oil in this part of the state. This condition has been found on other "Oswald lime" producing leases in Russell county.

No new developments occurred in the vicinity of the Miller well due to the unfavorable economic conditions prevailing. It is quite probable that a large area will be found to be productive as the well is the highest well in the county, on the top of the "Oswald lime." It appears somewhat doubtful that any pre-Pennsylvanian sediments will be found in this well between the "Oswald lime" and pre-Cambrian, as a well in sec. 26, T. 14 S., R. 14 W. entered pre-Cambrian rocks without finding Ordovician sediments.

Oil and Gas Resources of Kansas

Three offsets to the extension well of the Signal Oil Company at No. 1 Sellens, SE cor. NW $\frac{1}{4}$ sec. 26, T. 15 S., R. 13 W., in the Sellens pool, were completed during 1931. They had initial productions of 180, 400 and 500 barrels, and produced from the "Siliceous lime," at depths of 3,300 to 3,345 feet. Signal Oil Company had no success in developing further production around its No. 1 Rude, NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 28, T. 15 S., R. 13 W., when two tests found sulphur water in the "Siliceous lime." The first of these was No. 1 Berry, NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 27, T. 15 S., R. 13 W., an east offset to No. 1 Rude, which found the "Siliceous lime" at 3,433 feet, 89 feet lower structurally than it was found in the Rude well. The west offset, No. 2 Rude, NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 28, reached "Siliceous lime" at 3,418 feet, 73 feet lower than it was found in No. 1 Rude. These wells supply interesting data in regard to the unusual structural conditions that were previously unknown in Russell county.

Several wells in the Sellens district have found encouraging shows of oil in the 90-foot pay in the "Oswald series." Some of them have received short tests and have indicated production in commercial quantities, but no attempt has been made to produce them. Treatment of these wells with acid offers interesting possibilities.

During 1931-1932, seven wells in the old Fairport and South Fairport fields were deepened to lower pays in the "Oswald series" and completed with new production capacities. Best results were experienced in the South Fairport field, some of the wells producing more oil per day when drilled to the 75-foot and 98-foot pays than when first completed in the upper part of the "Oswald lime." One of the most interesting completions of the period was Stearns-Streeter Company and Yankey's No. 7 Oswald, NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 8, T. 12 S., R. 15 W., on the apex of the Fairport anticline. This well had been a fine producer when first completed in 1925, after finding the top of the "Oswald lime" at 2,918 feet. Production was secured in the top of the lime, the 30-foot, the 45-foot, 130-foot, 160-foot, 180-foot, and 220-foot pays, but due to mechanical difficulties the well had never been able to produce to capacity. When drilled deeper, in December, 1931, it found oil at 3,200 to 3,205 feet in lime, but drilled directly below into pre-Cambrian granite to 3,207 $\frac{1}{2}$ feet, total depth. It swabbed at the rate of 42 barrels per day and was produced for a few months before the same mechanical difficulties, which had interfered with its production previously, caused its abandonment. The discovery of a new pay in the "Oswald lime" about 285 feet below its top and immediately overlying

granite is decidedly interesting, and shows that all possibilities of production in the "Oswald lime" have not been exhausted until that series has been completely penetrated.

There were three completions in the Gorham field in 1931-1932, and results were mixed. Gorham sand production was extended one location east by Stearns-Streeter Company and Yankey, No. 4 Mermis, sec. 33, T. 13 S., R. 15 W., which found noncommercial oil in the regular 30-foot pay in the "Oswald lime." Gorham sand (Pennsylvanian basal conglomerate) was drilled from 3,296 feet to 3,300 feet, total depth, the latter 2 feet of sand being quite feldspathic, indicating proximity to granite. This well tested 13 barrels per hour on the swab after the head was off.

Keys Petroleum Company was less successful with No. 13 Mills, SW cor. SE $\frac{1}{4}$ sec. 33, T. 13 S., R. 15 W., which reached pre-Cambrian granite at 3,297 feet and drilled to 3,353 feet, total depth. It was plugged back to 3,109 feet to test out shows at 3,074 and 3,092 feet, in the 30- and 45-foot pays, respectively. After producing about 25 barrels per day for several weeks it was abandoned.

In July, 1932, Billings Oil and Gas Company extended "Oswald lime" production in the Gorham field one-half mile eastward with No. 1 Witt, NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 14 S., R. 15 W. "Oswald lime" was topped at 3,009 feet, but the pay was found at 3,039 to 3,042 feet, where oil rose in the hole to the 2,200-foot level. It was completed for 144 barrels. This well is less than one-half mile north of a test abandoned in 1925 by the Producers and Refiners Corporation at No. 1 Mermis, SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 14 S., R. 15 W. It had a show of oil in the regular 30-foot pay in the "Oswald lime" at 3,055 feet, and found some oil at 3,250 to 3,255 feet in what has since been determined as the Gorham sand (Pennsylvanian basal conglomerate), but was deepened into pre-Cambrian granite, topped at 3,255 feet to 3,327 feet.

