

74
46

KGS
OF
31-1

THE NATURAL GAS RESOURCES OF KANSAS

By

Raymond C. Moore
assisted by J. L. Garlough, Lawrence Hay,
F. G. Holl, and J. W. Cckerman

State Geological Survey of Kansas

Smith - Hutchinson

Av price per M 5¢ to land owner
1.26 gal gas per M

KGS
OF
31-1
c. 1

est 14 mill ft per acre
1,076 a proven

Pipe

Colo Utilities 8" Lamar

P.S. 24 Indpls Amr Hugo

W Gas + P.L. Co S Dak (S Falls)

Cameron Utility from Texas Co Okla
St Paul Mpls Lincoln, Des Moines Sioux City

4" line to Liberal branch from Mullineville not yet built

gas producible from gas without damage 25%
argus has produced

39% of now transported

44.6 Av thickness of pay

21.3 Porosity

435# - 32.6 R.P.

100%

→ 15,203,765,000

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For the Public Service Commission of Kansas

Nov. 1, 1931

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estimated
1011

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3,902,964,000 cuft used from Hugoton to 6/1/31

	Prod met	Proved	Prob
SE Kans -	9,214,026, (27)	11,654,000	48,150,000
NE Kansas	3,974,333 (11)	9,559,751	47,788,200
EC "	7,030,946 (20)	39,651,500	46,440,500
W "	13,927,083		
McPherson		52,788,000	108,903,000
Hugoton			8,178,345
Others			7,727,647 036
Total		7,812,482,036	7,894,166 036
		9,683,253,287	8,036,560,036

7,727,647 036
6

7,166,519,

5382 076 817
2428 405 219
7812 482 036

5219,940,198
2428,405,219
8,178,345,317

966,370,000

7,730,520,000

10,569,440,000

THE NATURAL GAS RESOURCES OF KANSAS

ADVANCE SUMMARY

The survey of natural gas resources of Kansas that has been made by the State Geological Survey shows that the production of Kansas gas fields was 34,146,350 M. cu. ft. in 1930, and it is estimated that the production for 1931 will exceed 40,000,000 M. cu. ft.

Study of geological and production data in the known gas fields of Kansas indicates a total "proved reserve" for the state of 5,449,940,098 M. cu. ft. A conservative estimate of probable additional reserve amounts to 752,170,119 M. cu. ft., making a total "probable reserve" of 6,202,110,217 M. cu. ft. The so-called "proved reserve" represents the quantity of undeveloped gas in Kansas fields as determined from production-pressure decline curves, time-production curves, and from volumetric computations. The figures are ultra-conservative in most cases. The "probable reserve" represents the judgment of Survey geologists of the gas production that reasonably may be expected from the known fields of the state. It contemplates production to lower pressures (averaging about 50 pounds) than used in computing the proved reserves, and it includes territory adjoining proved fields that is regarded as probable gas-producing. Both the "proved reserve" and the "probable reserve" represent gas recoverable from the ground, and not the total amount of gas existent in the various fields.

For purposes of this investigation the state was divided into four districts: (A) Southeastern Kansas, including chiefly the long-time producing areas of Montgomery, Wilson, Allen and Bourbon counties; (B) Northeastern Kansas, containing fields in Linn, Anderson, Franklin, Miami, Johnson and Wyandotte counties; (C) Central Kansas, including especially Chautauqua, Elk, Cowley, Butler, Greenwood and Chase counties; and (D) Western Kansas, with most important production in McPherson, Barber, Stevens, Grant and Seward counties.

The Southeastern Kansas district produced 9,814,046 M. cu. ft. in 1930 which was 27 per cent of the production of the state. The proved reserve of the district is figured at 11,654,000 M. cu. ft., which amounts to two-tenths of one per cent of the proved reserve of the state. The probable reserve of Southeastern Kansas is estimated at 48,150,000 M. cu. ft., which equals one-half of one per cent of the probable reserve of the state.

Northeastern Kansas produced 3,974,383 M. cu. ft. in 1930, amounting to about 11 per cent of the state's production. The proved reserve is set at 9,557,781 M. cu. ft., and the probable reserve at 47,788,900 M. cu. ft. These figures are very small as compared to the state totals.

The East Central Kansas district produced 7,030,946 M. cu. ft. in 1930, which is 20 per cent of the total production of the state for that year. The proved reserve is computed at 39,651,500 M. cu. ft. and the probable reserve at 46,410,500 M. cu. ft.

Western Kansas contains the great undeveloped gas reserve of the state, amounting to almost 99 per cent of the total proved reserve, and more than 97 per cent of the total probable reserve. Production from Western Kansas in 1930 amounted to 13,927,083 M. cu. ft., the gas coming chiefly from McPherson and Barber counties. The chief reserves are located in McPherson county (proved reserve 52,788,000 M. cu. ft., probable reserve 108,903,000 M. cu. ft.) and the Hugoton district of southwestern Kansas (proved reserve 5,299,241,817 M. cu. ft., probable reserve 5,893,241,817 M. cu. ft.). The area in the Hugoton district regarded as proved gas-producing territory amounts to 651,000 acres, nearly equal to 30 entire townships. The computed average acre yield of gas in the Hugoton field is 8,144 M. cu. ft.

Maps showing distribution of the fields, of gas pipe-lines and indicating the proportion of gas reserves by districts are appended.

THE NATURAL GAS RESOURCES OF KANSAS

By Raymond C. Moore

assisted by J. L. Carlough, Lawrence Hay, F. G. Holl and J. W. Cokerman

State Geological Survey of Kansas

Introduction

At the request of the Public Service Commission, the State Geological Survey has undertaken an investigation of the natural gas resources of Kansas, the chief results of which are presented in this report. The work has included the preparation of maps showing productive gas fields in the state, compilation of recent production data and computation of the reserve gas supplies of the known fields in Kansas. The Commission made available for this work the services of three Wichita geologists, Messrs. J. L. Carlough, Lawrence Hay and F. G. Holl, who have had long experience in oil and gas work. Members of the Survey staff who aided in the work are Mr. J. W. Cokerman, Roland Stever, Herman Rosenthal, O. L. Furse and Dwight Bingham.

In the assembling of data it was found convenient to divide the state into four districts: (1) Northeastern Kansas, including Linn, Anderson, and Coffey counties and the territory to the north, (2) southeastern Kansas, including Bourbon, Allen and Woodson counties and territory to the south, (3) Central Kansas, including territory as far west as Wichita and (4) Western Kansas, including all of the territory west of the prime meridian. The outline of districts is indicated on the accompanying state map, which also shows graphically the estimated gas reserves according to districts. To a large extent this division of the state into districts conforms with significant differences in geological conditions bearing on gas production, in the distribution of activities of the major gas companies and in field conditions and the nature of the records concerning gas production, which are of practical importance in computing gas reserves.

Some of the fields of the Northeastern and Southeastern districts have been producing for upwards of twenty years. In some cases good gas wells have been obtained in areas that were first drilled forty or even fifty years ago. The accurate estimation of reserves in this region is especially difficult, but it is clear that the potential gas supplies of the eastern one-fourth of the state are small as compared with those of the western districts.

It is desirable to make acknowledgment here of the very cordial assistance to the Geological Survey of practically every gas-producing company in the state. Without this aid the investigation could not have been completed. Incidentally, it may be stated here that the records of production, of rock pressure and all other data concerning the gas wells of the state are taken from the records of individual companies and operators. They are believed to be entirely accurate, but the findings of this survey naturally rest on these data.

Discussion of the general geology of Kansas and detailed discussion of the structure and stratigraphy of gas producing areas are regarded as unnecessary in this summary of production and reserves of the gas fields. Indeed, the gathering of geological information in many of the fields would have extended much too greatly the time required in assembling data and would have enlarged the report considerably without adding essential information. The general conditions in each of the fields are fairly well known. Mainly for the purpose of reference in connection with producing horizons mentioned in connection with notes on different gas areas the following tabulation of main stratigraphic divisions of the state and the location of gas producing horizons is given.

Permian

Big Blue Series

Sumner Group

Wellington formation
 Herrington limestone
 Enterprise shale
 Lata limestone

Chase Group

Winfield limestone
 Doyle shale
 Fort Riley limestone
 Florence flint
 Hatfield shale
 Wreford limestone

Council Grove Group

Carrison shale
 Cottonwood limestone
 Eskridge shale
 Nova limestone

Tavies Group

Elmdale shale
 Americus limestone

Pennsylvanian

Virgil Series

Wabaunsee Group

Adaire shale
 Brownville limestone
 McKissick Grove shale
 Tarkio limestone
 Willard shale
 Euporia limestone
 Humphrey shale
 Burlingame limestone
 Scranton shale
 Howard limestone
 Severy shale

Shawnee Group

Topeka limestone
 Calhoun shale
 Deer Creek limestone
 Tecumseh shale
 Leecompton limestone
 Kanwaka shale
 Kereford limestone
 Grand limestone

Douglas Group

Lawrence shale
 Amazonia limestone
 Stranger sandstone

Pennsylvanian (continued)

Pottawatomie Series

Lansing Group

- shale
- Iatan limestone
- Weston shale
- Stanton limestone
- Vilas shale
- Plattsburg limestone
- Bonner Springs shale
- Farley limestone
- Island Creek shale
- Argentine limestone

Wyandotte Group

- Lanc shale
- Iola limestone
- Chanute shale
- Drum limestone
- Quivira shale
- DeKalb limestone
- Cherryvale shale

Bronson Group

- Wintercet limestone
- Galesburg shale
- Bethany Falls
- Ladore shale
- Hertha limestone

Des Moines Series

Marmaton Group

- Pleasanton shale
- Altamont limestone
- Bandera shale
- Peru sand
- Fawnee limestone
- Labette shale
- Fort Scott-Oswego limestone

Cherokee Shale

- Wayside sand
- Bartlesville sand
- Burgess sand

Mississippian

- Mississippi "lime" "chat"
- Chattanooga shale

Siluro-Devonian

- Hunton limestone

Ordovician

- Sylvan shale
- Viola limestone
- Simpson formation

Cambre-Ordovician

- Arbuckle-"siliceous" limestone

Pre-Cambrian basement igneous rocks.

Methods of Estimating Gas Reserves

Various methods have been employed in obtaining the figures for gas reserves in the different fields.

(1) The preferred method, where sufficient data are available, is the cumulative production-rock pressure decline curve. In this successive readings of rock pressure in a well or field are plotted against total production at the time of the pressure reading. In accordance with Boyle's law for gases, which states that the amount of gas in a given space is directly proportional to its pressure, there is a steady drop in the pressure of the gas in a well or field as gas is extracted. The curve that is plotted from production and pressure data may be extended beyond the part controlled by the records and gives one of the most reliable means of determining the future gas production.

(2) In some cases the cumulative production-rock pressure curve method can not be used satisfactorily. The field may be too new, the amount of gas produced too small and the decline of pressure insufficient to give definite form to the decline curve. This is true of the great southwestern Kansas gas field around Hugoton. A method used here has been the careful determination of average porosity of the pay zone based on well core samples, determination of the average thickness of the pay, and computation of the amount of gas in the pay per acre at the measured rock pressure. Estimation of the reserve of the entire field then rests on determination of the number of acres of productive gas territory and on the assumption of persistence of average porosity and thickness in the pay zone.

(3) In most of the eastern Kansas gas fields it has been found most satisfactory to take the actual production records plotted against time as a basis of estimating reserves. Production-pressure decline curves can be constructed for individual wells and small districts, but there is such variation, both in the

nature and completeness of the field data, that estimates based on Boyle's law are not very useful. Further, it is impracticable to take pressure readings on shale gas wells, which are numerous in parts of the eastern Kansas territory and consequently in many cases there are no pressure readings available. Therefore, in these districts estimates of reserve gas supplies are based on an extension of the production curves into the future.

(4) Finally there is the case of newly discovered gas-producing areas where there are no production records and the only information available is the initial open flow and rock pressure of one or two wells. In some cases estimate can be made of the size of the gas-producing territory from knowledge of the local geologic structure, but it is obvious that estimation of gas reserves in such a case is little more than a scientific guess.

It has been thought desirable to submit two sets of figures on reserves, one of which is designated "Proved Reserves" and the other as "Probable Reserves". Proved Reserves represents a conservative, in some cases an ultra-conservative determination of undeveloped gas based on production-pressure decline curves, time-production decline curves and the like. In the case of certain western Kansas gas fields where wells are producing against a high line pressure, (up to 370 pounds) production is figured only down to 100 pounds pressure, notwithstanding the virtual certainty that the wells will ultimately be produced at much lower pressures. In the case of fields like the Hugoton district, only the territory fairly well proved by actual drilling up to the present time (November 1, 1931) is included. There is strong probability that the field will be enlarged by future drilling. In the case of many eastern Kansas fields the proved reserve is barely one year's production. Experience indicates clearly that we may count reasonably on a reserve equal to four or five times the present annual production. Accordingly, this would increase the figures given for Proved Reserve of these fields four or five times; the larger

estimate thus obtained is designated as Probable Reserves. The new fields on which there is no real basis for estimating reserves are not included under the head of Proved Reserves.

The figures for Probable Reserves represent the judgement of survey geologists as to the gas production that reasonably may be expected from the known fields of the state. In some cases these estimates may prove to be too high, in others they are probably too low. In central Kansas and some of the western Kansas fields, like those in Barber County, an increase in the Probable Reserves over the Proved Reserves is derived by extending the productive life of the wells to a lower limit (varying in different fields, but averaging about 50 lbs.). In the decline of a gas field, the essential conditions controlling the economic limit of production are the condition of the gas market and the cost of securing the low-pressure gas. In some eastern fields gas is being produced at less than atmospheric pressure. In the Hugton district there is a considerable increase in the figure for Probable Reserve, due mainly to inclusion of additional probable gas-producing territory. This and the estimate for undeveloped fields are naturally more speculative than the increases based on extensions of the production-pressure decline curves. The eastern Kansas probable reserves are set at five times the present annual production from this district.