The three dry wildcats had encouraging showings of oil. Kruger et al. No. 1 Bratton, center NE $\frac{1}{4}$ sec. 33, T. 11 S., R. 13 W., found the top of the "Oswald lime" at 3,057 feet, show of oil that filled the hole 200 feet in 36 hours at 3,091 to 3,095 feet, more oil at 3,112 feet, and at 3,132 to 3,136 feet, but not enough to give commercial production. A hole full of water was found in the Pennsylvanian basal conglomerate at 3,450 feet, and the top of the "Viola lime" at 3,450 feet. The hole was abandoned at 3,535 feet.

Southeast of the Bratton test and north of Bunker Hill, Austin Drilling Company et al. abandoned No. 1 Rockefeller, SE cor. sec.

6, T. 13 S., R. 12 W., which was plugged at 3,557 feet after finding a hole full of water in that formation topped at 3,554 feet. An excellent show of oil was found at 3,042 feet to 3,046 feet after the top of the "Oswald" had been reached at 3,003 feet, but other pays in the "Oswald lime" yielded only small shows of oil with some water, and the well was drilled deeper. Water was found in the conglomerate drilled from 3,357 feet to 3,434 feet, and at the latter depth the top of the "Viola lime" was found. The base of the "Viola" was reached at 3,515 feet and Decorah green shale and sand was drilled from that depth to the top of the "Siliceous lime."

Deeprock Oil Corporation and Tom Palmer's No. 1 Pasek, center SE $\frac{1}{4}$ sec. 3, T. 14 S., R. 11 W., was unusually interesting in view of the horizon of its oil showing. After the top of the "Siliceous lime" was reached at 3,317 feet a hole full of water was found at 3,340 feet. This was cased off and a show of oil found at 3,412 to 3,427 feet, but the test was abandoned at that depth after failing to produce commercially. No showings of oil were encountered in the "Oswald lime," topped at 2,950 feet.

Saline County

One well produced a small amount of oil in Saline county in 1930, but there has been no production in the county since. It was Stanolind Oil and Gas Company No. 1 Olson, in the NW $\frac{1}{4}$ sec. 10, T. 16 S., R. 3 W., which produced 1,405 barrels of oil until December 18, 1930, from a cherty dolomite roughly correlated with "Viola lime" at a depth of 3,302 to 3,315 feet. A near-by test was abandoned in 1931, when Stanolind Oil and Gas Company abandoned No. 1 Martin, NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T. 16 S., R. 3 W., at a total depth of 3,534 feet.

On the same northeast trending subsurface axis as the Olson and Martin wells, and near Salina, Detrick et al. completed No. 1 Sudendorf, SE $\frac{1}{4}$ sec. 30, T. 14 S., R. 2 W., at 3,510 feet, after reaching the "Siliceous lime" at 3,470 feet. It was near a well drilled some years ago that found several shows of oil and gas. Northwest of Salina, Twin Mounds Oil Company completed No. 1 Weiss, NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T. 13 S., R. 4 W., as a dry hole at 3,525 feet. The Mississippi limestone in this well ran from 3,060 to 3,401 feet and the hole probably stopped in rocks of Siluro-Devonian age.

Although a number of well-defined "highs" have been found in Saline county and many of the wells drilled have found shows of oil sufficiently promising to attract more than ordinary interest, the

county has been more or less ruled out as a petroliferous area in the minds of oil company executives and independent operators. Repeated failures in the most attractive areas have been increasingly discouraging. It is quite probable that Saline county must await some venturesome wildcatter who is willing to disregard the lessons of experience and take a long chance before commercial production will be found.

Sedgwick County

Sedgwick county in 1931 and 1932 sustained active development in a quiet manner which was productive of results if not spectacular. The development of the Eastborough field furnished most of the activity during the former year, and important drilling occurred in the Eastborough, Greenwich, and Goodrich fields in 1932. No new fields were discovered in either year. Ninety-eight tests were drilled in the county in the biennium, of which seventy produced oil, one gas, and twenty-seven failed. All but five of them were in the eastern ranges of the county. A tabulation of results for each of the four important fields of the county and the miscellaneous tests is given in Table 12.

One of the outside completions was No. 2 Duncan of Patton et al., SW cor. NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 6, T. 26 S., R. 2 E., which was completed with a production of 600 barrels the first 24 hours from sand above the "Mississippi lime" at 2,988 to 2,990 feet. It was an offset to the No. 1 Swanson of the same group completed in 1929, but which went to water rapidly after a few months' production. This well likewise showed large amounts of water early in its production

TABLE 12.—Developments in Sedgwick county in 1931-1932

FIELD.	Year.	Total wells.	Oil.	Gas.	Dry.	Old wells drilled deeper.
Eastborough.....	1931	32	29	0	3	14
	1932	12	10	0	2	6
Greenwich.....	1931	5	5	0	0	4
	1932	12	10	0	2	7
Goodrich.....	1931	3	3	0	0	2
	1932	15	10	0	5	2
Valley Center.....	1931	0	0	0	0	0
	1932	3	2	0	1	1
Miscellaneous.....	1931	8	0	0	8	1
	1932	8	1	1	6	0
Totals.....	1931	48	37	0	11	21
	1932	50	33	1	16	16

history and it appears unlikely that a profitable area has been uncovered.

An attempt to develop gas production at the southeast edge of Wichita resulted in disappointment and the completion of one small gas well and three dry holes. The well, a twin to an old test drilled in 1929, was Will Schweiter et al. No. 1 Fee, SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T. 27 S., R. 1 E., which was completed at a total depth of 1,504 feet in sand topped at 1,490 feet. The producing sand appears to occur in the Severy shale and is a horizon that has produced minor amounts of gas in many scattered localities in central Kansas. The initial production of this well is reported at 2,500,000 feet per day, but the gas appears to be low in heat units.