Summary of Kansas natural gas production and reserves

Compilation of available production data indicates that Kansas produced 34,146,350,000 cubic feet of gas in 1930, and in the first half of 1931 19,242,681,000 cubic feet.

The total Proved Reserves of natural gas in Kansas, according to the figures of the Geological Survey are 5,449,940,098,000 cubic feet and the Probable Reserves are 6,202,110,217,000 cubic feet. As previously explained, it is believed that the figures for Proved Reserves are an underestimate and that

the figures for Probable Reserves represent a reasonable approximation of the amount of gas that is likely to be produced from the gas fields that are now known.

The Probable Reserve total does not take into account any estimated production from additional gas fields that will be discovered in future. Various features in the geology of Kansas that are now known and the great incompleteness of exploration of many parts of the state by drilling, make absurd the assumption that we now know all of the gas-producing territory of Kansas.

Detailed tabulation of data on the various gas fields of the state, arranged by districts, follow:

Table I. Natural gas production of Kansas for 1930 and estimated gas reserves of Kansas, by districts

District	1930 Production in M. cu. ft.	Reserves in M. cu. ft.	
		Proved ^{1/}	probable ^{2/}
S. E. Kansas	9,214,046	11,654,000	46,150,000
N. E. Kansas	3,974,335	9,557,781	47,786,900
East Central Kansas	7,030,946	39,081,500	46,410,500
Western Kansas	13,927,023	6,364,076,817	6,059,760,817
Total	34,146,350	5,449,940,098	6,202,110,217

^{1/} "Proved reserve" represents a conservative estimate based on most reliable evidence of producing conditions in the known gas fields of the state.

^{2/} "Probable reserve" represents the judgment of Survey geologists as to the reasonable expected yield of the known gas fields of the state.

Supplement A

SOUTHEASTERN KANSAS DISTRICT

SUMMARY AND DETAILED DATA ON GAS PRODUCTION AND RESERVES

General statement. The southeastern Kansas district includes the following counties: Allen, Bourbon, Cherokee, Crawford, Labette, Montgomery, Neosho, Wilson and Woodson. Gas is produced in all of the counties but Cherokee and Crawford counties. The history of the region shows that many of the gas areas are redrilled after a period of inactivity and again produce considerable amounts of gas. This is due to the fact that there are so many producing horizons in the lower Pennsylvanian rocks that it is often possible to redrill and secure gas from one of these zones when another zone, from which the gas was formerly produced, has been exhausted.

The chief producing horizons are the Bartlesville, Wayside, and Hancock sands in the Cherokee shale, the "Covego lime" (Fort Scott), and the Peru sand in the Marmaton formation. The lenticular nature of the gas horizons and other factors make the delimitation of fields difficult. The exact number of wells is difficult to ascertain due to the fact that many wells are owned by individuals or small operators and are not recorded. Also there has been repeated redrilling in areas once exhausted. About 1,550 wells are represented by data examined in studying the southeastern Kansas district for this report. The production for this district in 1930 was 9,214,046 M. cu. ft., which is 27 per cent of all the gas produced in the state for that year.

The estimated "proved gas reserves" herein given are based on decline curves in about one-half of the fields and in the remaining fields, on the past production record. The estimated proved reserves of the southeastern Kansas district are one-half of one per cent of the total for the state. The "probable gas reserves" are estimated as amounting to about four times the 1930 production in the southeastern

Supplement A

Southeastern Kansas District

Kansas district, in addition to the proved reserves, which are only slightly over one year's supply. That is, the probable reserves are figured as approximately equal to five times the 1930 production. The figure for probable reserves seems to be conservative, since gas will undoubtedly be produced on about the same scale as now during the next five years. Indeed, one cannot foresee the final exhaustion of the eastern Kansas gas areas. They have produced moderate amounts of gas for many years and there is no reason to believe that they will not continue to do so.

A summary of the gas production of the southeastern Kansas district for 1930 and the estimated proved and probable reserves, by counties, is given in the following Table A-I.

Table A-I. Summary of gas production for 1930 and estimated gas reserves by counties

County	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable re- serves in M. cu. ft.
Allen	3,632,509	4,044,000	18,500,000
Bourbon	33,437	185,000	320,000
Labette	249,622	357,000	1,200,000
Montgomery	2,269,904	3,868,000	12,950,000
Necaho	335,089	100,000	1,400,000
Wilson	2,675,075	2,820,000	13,500,000
Woodson	<u>18,410</u>	<u>220,000</u>	<u>220,000</u>
	9,214,046	11,654,000	48,150,000

Detailed data and notes on the gas-producing areas of the southeastern Kansas district are presented in the following pages, by counties.

Supplement A

Southeastern Kansas District

ALLEN COUNTY

The Allen County gas reserves were estimated from the 1930 production and in the case of the Oklahoma Natural Gas Company production in the Southwest, Northwest, and Northeast Chanute districts, decline curves based on monthly production figures for 1929-1931 were used. Much of the production data were not available and the proved reserves were estimated as equalling the 1930 production. In view of the past history of the shale gas production in southeastern Kansas, it seems logical to conclude that the Allen County gas producing areas will continue their present production for at least five years. The proved reserves equal about one year's supply and four times the 1930 production was added to the proved reserves to get the probable reserve figures.

A summary of the gas production of Allen County for 1930 and the estimated proved and probable reserves is given in the following Table A-2.

Item	1930 Production	Proved Reserves	Probable Reserves
Gas	1,000,000 cu. ft.	1,000,000 cu. ft.	4,000,000 cu. ft.

The following are the problems to which attention should be given: 1. The location, depth, and production of wells. 2. The location of proved reserves. 3. The location of probable reserves. 4. The location of unproved reserves. 5. The location of gas production in 1930. 6. The location of gas production in 1931. 7. The location of gas production in 1932. 8. The location of gas production in 1933. 9. The location of gas production in 1934. 10. The location of gas production in 1935. 11. The location of gas production in 1936. 12. The location of gas production in 1937. 13. The location of gas production in 1938. 14. The location of gas production in 1939. 15. The location of gas production in 1940.

Oklahoma Natural Gas Company. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1930. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1931. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1932. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1933. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1934. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1935. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1936. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1937. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1938. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1939. The gas production in the Oklahoma Natural Gas Company district was 1,000,000 cu. ft. in 1940.

Supplement A
Southeastern Kansas District

ALLEN COUNTY (cont'd.)

Table A-2. Gas Production for 1930 and estimated gas reserves of Allen County

Operator of Field	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable re- serves in M. cu. ft.
J. F. Horton	33,286	50,000	183,000
Okla. Natural NW. Chanute	1,364,767	1,725,000	7,164,000
Okla. Natural NW. Chanute	141,237	72,000	626,000
Okla. Natural NE. Chanute	194,139	224,000	1,000,000
Humboldt purchased from Fuseman Gas Co.	66,197	70,000	314,000
Monarch Cement Co.	899,672	900,000	4,490,000
Okla. Natural Iola district	933,211	1,000,000	4,723,000
	3,632,509	4,044,000	18,500,000

The following are the producers in Allen County:

J. F. Horton, Iola, Kansas. 1930 production 33,286 M. cu. ft. No data available on number and location of wells and producing horizons. The estimate of proved reserves based on 1930 gas production is 50,000 M. cu. ft. The estimated probable reserves are 183,000 M. cu. ft., derived by adding four times the 1930 production to the estimated proved reserves.

Oklahoma Natural Gas Company. About 400 gas wells in the three Chanute districts produced 1,700,143 M. cu. ft. in 1930. Records of monthly production for 1929, 1930, 1931 were available and monthly-production decline curves based on

Southeastern Kansas District

ALLEN COUNTY (cont'd.)

these figures gave an estimated proved reserve of 2,024,000 M. cu. ft. The estimated probable reserve figures were secured by adding four times the 1930 production to the estimated proved reserves.

The Oklahoma Natural Gas Company in 66 wells in the Iola district produced 933,211 M. cu. ft. in 1930. The proved reserve of 1,000,000 M. cu. ft. is based on the 1930 production. It is estimated that the district should produce at least an equivalent to the 1930 production. The estimated probable reserves are four times the 1930 production plus the estimated proved reserves.

The Humboldt City Plant purchased from the Pusman Gas Company and the Monarch Cement Company 66,197 M. cu. ft. of gas in 1930. This was secured by the above companies from scattered wells in Allen County. The assumption that these wells should produce at least an equivalent of the 1930 production gave an estimated proved reserve figure of 70,000 M. cu. ft. The estimated probable reserves are figured on a five-year future production and secured by adding four times the 1930 production to the estimated proved reserves.

The Monarch Cement Company produced 899,672 M. cu. ft. in 1930. The proved reserves were estimated as equivalent to the 1930 production in the absence of monthly production figures from which to construct decline curves. The proved reserves of 900,000 M. cu. ft. plus four times the 1930 production gives a probable reserve of 4,490,000 M. cu. ft.

Supplement A

Southeastern Kansas District

BOURBON COUNTY

The estimated proved reserves in the Bourbon County gas fields are based on figures secured from the Union Gas Corporation, Independence, Kansas. The acreage and wells of the Southwestern Gas Company were purchased July 31, 1929, by the Empire Oil and Refining Company and at that time the reserves were estimated at 260,000 M. cu. ft. on the basis of production decline curves. Since then 14,565 M. cu. ft. have been produced, leaving a reserve of 165,435 M. cu. ft., or roughly 165,000 M. cu. ft.

A summary of the gas production of Bourbon County for 1930 and the estimated proved and probable reserves is given in the following Table A-3.

Table A-3. Gas Production for 1930 and estimated gas reserves in Bourbon County

Operator	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable re- serves in M. cu. ft.
Empire O. & R. Co.	33,437	165,000	320,000

The Empire Oil and Refining Company has 43 wells in the Bourbon County field, with a 1930 production of 33,437 M. cu. ft. of gas. The reserves given are those of the Southwestern Gas Company figured at the time of sale, July 31, 1929, on the basis of monthly production decline curves. The production is from sands in the Cherokee shales.

Supplement A
 Southeastern Kansas District

LABETTE COUNTY

The estimated proved reserves for Labette County were figured in several ways. In the case of the Union Gas Corporation much of the gas was purchased and no records were available so that the estimated proved reserves were figured as equaling an equivalent to the 1930 production. The J. L. Murphy reserves were figured on a pressure decline curve with 10 pounds minimum pressure. The A. M. Robertson reserves were figured from a pressure decline curve with 20 pounds minimum pressure. Production figures from 1924 to 1931 on the Dennis Gas Company holdings gave a good production decline curve. In each case the probable reserves were estimated at about five times the 1930 production on the assumption that production would continue on about the same scale for at least five years.

A summary of the gas production of Labette County for 1930 and the estimated proved and probable reserves is given in the following Table A-4.

Table A-4. Gas production for 1930 and estimated gas reserves in Labette County

Operator	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable re- serves in M. cu. ft.
Union Gas Corp.	133,428	150,000	600,000
J. L. Murphy	15,690	67,000	70,000
A. M. Robertson (Empire purchase)	47,551	40,000	200,000
Dennis Gas Co. (Empire purchase)	52,993	100,000	250,000
	249,662	357,000	1,200,000

Southeastern Kansas District

LABETTE COUNTY (continued)

The Union Gas Corporation holding and purchasing wells produced 133,428 M. cu. ft. in 1930. The estimated proved reserves are 150,000 M. cu. ft. or about the equivalent of one year's supply equal to that of 1930. Production data from which to construct decline curves were not available. The estimated probable reserves are figured as equivalent to about five times the 1930 production. There are 33 wells in these leases producing from the Cherokee shale, sands in the Cherokee shale and the Oswego lime.

The J. L. Murphy Producing Company had 8 wells that produced 15,690 M. cu. ft. of gas in 1930 from sand in the Cherokee shale. The estimated proved reserves were based on a pressure decline curve. The original pressure in the wells was 66 pounds and had declined to 35 pounds. By continuing the curve to 10 pounds pressure an estimated reserve of 67,000 M. cu. ft. was secured. The probable reserve is based on an equivalent to five years production on a par with the 1930 production.

A. M. Robertson produced 47,551 M. cu. ft. of gas in 1930 in 7 wells in the Bartlesville sand. The gas was purchased by the Empire Oil and Refining Company. The estimated proved reserves were secured from a pressure decline curve. The original pressure was 230 pounds and has declined to 140 pounds. A continuation of the curve to 20 pounds minimum pressure showed a reserve of 40,000 M. cu. ft. The probable reserve is logically based on future wells which will bring up the pressure for a while as is shown in the variable curve of these leases.

The Dennis Gas Company had a 1930 production of 52,993 M. cu. ft. of gas from sands in the Cherokee shale. A curve was constructed from monthly production from January, 1929 to date and the proved reserves were estimated at 100,000 M. cu. ft. The estimated probable reserves are figured on an equivalent to five times the 1930 production.

Supplement A

Southeastern Kansas District

MONTGOMERY COUNTY

The estimated "proved gas reserves" of Montgomery County were generally figured as about equivalent to the 1930 production of the various companies and independent operators. The production data were insufficient in most cases to construct a monthly decline curve but in the case of the Union Gas Corporation's Coffeyville wells and the wells of the Gas Utilities Company production data back to 1927 were available and decline curves were used.