Three near-by tests, one of which was an east offset, were unsuccessful. They are located in the SW cor. of sec. 26, the NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, and the center of the NW $\frac{1}{4}$ sec. 35, all in T. 27 S., R. 1 E., and were abandoned at 1,567, 1,587, and 1,550 feet, respectively.

The results of wildcat prospecting are shown in Table 13.

GOODRICH FIELD. Although discovered December 3, 1928, by the completion of No. 1 Goodrich of the Marland Oil Company, SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 16, T. 25 S., R. 1 E., flowing an estimated 7,000 barrels of oil per day from the chat at 3,010 to 3,020 feet, the Goodrich field received most of its development in 1931 and 1932. Only three other producing wells in addition to the discovery well had been completed in the field to the close of 1929 and no activity occurred in 1930. No. 1 Westerfield was the only well that was producing from below the chat, it being a failure in that pay. The Misener dolomite, at 3,326 to 3,335 feet, supplied its production, which was small at first, but gradually increased to about 90 barrels daily.

However, in August, 1931, the Continental Oil Company, successor to the Marland company, began deepening No. 1 Earl Black, SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 16, and it was completed in the Misener dolomite the following month. The details of all wells completed in the Goodrich field in 1931-1932 are given in Table 14. The only well not included in this table is No. 1 Westerfield, NW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 16, completed in April, 1929, as the discovery well in the Misener dolomite.

The success at No. 1 Earl Black spurred the Continental to test out its large block of leases further and the first result was the dis-

TABLE 13.—Wildcat completions in Sedgwick county, 1931-1932

LOCATION.	Total depth.	Remarks.
NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T. 25 S., R. 1 W.	3,744	Abandoned in "Viola lime."
SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 1, T. 27 S., R. 1 E.	3,413	"Viola lime" at 3,358 feet.
SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5, T. 27 S., R. 2 E.	3,352	Misener sand 3,314-3,315 feet; "Viola lime" 3,315-3,348 feet; abandoned in Simpson sand.
NE cor. sec. 17, T. 27 S., R. 2 E.	2,963	Hole full of water in top of "Mississippi lime" at 2,957 feet.
NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 1, T. 28 S., R. 1 E.	3,458	Simpson sand at 3,360 feet; "Siliceous lime" at 3,454 feet.
SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 4, T. 28 S., R. 1 E.	3,100	"Mississippi lime" at 3,065 feet; hole full of water at 3,095 feet.
SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 24, T. 28 S., R. 1 E.	3,590	"Viola lime" at 3,475 feet; Simpson at 3,480 feet; "Siliceous lime" at 3,570 feet.
Cen. SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 8, T. 28 S., R. 2 E.	3,458	Simpson at 3,350 feet; "Siliceous lime" at 3,440 feet.
Cen. SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 28 S., R. 2 E.	3,516	Simpson at 3,234 feet; "Siliceous lime" at 3,303 feet. Deepened in 1933.
NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 31, T. 28 S., R. 1 W.	3,838	"Mississippi lime" 3,453 to 3,715 feet; "Viola lime" 3,776-3,799 feet; abandoned in Simpson sand.
NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 29 S., R. 1 E.	3,608	Simpson at 3,505 feet; "Siliceous lime" at 3,575 feet.

covery of commercial production in the Kansas City "lime" and a three-quarter mile eastward extension of the field by No. 1 Casey, in sec. 15, completed December 14, 1931. However, this field was defined to the northwest, north, and east by dry holes and a dry hole of Stearns and Rosenthal in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 11, which found pre-Pennsylvanian formations much lower than wells on both sides of it, suggests a faulted condition, discouraging development to the south.

By the close of 1932, there were five wells producing from the Kansas City "lime" at slightly over 2,600 feet and six wells producing from the Misener dolomite at depths greater than 3,300 feet. A total of six dry holes have been drilled in or around the field and there appeared little chance for an extension of the producing area except to the west and southwest. The producing area of 700 acres has several undrilled inside locations. The "Viola lime," "Wilcox" sand, and "Siliceous lime" appear to have been adequately tested and found nonproductive. The subsurface structure, as delineated on the top of the Misener dolomite, reveals a somewhat symmetrical dome with an east-west axis, except for the possible fault mentioned

TABLE 14.—Well completions in Goodrich field, 1931-1932

COMPANY.	Well lease.	Location.	Remarks.
Continental Oil.....	1 S. Black.....	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 9, T. 25 S., R. 1 E.....	Hole full of water in Misener dolomite 3,394-3,410 feet. "Viola lime" 3,430-3,465 feet. "Siliceous lime" at 3,550 feet. Total depth 3,585 feet.
Continental Oil.....	1 Horton.....	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 10, T. 25 S., R. 1 E.....	Hole full of water in Misener dolomite 3,452-3,466 feet total depth.
Continental Oil.....	1 Brown.....	NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 25 S., R. 1 E.....	Kansas City "lime" pay 2,614-2,618 feet. Swabbed 142 barrels in 19 hours.
Continental Oil.....	2 Brown.....	CSL NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 25 S., R. 1 E.....	Show oil and water at 2,572 feet in Kansas City "lime." Misener dolomite 3,410-3,443 feet, with show of oil at 3,413 feet and hole full of water at 3,433 feet. Abandoned at 3,502 feet in "Wilcox" sand.
Continental Oil.....	1 Casey.....	SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 15, T. 25 S., R. 1 E.....	Kansas City "lime" pay 2,614-2,616 feet, 480 barrels per day.
Continental Oil.....	1 Hampson.....	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 15, T. 25 S., R. 1 E.....	Show oil 2,620 feet in Kansas City "lime." Misener dolomite 3,411-3,445 feet, with hole full of water at 3,415 feet. "Viola lime" 3,450 feet. Total depth, 3,457 feet.
Rosenthal et al.....	1 Green.....	CSL N $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 25 S., R. 1 E.....	Kansas City "lime" pay 2,622-2,626 feet. Pumped 90 barrels in 12 hours.
Rosenthal et al.....	1 Pinson.....	CNL SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 25 S., R. 1 E.....	Kansas City "lime" pay 2,604-2,613 feet; 114 barrels in 12 hours. Deepened. Misener dolomite 3,392-3,393 feet; 165 barrels in 24 hours.
Continental Oil.....	1 E. Black.....	SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 16, T. 25 S., R. 1 E.....	Deepened from chat, old total depth 3,012 feet. Misener dolomite 3,334-3,337 feet; 205 barrels in 12 hours.
Continental Oil.....	2 Casey.....	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 16, T. 25 S., R. 1 E.....	Kansas City "lime" pay 2625-2,631 feet. Pumped 40 barrels in 24 hours.
Continental Oil.....	1 Goodrich.....	SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 16, T. 25 S., R. 1 E.....	Deepened from chat, old total depth 3,020 feet. Misener dolomite 3,341-3,347 feet; 490 barrels in 24 hours.
Continental Oil.....	2 Goodrich.....	NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 16, T. 25 S., R. 1 E.....	Deepened from chat, old total depth 3,039 feet. Misener dolomite 3,334-3,340 feet. Pumped 605 barrels in 24 hours.

TABLE 14.—Well completions in Goodrich field, 1931-1932—CONCLUDED

COMPANY.	Well lease.	Location.	Remarks.
Continental Oil.....	1 Rauch.....	CN ^L SE ¹ / ₄ SE ¹ / ₄ sec. 16, T. 25 S., R. 1 E.....	Misener dolomite 3,346-3,352 feet. Swabbed 320 barrels in 12 hours.
Continental Oil.....	1 Smith.....	NE ¹ / ₄ NE ¹ / ₄ SE ¹ / ₄ sec. 16, T. 25 S., R. 1 E.....	Kansas City "lime" pay 2,613-2,614 feet. Swabbed 475 barrels in 9½ hours.
Continental Oil.....	2 Smith.....	CS ^L NE ¹ / ₄ SE ¹ / ₄ sec. 16, T. 25 S., R. 1 E.....	Show oil 2,605-2,610 feet in Kansas City "lime." Misener dolomite 3,359-3,368 feet. Swabbed 60 barrels in 12 hours.
Stearns-Rosenthal....	1 Park.....	NE ¹ / ₄ SE ¹ / ₄ SE ¹ / ₄ sec. 16, T. 25 S., R. 1 E.....	Show oil 2,596-2,599 feet in Kansas City "lime." Misener dolomite 3,427-3,453 feet, total depth. Hole full of water 3,431-3,445 feet.

above. Water is produced with the oil from both the Kansas City "lime" and Misener dolomite horizons and the three wells that formerly produced from the Mississippian chat also made considerable water. Recovery per acre will probably compare favorably with Valley Center leases.

EASTBOROUGH FIELD. A total of forty-four wells were completed in the Eastborough field in 1931 and 1932. Most of the development occurred in 1931 as only six new wells were drilled in 1932, although seven old wells were deepened to lower horizons.

Four of the forty-four tests were dry and abandoned, one being drilled only to the chat, while three were completed in the deeper pay in the Ordovician. Two old chat wells were deepened to the Ordovician without success. One of these, on the west side of the field, was plugged back to the chat and recompleted as a producer, but the other when plugged back to the chat produced for only a few weeks before it was permanently abandoned. Chat production covers a greater area than deep pay production, especially on the west flank of the structure. The occurrence of most of the chat oil on the west and southwest flanks of structures in central Kansas is quite common.

Ten producing wells were completed in the chat, and thirty found their production in the lower pay, but of these thirty, twenty were old chat wells whose production had fallen to such low levels that it was deemed advisable to deepen them to the lower horizons. This deepening was due to the encroachment of water in the chat in parts of the field and to the more profitable production found in the lower pays. Some chat wells were produced for but a few months before being deepened to the lower horizons. However, it is true that in a few cases profitable chat wells were prematurely deepened only because their offsets, which were not such large wells, had been deepened.

Chat production is found in this field at depths somewhat exceeding 2,900 feet, while the deep pay is found at an average depth of about 3,250 feet. The chat is known to represent the weathered surface of the "Mississippi lime," and above it a detrital zone of sand, variegated shale and weathered chert is found in many wells on the edge of the field. Some wells showed oil in this detrital zone.