The estimated "probable gas reserves" were secured by the addition of four times the 1930 production to the estimated proved gas reserves. As in the other counties of the Southeastern Kansas District it is probable that production will continue on about the same scale for at least five years. The Gas Utilities Company wells were shut down in 1930 and the estimated proved gas reserves were based on a production decline curve. The estimated probable reserves are given as the same as the proved reserves for the figure obtained from the decline is about five times the 1929 production.

A summary of the gas production of Montgomery County for 1930 and the estimated proved and probable reserves is given in the following Table A-5.

Supplement A

Southeastern Kansas District

MONTGOMERY COUNTY (cont'd).

Table A-5. Gas production for 1930 and estimated gas reserves of Montgomery County

Operator	Wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Edgar Zinc Co.		1,321,312	2,500,000	7,784,000
Union Gas Corp.	153	623,559	600,000	3,092,000
Union Gas Corp. (Coffeyville)	20	68,382	98,000	370,000
Gas Utilities	84	Shut down most of year	410,000	410,000
Cavert P.L. Co. (Empire Purchase)		152,165	150,000	758,000
Okla. Natural (Independence)		57,107	60,000	288,000
Okla. Natural (Coffeyville)		17,840	20,000	88,000
Okla. Natural (Cherryvale)		29,539	30,000	160,000
		2,269,904	3,868,000	12,950,000

The Union Gas Corporation purchased 20,000 M. cu. ft. of gas from the Coffeyville district in 1930 from 20 wells. Production data on these wells were available back to 1927 and the estimated proved gas reserves were based from a production decline curve. In view of the history of the region there the 1930 production is given as estimated "probable gas reserves".

The Gas Utilities Company, Independence, Kansas, had 84 wells in Montgomery County. These wells were shut in during most of 1930, but are now to be opened up again. Production figures from 1927 were available and the estimated proved

Supplement A

Southeastern Kansas District

MONTGOMERY COUNTY (continued)

Detailed data regarding the various producers in Montgomery County are presented below.

The Edgar Zinc Company, Cherryvale, Kansas, produced 1,321,312 M. cu. ft. of gas in 1930 from about 400 wells in Montgomery and Iabette counties. The production is from sands in the Cherokee shale. Mr. McMillan believes that there is enough gas in the area to supply them with 2,000 M. cu. ft. per day for 10 years or about 7,000,000 M. cu. ft. available. This of course calls for further drilling. A two years supply was used in this case for the estimated "proved gas reserves" figure and four times the 1930 production plus the estimated proved gas reserves is given as the estimated "probable gas reserves".

The Union Gas Corporation from leases and purchasing areas had a 1930 gas production of 623,559 M. cu. ft. from 133 wells. The producing horizons are sands in the Cherokee shale and the "Osage lime". The data was not sufficient to construct a decline curve so the estimated "proved gas reserves" were considered equal to the 1930 production. The estimated "probable gas reserves" are about five times the 1930 production.

The Union Gas Corporation purchased 68,382 M. cu. ft. of gas from the Coffeyville district in 1930 from 20 wells. Production data on these wells were available back to 1927 and the estimated "proved gas reserves" were derived from a production decline curve. In view of the history of the region five times the 1930 production is given as estimated "probable gas reserves".

The Gas Utilities Company, Independence, Kansas, has 84 wells in Montgomery County. These wells were shut in during most of 1930, but are soon to be opened up again. Production figures from 1927 were available and the estimated "proved

Supplement A

Southeastern Kansas District

MONTGOMERY COUNTY (continued)

gas reserves", according to a production decline curve, were 410,000 M. cu. ft. Since this is almost five times the 1929 production it is also given as the estimated probable gas reserves.

The Covert Pipe Line Company had a production of 152,165 M. cu. ft. in 1930 and in the absence of production data the estimated "proved gas reserves" are based on the 1930 production. The estimated "probable gas reserves" are five times the 1930 production.

The Oklahoma Natural Gas Company produced 57,107 M. cu. ft. in the Independence district, 17,840 M. cu. ft. in the Coffeyville area, and 29,539 M. cu. ft. in the Cherryvale area in 1930. No production data were available and the estimated "proved gas reserves" in the three districts are considered as equivalent to the respective 1930 productions. The estimated "probable gas reserves" are five times the 1930 production of each of the districts.

Supplement A
Southeastern Kansas District

NEOSHO COUNTY

Island Pool has 53 wells producing from the Mississippi "lime" and yielded 335,089 M. cu. ft. in 1930. The pressure decline curve constructed from production data ran from 50 pounds to 10 pounds and a continuation of the curve showed a reserve of 100,000 M. cu. ft. without further drilling to bring the pressure up temporarily. On the basis of five years production comparable to 1930 the estimated probable reserves are figured as 1,400,000 M. cu. ft.

A summary of the gas production of Neosho County for 1930 and the estimated proved and probable reserves is given in the following Table A-6.

Table A-6. Gas production for 1930 and estimated gas reserves in Neosho County

Field	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable re- serves in M. cu. ft.
Island Pool	335,089	100,000	1,400,000

The Island Pool has 53 wells producing from the Mississippi "lime". The pressure decline curve was used in estimating the proved reserves.

The Island Pool proper does not have a large reserve according to its production data and decline curves, but there are two fields just north and east of the Island Pool. There are good wells in these fields that are shut in because they have not been connected. In view of this the estimated probable reserve is much larger than the Island Pool proper would permit.

Supplement A

Southeastern Kansas District

WILSON COUNTY

The estimated "proved gas reserves" of Wilson County are based either on 1930 production or on production decline curves. Mr. C. W. Studt of the Union Gas Corporation estimated the proved gas reserves of their holdings and purchases as 1,000,000 M. cu. ft. The decline curve of the Midwest Gas Company production from 1925 to July 1, 1931, shows only 740,000 M. cu. ft., but in view of the production of 1,274,745 M. cu. ft. in 1930, 1,000,000 M. cu. ft. was added to the 740,000 M. cu. ft. as their production will probably continue on about the same scale.

The estimated "probable gas reserves" are figured as equivalent to a five years' supply on a par with the 1930 production of the various companies.

A summary of the gas production of Wilson County for 1930 and the estimated proved and probable gas reserves are given in the following Table A-7.

Table A-7. Gas production for 1930 and estimated gas reserves of Wilson County.

Operator	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Union Gas Corp.	1,317,349	1,000,000	6,262,000
Midwest Gas Co.	1,274,745	1,740,000	6,830,000
Oklahoma Natural Gas Company	82,981	80,000	408,000
	2,675,075	2,820,000	13,500,000

Southeastern Kansas District

WILSON COUNTY (continued)

Detailed information relative to the producing companies in Wilson County is given below.

The Union Gas Corporation produced 1,317,349 M. cu. ft. from 357 wells in Wilson County in 1930. Production came from sands in the Cherokee shale and from the "Cawego lime". C. W. Studt estimated the proved gas reserves as 1,000,000 M. cu. ft. on the basis of production decline curves. The estimated probable gas reserves are about five times the 1930 production.