The deep pay occurs in a variable lithologic unit between the base of the Chattanooga shale and the top of the "Viola" limestone. This unit varies from 4 feet in the south end to 17 feet in the central portion of the field. It is occupied by pure sand,

sucrose dolomite, shale, or a combination of the three and this section is best assigned to the Misener, although there is sufficient evidence to regard the shale member as Sylvan shale. In some cases it is believed that some of the oil comes from the underlying "Viola lime," but the contacts are so gradational that this cannot be definitely determined.

The field was discovered in August, 1929, by the completion of Producers and Refiners Corporation et al. No. 1 Mackey, SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 30, T. 27 S., R. 2 E., which had an initial production of 85 barrels from chat at 2,956 to 2,970 feet. Development lagged until June, 1930, when Fisher and Lauck completed No. 2 Trustee, SW cor. SE $\frac{1}{4}$ sec. 30, T. 27 S., R. 2 E., for 1,800 barrels daily from the chat at 2,935 feet. First deep-pay production was found by Vickers Petroleum Company and Hinkle's No. 1 Keys, NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 27 S., R. 2 E., which had an initial production of 1,500 barrels per day when completed July 21, 1930, at 3,238 to 3,242 $\frac{1}{2}$ feet. Activity increased throughout the remainder of 1930 and continued in 1931, with a slowing up in 1932.

Production has been developed in the SW cor. of sec. 17, along the south line of sec. 18, the east half of sec. 19, and the central portion and in the SW $\frac{1}{4}$ of sec. 30, T. 27 S., R. 2 E. Two wells in secs. 24 and 25, T. 27 S., R. 1 E. produced from the chat for a few months.

The field has a proved area of about 400 acres. Up to the first of 1933 the average recovery per acre had been about 10,000 barrels, and the estimated ultimate yield is at least 15,000 barrels per acre. The vicinity of the Eastborough field was core drilled by several companies and rejected by them, and its development may be attributed largely to the application of subsurface geology.

A well on the west side of the field that produced a small amount of oil from the chat was deepened in 1932 and abandoned at 3,341 feet. It was Blankenship Petroleum Company's No. 1 Schott, SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 27 S., R. 1 E., about three-quarters of a mile west of the closest production. It made 30 barrels initially from chat at 2,978 to 2,990 feet when completed December 5, 1930, but soon settled to 5 barrels daily and was shut down. When deepened it found a show of oil and a hole full of water at the top of the deeper pay horizon at 3,316 to 3,318 feet.

GREENWICH FIELD. Only five wells were completed in the Greenwich field in 1931, of which one was a new well, three were old chat producers deepened to the "Viola lime," and one was a "Viola

lime" well deepened to the lower Simpson sand. The last was No. 3 Hamant of the Gypsy Oil Company, SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 14, T. 26 S., R. 2 E., which made 115 barrels per day initially at 3,327 feet, total depth. This is the second commercial producer in the lower Simpson sand in this field and in the state. The "Viola lime" producers were drilled by the Shell Petroleum Company on its Fisher and Lagrisse leases in sec. 15, and averaged 645 barrels per well per day initially.

During 1930 and 1931 all but one of the producers on the Greenwich townsite were abandoned. These wells were located on the southwest flank of the structure and water intrusion in both the chat and "Viola limestone" pays flooded the field so rapidly that the lifting cost of the fluid was prohibitive. A belated attempt to extend production to the southwest of the townsite resulted in a failure in 1932, when Covell et al. abandoned No. 1 Rapp, NE cor. sec. 21, T. 26 S., R. 2 E., at a total depth of 3,384 feet. After topping chat at 2,902 feet, considerable water and some oil was found at 2,908 to 2,913 feet, but nothing further developed in the Ordovician and the hole was abandoned.

Although the Shell Petroleum Company discovered the Greenwich field April 27, 1929, with its No. 1 Lagrisse, SE cor. NE $\frac{1}{4}$ sec. 15, T. 26 S., R. 2 E., which made 2,118 barrels initially at 3,164 to 3,170 feet in the "Viola lime," several good wells were drilled near it and in the section to the east as late as 1932. Three of them were chat wells with initial productions ranging from 124 to 2,469 barrels per day. The latter well, Gypsy Oil Company No. 5 Hamant, NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, found three feet of porous chat at 2,865 to 2,868 feet for the highest initial production of any well in the field. Seven tests were completed in the "Viola lime" in this field with an average initial production of 280 barrels daily, but of these five were old wells deepened from the chat.

An interesting abandonment of the year was that of the discovery well of lower Simpson sand production in the state, Shell Petroleum Company, No. 2 Borg NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 14, T. 26 S., R. 2 E., completed December 12, 1929. Although water in abundance had been found in the top of the chat at 2,942 to 2,953 feet, the top of the "Viola lime" at 3,229 feet, and the top of the Simpson sand, or "Wilcox," at 3,280 feet, oil was found in the lower part of the Simpson sand at 3,352 to 3,354 feet for an initial production of 264 barrels daily. Deepening was commenced on July 30, 1932, and the well abandoned without finding any commercial

production September 3, 1932. The top of the "Siliceous lime" was reached at 3,375 feet and a hole full of water at 3,404 feet, total depth.

VALLEY CENTER FIELD. After a year of inactivity in 1931, the Valley Center field was the scene of three completions on 1932, one of them being an old well drilled deeper and abandoned. This was No. 9 Wilson of Skelly Oil Company et al., SW cor. NE $\frac{1}{4}$ sec. 1, T. 26 S., R. 1 W., which was deepened from 3,367 feet. A small show of oil was found in the "Wilcox" sand at 3,432 to 3,436 feet, but after the "Siliceous lime" was topped at 3,451 feet, a hole full of water was encountered at 3,461 to 3,466 feet and the hole abandoned at 3,474 feet.

Continental and Gypsy Oil Companies' attempts to extend the limits of the field to the west and south led to unimportant results. No. 1 Lambe, SE cor. NW $\frac{1}{4}$ sec. 12, T. 26 S., R. 1 W., found the top of the dolomite pay, probably Misener in age, at 3,330 feet and was completed at 3,339 feet, swabbing 126 barrels of oil and 56 barrels of water in March; but in the following month was deepened to 3,462 feet, after which it was plugged back to 3,339 feet and recompleted with a production of 40 barrels of oil and 200 barrels of water. Top of the "Wilcox" sand was found at 3,354 feet and top of the "Siliceous lime" at 3,438 feet, in which a hole full of water was found at 3,450 to 3,462 feet. No. 1 Bishop, NW cor. NE $\frac{1}{4}$ sec. 13, T. 26 S., R. 1 W., reached the top of the chat at 3,021 feet, had a good show of oil and water at 3,058 to 3,060 feet, more oil and water at 3,076 to 3,088 feet, and topped the Misener dolomite at 3,362 feet. After being drilled to 3,371 feet in dolomite, it was produced for a short time at the rate of 8 barrels of oil and 144 barrels of water per day. It was then plugged back to 3,087 $\frac{1}{2}$ feet and pumped 12 barrels of oil daily with considerable water from the chat.

The completion of these wells definitely limits the rich producing area of this field. Like other fields in central Kansas producing from pre-Mississippian or Misener formations, this field owes its large yield to a strong water drive. Unfortunately this water drive was not controlled as well as it might have been and the higher lifting costs necessitated by the disposal of large amounts of water has caused the early abandonment of many wells that otherwise would still be producing.

With an average recovery of over 15,000 barrels per acre, and a producing area of 1,100 acres, the Valley Center field has been the

richest field in Sedgwick county. There probably will be little more activity in this field in the future as it seems to be well defined and adequately developed, except for some parts in which the 2,600-foot Kansas City "lime" pay is productive.

Stevens, Morton and Grant Counties

Development in the Hugoton gas field in the years 1931 and 1932 has been limited primarily to the drilling of locations within the proved limits of the field.

Stevens county had 25 wells drilled in 1931, all of which were gas producers. The aggregate initial flow of these wells was 179,732,-154 cubic feet of gas. This brought the total number of completions to 107 gas wells, with an initial open flow of 715,202,494 cubic feet. All wells drilled within the limits of the field have been productive.

In Morton county, there was one gas well and one dry hole drilled in 1931. The gas well had an initial production of 2,909,-565 feet. The dry hole, Hydraulic Oil Company No. 1 School, NW cor. SE $\frac{1}{4}$ sec. 22, T. 34 S., R. 43 W., was abandoned September 16, 1931, at a depth of 3,450 feet in what is thought to be a Pennsylvanian limestone. Several shows of gas were recorded in the Hugoton gas horizon of the Big Blue group of the Permian. There have been 27 wells drilled to the gas pay in Morton county with a total initial production of 155,061,091 cubic feet of gas.

There were no developments in Morton and Stevens counties in 1932, and no wells were drilled in Grant county in 1931 or 1932.

Gas was discovered in the Hugoton field in May, 1927, but it was not until May, 1929, that gas was produced and sold from the field. The total production for the year 1931 was 4,379,831,000 cubic feet; for the year 1932, 10,718,233,000 cubic feet, and the total production to January 1, 1933, was 16,211,598,000 cubic feet.

Sumner County

Activity in Sumner county slumped sharply to a total of five completions in 1931 and six in 1932. This decrease was due to the failure of operators to discover new pools and their reluctance to develop old fields or drill wildcat wells. Several stratigraphically located wells were drilled defining old fields or condemning promising parts of the county.

The discovery well of the Caldwell pool was deepened and abandoned in the "Siliceous lime" and a northeasterly test was dry in

the "Wilcox" sand, the producing horizon of the field. No. 1 Douglas of the Gypsy Oil Company, SW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 16, T. 35 S., R. 3 W., completed for 1,700 barrels initially in the "Wilcox" sand at 4,769 to 4,784 feet April 10, 1929, was deepened to a total depth of 5,076 feet. Top of the "Siliceous lime" was reached at 4,969 feet and at 5,062 feet, 93 feet in the lime, the hole filled with water. No. 2 Douglas, SW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 16, T. 35 S., R. 3 W., drilled "Mississippi lime" from 4,364 to 4,728 feet, "Viola lime" from 4,813 to 4,824 feet, Simpson dolomite and shale to 4,847 feet, at which depth "Wilcox sand" was found, with a hole full of water at 4,849 feet, total depth.