The Midwest Gas Company produced 1,274,745 M. cu. ft. from 400 wells in 1930. About 350 of these wells were in Wilson County, the remaining 50 wells being scattered in parts of Neosho and Montgomery County. The production decline curve from 1925 to July 1, 1931, shows only a reserve of 740,000 M. cu. ft. It is expected that the Midwest Gas Company will continue on the same production scale and 1,000,000 M. cu. ft. is added to the "proved gas reserves" figure on this assumption. The "probable gas reserves" are approximately five times the 1930 production.

The Oklahoma Natural Gas Company produced 82,981 M. cu. ft. in the Fredonia district in 1930 from sands in the Cherokee shales. The estimated "proved gas reserves" are considered as about equivalent to the 1930 production and as has been the case in other properties in the area the estimated probable gas reserves are five times the 1930 production.

Supplement A

Southeastern Kansas District

WOODSON COUNTY

The Union Gas Corporation has three wells in sections 9 and 22, T. 25 S., R. 14 W. in the Mississippi line. The original rock pressure was 440 pounds and has decreased to 250 pounds since 1927. The "proved gas reserves" estimated from the pressure decline curve are 280,000 M. cu. ft. The production in 1930 was only 18,410 M. cu. ft., so the proved reserves will last more than the five years assigned to probable reserves in the southern Kansas district. The same figure is, therefore, given for the estimated probable reserves.

The gas production of Woodson County for 1930 and the estimated proved and probable gas reserves are given in Table A-8.

Table A-8. Gas production in 1930 and estimated proved and probable gas reserves of Woodson County

Operator	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable re- serves in M. cu. ft.
Union Gas Corp.	18,410	280,000	280,000

Supplement B

NORTHEASTERN KANSAS DISTRICT

SUMMARY AND DETAILED DATA ON GAS PRODUCTION AND RESERVES

General statement. The northeastern Kansas district includes Anderson, Coffey, Douglas, Franklin, Johnson, Linn, Miami, Wyandotte and Leavenworth counties. Much of the gas development in these counties is very recent and as a result further drilling and extension of fields is to be expected. Production is from sands in the Pleasanton formation and Cherokee shales, together with a little shale gas from the lower Karmaton group and upper Cherokee shale. The wells are of small capacity, averaging less than one-half million cubic feet per day. The average yearly production per well is less than five million cubic feet of gas. The wells in this district are widely scattered and few definite fields can be delineated.

The "proved gas reserves" are estimated by means of decline curves to 10 pounds pressure wherever data were available. In the absence of data the reserves were estimated from 1930 production.

The "probable gas reserves" are arrived at by multiplying the decline curve figures by five. The use of this factor is in accordance with the experience of gas producers of the district. For the past ten years production has been practically constant due to continual drilling in areas already considered proven.

The gas production for 1930 and estimated proved and probable gas reserves are summarized by counties in Table B-1.

Supplement B

NORTHEASTERN KANSAS DISTRICT

SUMMARY AND DETAILED DATA ON GAS PRODUCTION AND RESERVES (continued)

Table B-1. Gas production in 1930 and estimated gas reserves in Northeastern Kansas District

County	Production in 1930 in M. cu. ft.	Estimated proved re- serves in M. cu. ft.	Estimated probable ree- serves in M. cu. ft.
Anderson	804,091	2,108,969	10,544,845
Coffey	25,413	135,690	678,450
Douglas	4,256	40,070	200,350
Franklin	258,977	554,438	2,772,190
Johnson	67,565	821,053	4,105,265
Lincoln	945,909	1,406,000	7,030,000
Miami	1,617,662	2,993,820	14,969,100
Wyandotte and Leavenworth	250,460	1,497,741	7,488,700
	3,974,535	9,557,781	47,788,900

Detailed data on the gas producing areas in the Northeastern Kansas district

are given on the following pages, by counties.

Supplement B

Northeastern Kansas District

ANDERSON COUNTY

There are but two distinct fields in Anderson County, Hazlett and Welda, and the rest of the wells are widely scattered. This, coupled with the fact that the different pipe line companies collect from many individual leases, makes the systematic compilation of data very difficult. The estimates of the "proved gas reserves" are figured on the basis of a pressure decline in the Welda field, by monthly production curve in the Hazlett field and estimated from the 1930 production in the remainder of the producing areas.

The estimated "probable gas reserves" are five times the proved reserves. This is the common practice in northeastern Kansas in estimating probable reserves because of the continued development to replace the small wells now producing.

The gas production for 1930 and the estimated proved and probable reserves are given for the fields in Anderson County in Table B-2.

Table B-2. Gas production in 1930 and estimated gas reserves in Anderson County.

Field	No. wells	Production in 1930 in M. cu. ft.	Proved Reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
City of Garnett		97,244	200,000	1,000,000
Hazlett	16	313,287	185,000	925,000
Miscellaneous		142,904	200,000	1,000,000
Welda	59	250,596	1,523,969	7,619,845
		804,091	2,108,969	10,544,845

Supplement B

Northeastern Kansas District

ANDERSON COUNTY (continued)

The various fields in Anderson County are described in detail in the following paragraphs.

Hazlett field. Sixteen wells in T. 21 S., R. 21 E. producing from sands in the Cherokee shale constitute this field. Development is recent in this field, having been opened early in 1930. Western Gas Company controls this production. Reserves are based on monthly production curve.

Welda field. This field is located in T. 21 and 22 S., R. 19 E. There are 59 wells active in the field at the present time. Production is from sands in the Cherokee shale. The rock pressure has declined from 125 pounds to 22 pounds and the estimated proved reserves are figured from the extension of the curve to 10 pounds. The gas is purchased by the Empire Oil & Refining Company.

City of Garnett. The city of Garnett uses about 100,000 M. cu. ft. of gas per year. Most of the gas is from local wells and data were not available from which to plot curves. The proved gas reserves are estimated as 2 years' supply or 200,000 M. cu. ft.

The miscellaneous production includes the Rhinehart Lane No. 1 in sec. 26, eastern T. 19 S., R. 22 E. and wells owned by the Schimerhorn Oil Company in Anderson County. These wells had a 1930 production of 142,904 M. cu. ft. and the reserve is estimated at 200,000 M. cu. ft.--a little over a year's supply.

Supplement B

Northeastern Kansas District

COFFEY COUNTY

The production of the Union Gas Corporation's wells in Coffey County in 1930 was 25,413 M. cu. ft. and the estimated "proved gas reserves" are figured from a pressure decline curve, carried to 10 pounds minimum pressure. The estimated "probable gas reserves" are figured as five times the proved reserves. This is the practice of gas men in this territory.

A summary of the 1930 gas production and estimated proved and probable gas reserves is given in Table B-3.

Table B-3. Gas production in 1930 and estimated gas reserves of Coffey County

Operator	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Union Gas Corp.	2	25,413	135,690	678,450

The two Union Gas Corporation wells in sec. 9, T. 22 S., R. 14 E. are producing from the 1,330 foot sand or the squirrel sand, and in 1930 yielded 25,413 M. cu. ft. of gas. The initial rock pressure was 515 pounds and has dropped to 369 pounds. The estimated proved gas reserves are figured from a pressure decline curve cut off at 10 pounds minimum pressure.