Shell Petroleum Company completed No. 10 Churchill, center NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T. 31 S., R. 2 E., in Stalnaker sand at 1,830 to 1,890 feet as the third key well for use in a gas drive program. On the west side of the Slick-Carson field, most of which lies in Cowley county, Prairie Oil and Gas Company completed No. 2 Conrad as a dry hole in the "Siliceous lime," with a hole full of water at 3,524 feet. It is in the SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 24, T. 32 S., R. 2 E.

The only completion in the Padgett field in T. 34 S., R. 2 E., was J. P. Tighe et al. No. 2 Theissen, NW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 22, a north offset of the discovery well of the Continental Oil Company, completed in 1924. No. 2 Theissen made 120 barrels per day from Mississippian chat at 3,474 to 3,502 feet.

In the North Vernon field, Watchorn Oil and Gas Company abandoned No. 1 Rosecrans, SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 17, T. 35 S., R. 2 E., in the "Mississippi lime" at 3,522 feet.

Harris and Haun were more successful with their No. 1 Duncan, center NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 15, T. 35 S., R. 2 E., but it made only 60 barrels of oil with 20 barrels of water per day from chat at 3,417 to 3,455 feet.

There were four interesting wildcats abandoned in the two-year period. Burlingame and Long abandoned the third test in the area south of Corbin when they plugged No. 2 Rex, SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 22, T. 33 S., R. 3 W., at a total depth of 4,548 feet. "Mississippi lime" ran from 4,070 to 4,462 feet, with a show of oil and gas at the top, and three bailers of water per hour at 4,125 feet, but no oil was found in the "Wilcox" sand at 4,528 feet. Several miles northwest Van Mater and Lancaster found a failure at a total depth of 4,510 feet in No. 1 Porter, NE cor. SW $\frac{1}{4}$ sec. 12, T. 33 S., R. 4 W., after finding "Mississippi lime" at 4,075 to 4,410 feet and "Wilcox" sand and water at 4,492 feet.

Benedum and Trees No. 1 Foy, SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 14, T. 34 S., R. 1 W., was quit at 4,348 feet in the "Wilcox" sand topped at 4,305 feet. The "Mississippi lime" was passed through between 3,909 and 4,238 feet. Trees Oil Company drilled their No. 1 Collins, NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 6, T. 34 S., R. 2 E., to 4,000 feet. It found the "Mississippi lime" at 3,597 feet, a hole full of water at 3,639 feet, the base of the "Mississippi lime" at 3,855 feet, and the "Wilcox" sand at 3,955 feet, with water at the total depth.

Stafford County

Five tests had been drilled for oil and gas in Stafford county before the discovery of commercial oil production in September, 1930, by the completion of Midwest Exploration Company (now Stanolind Oil and Gas Company) No. 36 Richardson, SE cor. sec. 36, T. 22 S., R. 12 W. Top of the "Siliceous lime" in this well was found at 3,537 feet and when drilled to 3,543 to 3,545 feet oil rose in the hole 3,000 feet. Two hundred eighty-five barrels were swabbed in 24 hours, but the hole was deepened to 3,583 feet where more oil was found. After penetrating the "Siliceous lime" 62 feet to 3,599 feet and finding no water, the well swabbed 340 barrels in six hours. It was tested, producing 2,000 barrels which was run into storage, and shut in. Several showings had previously been found up the hole. At 2,757 feet, 1,170,000 cubic feet of gas was found probably in a sand lens in the Severy shale, and 30 barrels of 38° oil was found at 3,268 feet, 23 feet below the top of the "Oswald" or Lansing "lime." At 3,305 feet, 4,160,000 cubic feet of gas was gauged.

In 1932 the completion of three near-by tests supplied more information concerning the value of this discovery. All were drilled by Stanolind Oil and Gas Company. The results were as follows:

No. 29 Allen, center SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 22 S., R. 11 W., completed February 2, 1932, had "Siliceous lime" at 3,537 to 3,560 feet, filled 3,450 feet with oil and swabbed 1,035 barrels initially.

No. 11 Figger, center NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 23 S., R. 12 W., completed April 15, 1932, had "Siliceous lime" at 3,579 to 3,616 feet, show of oil at 3,590 feet, more oil at 3,600 to 3,603 feet and swabbed 200 barrels initially.

No. 6 Brock, NW cor. NW $\frac{1}{4}$ sec. 6, T. 23 S., R. 11 W., completed June 14, 1932, had "Siliceous lime" at 3,531 to 3,570 feet, oil at 3,535 to 3,541 feet and 3,560 to 3,564 feet, and swabbed at the rate of 32 barrels per hour.

The completion of these three additional wells established this

area, officially known as the Richardson field, as an important productive locality. The fact that there appears to be two productive porous zones in the "Siliceous lime" is interesting. In other western Kansas fields producing from the "Siliceous lime" there has been a suggestion of more than one "pay" in that formation, but this field offers the best evidence of such a condition. It is worthy of mention at this point that in the eastern Kansas fields producing from the "Siliceous lime," the oil is usually found at the upper surface of the lime, whereas in central Kansas a number of wells have found their production some distance below the top. The lack of water in the upper part of the "Siliceous lime" in this field is also exceptional.