Supplement B

Northeastern Kansas District

DOUGLAS COUNTY

The Baldwin field has produced 34,930 M. cu. ft. to date with a drop in rock pressure from 300 to 175 pounds. The extension of the pressure decline curve to 10 pounds showed a proved gas reserve of 40,070 M. cu. ft. The probable gas reserves are estimated as five times the pressure decline curve figure in accordance with practice in the Northeastern Kansas gas area.

The production and reserves of Douglas County are given in Table B-4.

Table B-4. Gas production in 1930 and estimated gas reserves of Douglas County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserve in M. cu. ft.
Baldwin	1	4,258	40,070	200,350

The Baldwin field located in T. 14 S., Rs. 19 and 20 E. is a small field in southeastern Douglas County producing from shallow sand wells. At present there is only one producing well. The initial rock pressure was 300 pounds and has declined to 175 pounds. The gas is purchased by the Empire Oil and Refining Company.

Supplement C

Northeastern Kansas District

FRANKLIN COUNTY

Four fields in Franklin County produced 258,977 M. cu. ft. of gas in 1930. They are the East Ottawa field, South Ottawa field, Pomona field, and Peoria field. The pressure decline curves carried to 10 pounds pressure give an estimated proved gas reserve of 554,438 M. cu. ft. As has been done in the other counties of Northeastern Kansas, the estimated proved gas reserves are multiplied by five to give an estimated probable gas reserve for Franklin County.

A summary of the 1930 production and the estimated proved and probable gas reserves of the several fields in Franklin County is given in the following Table B-5.

Table B-5. Gas production in 1930 and estimated gas reserves of Franklin County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
East Ottawa	3	12,315	24,541	122,705
South Ottawa	15	237,384	445,737	2,228,685
Peoria	2	13,893	27,169	135,845
Pomona	3	9,278	56,991	289,955
	23	258,977	554,438	2,772,190

Detailed data regarding the four fields in Franklin County are given in the following paragraphs.

Supplement C

Northeastern Kansas District

FRANKLIN COUNTY (continued)

The East Ottawa field is located in T. 16 S., R. 20 E., Franklin County, and at present has three wells producing from sands in Cherokee shale. The original rock pressure was 122 pounds and has dropped to 70 pounds, with a total production of 36,459 M. cu. ft. The gas is taken into the Cities Service lines.

South Ottawa field is located in T. 17 S., Rs. 19 and 20 E. and has a total of 15 wells, producing from sands in Cherokee shale. The original rock pressure was 259 pounds and has dropped to 97 pounds. The total production to date has been 454,263 M. cu. ft. The gas is purchased by the Empire Oil and Refining Company.

The Peoria field, in T. 17 S., R. 20 E., has two wells producing from sands in Cherokee shale. The rock pressure has declined from 218 to 117 pounds since the field was opened up in October, 1929. The total production has been 19,836 M. cu. ft. The gas is purchased by the Empire Oil and Refining Company.

Pomona field in the NE. $\frac{1}{4}$ of sec. 25, T. 16 S., R. 17 E. has three wells producing from sands in Cherokee shale. The rock pressure has declined from 415 to 171 pounds. The total gas production is 169,009 M. cu. ft. The gas is purchased by the Empire Oil & Refining Company.

15

27,202

241,022

4,105,203

Detailed data on the gas producing fields in Johnson County are given on the following page.

Supplement B

Northeastern Kansas District

JOHNSON COUNTY

There has been but little gas development in Johnson County, but the prospect for more fields is good. At present the Cragg field and the Union Gas holdings and the Panhandle Eastern producing territory in southeastern Johnson County are the only developments. The Panhandle Eastern production from Johnson County is included in the Miami County section because of difficulty in segregating it from that in Miami County.

The estimated "proved gas reserves" are based on pressure decline curves carried to 10 pounds minimum pressure. The "probable gas reserves" are estimated as five times the proved gas reserves.

A summary of the production for 1930 and the estimated reserves, by fields, in Johnson County is given in Table B-6.

Table B-6. Gas production in 1930 and estimated gas reserves in Johnson County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Cragg	8	33,785	686,219	3,426,095
Union Gas Corp.	7	33,780	135,634	679,170
	15	67,565	821,853	4,105,265

Detailed data on the two producing fields in Johnson County are given on the following page.

Supplement B

Northeastern Kansas District

JOHNSON COUNTY (continued)

The Craig field in T. 12 S., R. 23 E., Johnson County, produced 33,765 M. cu. ft. of gas from eight wells in 1930. The production is from sand at the top of Cherokee shale. The pressure has declined from 188 to 34 pounds with a total production of 3,464,781 M. cu. ft. The gas is purchased by the Empire Oil and Refining Company.

The Union Gas Corporation has seven wells in Johnson County. One well in sec. 27, T. 13 S., R. 23 E. produced 3,997 M. cu. ft. in 1930. The rock pressure of this well declined from an initial pressure of 162 pounds to 80 pounds. Four wells in sec. 3, T. 13 S., R. 23 E. produced 23,315 M. cu. ft. in 1930 from sands in the Pleasanton formation and Cherokee shale. Two wells in secs. 17 and 18, T. 12 S., R. 24 E. produced 7,466 M. cu. ft. in 1930. The rock pressure decline has been from 164 to 162 pounds.

Reserve figures:

Production and estimated reserves are given in Table B-7.

Table B-7. Gas production in 1930 and estimated and probable reserves.

Field or Operator	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Blue Mound Oil. Nat.	933,211	1,400,000	7,000,000
Western Service Co.	15,000	0,000	20,000
	948,211	1,400,000	7,020,000

Supplement B

Northeastern Kansas District

LINN COUNTY

The production of gas in Anderson and Linn counties is so closely tied up that it has been difficult to separate the two counties. The division has been fairly accurate and into Linn County has been put the Oklahoma Natural Gas Company's production and purchases in the Blue Mound district and the production and purchases of the Western Service Company throughout Linn County.

The "proved gas reserves" of the Oklahoma Natural Gas Company's leases and purchase leases in the Blue Mound district are estimated from a cumulative production curve. The curve is not accurate from January, 1931 to July, 1931 due to subnormal demand and is not used in projecting the curve.

The estimates of proved gas reserves of the Western Service Company's holdings are from the extension of a cumulative production curve.

The "probable gas reserves" are estimated as five times the proved reserve figure.

Production and estimated reserves are given in Table B-7.

Table B-7. Gas production in 1930 and estimated gas reserves of Linn County.

Field or Operator	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Blue Mound Okla. Nat.	933,811	1,400,000	7,000,000
Western Service Co.	12,698	6,000	30,000
	946,509	1,406,000	7,030,000

Supplement B

Northeastern Kansas Division

Northeastern Kansas District

LINN COUNTY (continued)

LINN COUNTY

The Oklahoma Natural Gas Company produced and purchased 933,911 M. cu. ft. of gas in the Blue Mound district in 1930. The curve of cumulative production is inaccurate for January, 1931, to July, 1931, due to sub-normal demand.