A Stafford county well that caused a ripple of excitement in 1931 when it showed oil was abandoned in the "Siliceous lime" at 4,052 feet January 20, 1932. It was No. 1 Gray of Rosenthal et al., center NE $\frac{1}{4}$ sec. 11, T. 24 S., R. 13 W. It found "Viola lime" at 3,829 to 3,960 feet, with first oil at 3,834 feet, and 1,400 feet of oil came into the hole at 3,852 to 3,855 feet. Simpson green shale, dolomite and sand ran from 3,960 to 4,034 feet, and three bailers of water hourly was found at 4,024 feet. The top of the "Siliceous lime," and a hole full of water were found at 4,034 feet and the well abandoned at 4,052 feet, without testing the showings found above. It is quite probable that there will be further activity in the vicinity of this well when conditions warrant more exploration.

Developments in Other Counties

It was only natural that oil companies and operators in 1931 and 1932 would refuse to spend their resources in the development of reserves in absolutely unproved areas with production curtailed drastically throughout the country and the price of oil at very low levels. In some cases, however, due to the fact that large blocks of leases were about to expire or because various companies were willing to pool their acreage in an attempt to explore rank wildcat blocks, tests were drilled far from production. These tests in counties outside of those heretofore mentioned are tabulated in Table 15.

It will be noted that ten of the thirteen wells in this table reached the "Siliceous lime." All but four of the wells were drilled below 4,500 feet, and one passed 6,200 feet. Ten years ago a well that was more than 3,200 feet in depth was an exception and a test to 4,000 feet or more was a rarity. The footage and stratigraphic depth of

these wells shows that the owners were willing to go to great expense to adequately test out the areas explored.

Year after year since 1924, the drill has been adding much priceless geological information to the files of Kansas oil companies and in 1931 and 1932 this was certainly true. All wildcat wells were carefully logged and samples were saved on many of them "from the grass roots down." As knowledge of subsurface conditions in western and far western Kansas increases, the more remote areas of the state appear less forbidding and when better economic conditions return to the industry exploration work in this vast territory will be resumed on the scale of the peak year, 1929.

TABLE 15.—Miscellaneous western Kansas completions of 1931-1932

COUNTY.	Location.	Date.	Total depth.	Remarks.
Edwards	Sec. 30, T. 24 S., R. 18 W.	11-16-32	5,319	Oil shows at 4,552; 4,565, 4,573 feet in conglomerate. "Oswald lime" 3,995 feet, Mississippian 4,595 feet. "Siliceous lime" 4,968 feet.
Ford	Sec. 21, T. 25 S., R. 24 W.	11-23-32	5,782	Oil and gas shows at 1,975 and 3,025. "Oswald lime" 4,220 feet. Oil shows 4,335 and 4,750 feet. Gas shows 4,885 in conglomerate. Mississippian 4,890 feet. Ordovician 5,480 feet. Abandoned in "Siliceous lime."
Ford	Sec. 22, T. 29 S., R. 21 W.	10-27-31	6,206	"Oswald lime" 4,748 feet, Mississippian 5,268 feet. Reached "Siliceous lime."
Gove	Sec. 11, T. 12 S., R. 27 W.	2-3-31	4,856	Ordovician 4,550 feet; "Siliceous lime" 4,705 feet. No show of oil or gas.
Gove	Sec. 24, T. 13 S., R. 27 W.	1-16-31	4,813	Show oil at 4,065 feet in "Oswald lime." Ordovician 4,530 feet; "Siliceous lime" 4,671 feet.
Graham	Sec. 11, T. 9 S., R. 25 W.	10-28-31	4,656	No oil or gas shows. Poor log. Probably reached "Siliceous lime."
Harper	Sec. 21, T. 31 S., R. 6 W.	10-21-31	1,830	Abandoned in upper part of Pennsylvanian. No shows.
Ness	Sec. 25, T. 17 S., R. 25 W.	6-13-31	4,807	Base Pennsylvanian 4,418 feet; 500 feet of oil in hole at 4,374 to 4,376 feet in conglomerate. "Siliceous lime" 4,709 feet.
Pawnee	Sec. 27, T. 20 S., R. 18 W.	1-27-31	4,267	"Oswald lime" 3,680 feet; Conglomerate 4,095 to 4,160 feet. "Siliceous lime" 4,160 feet. No shows.
Pratt	Sec. 7, T. 26 S., R. 15 W.	2-26-31	4,956	"Oswald lime" and gas show 3,870 feet. Oil show 3,935 feet. 1,000,000 feet of gas at 4,299 to 4,302 feet in conglomerate (?). Base of Pennsylvanian 4,524 feet. "Siliceous lime" 4,680 feet.
Phillips	Sec. 25, T. 5 S., R. 18 W.	7-6-32	3,440	"Oswald lime" 3,075 feet. Good oil shows 3,097, 3,137, 3,195, and 3,330 feet. "Siliceous lime" and hole full of water 3,425 feet.
Rawlins	Sec. 3, T. 2 S., R. 35 W.	6-29-32	3,939	Dakota sand 2,120 feet. Permian 2,890 feet. Pennsylvanian 3,850 feet (?). Oil shows 3,669, 3,520, and 3,737 feet. Gas show and hole full water 3,925 feet.
Sheridan	Sec. 27, T. 7 S., R. 26 W.	11-23-32	4,540	"Oswald lime" 3,740 feet (?). Gas show 3,625 feet. Probably quit in Mississippian.