The Western Service Company produced 12,698 M. cu. ft. of gas around the Cox Compressor Station area. The reserves, based on a cumulative production curve, are very small.

A summary of fields of the 1930 production, proved reserves and probable reserves is given in the following Table B-3.

Table B-3. Gas production in 1930 and estimated reserves by field in Linn County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Brayton	12	78,543	25,000	270,000
Conley	25	147,846	300,000	1,400,000
Greedy	54	125,200	50,000	230,000
Low	24	137,540	400,000	2,000,000
Lawrence	2	151,501	200,000	3,400,000
T. Peala	172	700,250	1,100,000	8,000,000
V. Peala	11	57,207	50,000	400,000
Rantoul	35	155,400	500,000	1,500,000
Willisell	5	40,797	21,000	400,000
	360	1,617,584	2,920,000	14,900,000

Supplement B

Northeastern Kansas District

MIAMI COUNTY

The Panhandle and Eastern Pipe Line Company had a gas production in Miami (and adjacent counties) of 1,617,662 M. cu. ft. for 1930. The estimated "proved gas reserves" based on pressure decline curves to 10 pounds minimum pressure are 2,993,820 M. cu. ft. In the past three years 4.2 billion cubic feet have been produced and if this rate continues for ten years the estimated "probable gas reserves" of 14,969,100 M. cu. ft. is both possible and probable.

A summary by fields of the 1930 production, proved reserves and probable reserves is given in the following Table B-8.

Table B-8. Gas production in 1930 and estimated reserves by field in Miami County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Brucyrus	19	75,543	75,000	375,000
Fontana	23	147,548	290,000	1,450,000
Grealey	24	135,028	66,000	330,000
Lane	24	137,540	400,000	2,000,000
Osawatimie	40	181,561	692,231	3,461,155
E. Paola	172	700,699	1,118,636	5,593,180
W. Paola	23	67,967	99,000	495,000
Rantoul	35	128,449	201,953	1,009,765
Stillwell	8	43,227	51,000	255,000
	368	1,617,662	2,993,820	14,969,100

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Northeastern Kansas District

MIAMI COUNTY (continued)

Detailed data relative to the nine gas districts in Miami County are given in the following paragraphs.

Brucyrus district. This gas producing area is located in T. 16 S., R. 24-25 E. and had 19 producing wells late in 1930. The 1930 production was 78,543 M. cu. ft. The original average pressure of the wells was 115 pounds and is now 46 pounds. The estimated reserves are figured on a 10 pound basis. The Panhandle and Eastern Pipe Line Company controls this production.

Fontana district. Twenty-three active wells in T. 19 S., R. 20, 22, and 23 E. constitute the Fontana district. The total production in this field has been 279,767 M. cu. ft. and the 1930 production was 147,548 M. cu. ft. The initial pressure was 123 pounds and has dropped to 67 pounds. The proved reserves are estimated from the pressure decline curve carried to 10 pounds pressure. The production is from sands in the Pleasanton formation and Cherokee shale. Panhandle and Eastern Pipe Line Company takes the gas.

Greeley district. This field is located in T. 19 S., R. 20 E. and T. 20 S., R. 20 and 21 E., and has 24 active wells producing from sand in the Pleasanton formation and sands and shale in the Cherokee shale. The total production for this area has been 294,004 M. cu. ft. The proved reserves were figured on a 10 pound minimum pressure.

Lane district. This district is located in T. 18 S., R. 21 E. and T. 19 S., R. 21 E. Twenty-four wells are producing at present from sands in the Pleasanton formation and Cherokee shale. The total production has been 240,563 M. cu. ft. The estimated proved gas reserves are based on the pressure decline curve to 10 pounds.

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Northeastern Kansas District

MIAMI COUNTY (continued)

Oswatimic district. Producing wells in and around Oswatimic are included in this district. There are 40 active wells in this district. Production is from sands in the Pleasanton formation and Cherokee shale. The total production has been 457,769 M. cu. ft. The pressure decline curve carried to 10 pounds shows an ultimate production of 1,115,000 M. cu. ft. and leaves a reserve of 698,231 M. cu. ft. Panhandle and Eastern Pipe Line Company takes the gas from this field.

East Paola district. This large district lies in T. 17 S., Rs. 23 and 24 E., T. 16 S., Rs. 23-24 E., and T. 16 S., Rs. 23-24 E. and has 172 active wells. The production is from sands in the Pleasanton formation and Cherokee shale. The total production has been 1,881,366 M. cu. ft. The estimated proved reserves are based on 10 pounds minimum pressure. The Panhandle and Eastern Pipe Line Company handles this gas.

West Paola district. This is smaller than the East Paola district and lies in T. 17 S., Rs. 22 and 23 E. and has 23 active wells. The production is from sands in the Pleasanton formation and Cherokee shale. Total gas production has been 231,027 M. cu. ft. The proved reserves are estimated from the extension of the pressure decline curve to 10 pounds. The pressure has dropped from 85 to 47 pounds. The Panhandle and Eastern Pipe Line Company takes the gas from this district.

Rantoul district. Thirty-five wells located in T. 17 S., Rs. 20-21 E. constitute the Rantoul field. Production is from sands in the Pleasanton formation and Cherokee shale. The total production has been 428,047 M. cu. ft. The pressure decline curve is very irregular and has led to a conservative estimate taken to 10 pounds bottom pressure. The Panhandle Eastern Pipe Line take this gas.

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Northeastern Kansas District

MIAMI COUNTY (continued)

Stillwell district is a small field in T. 14 S., R. 25 E. containing eight active wells. The total production has been 119,182 M. cu. ft. Sands in the Pleacanton formation and in the Cherokee shale yield the gas. The rock pressure has declined from 82 pounds to 32 pounds. Estimated proved gas reserves were based on the extension of the curve to 10 pounds pressure. Panhandle and Eastern Pipe Line Company controls this gas.

Future development that is probable in these two counties, a summary, by fields, of the 1930 gas production and estimated reserves is given in the following table 2-9.

Table 2-9. Gas production in 1930 and estimated gas reserves, by fields in Kansas and northeastern section

Field	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Bethel	29,281	1,142,000	2,742,000
Fairfax Airport	180,216	120,000	675,000
Decker lease	12,505	200,000	250,000
Wilburn		10,504	54,000
	232,507	1,462,504	3,921,000

Details of the various fields are given in the following paragraphs.

Bethel pool. This gas producing area is located in T. 20 S., R. 25 E., Woodson County. It was opened in December, 1920, and produced only a small amount of gas in 1930. At present there are 26 active wells operating with an

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Northeastern Kansas District

WYANDOTTE AND LEAVENWORTH COUNTIES

The major part of the production and reserves listed here are in Wyandotte County. Some of the lines connect with the wells in Leavenworth County and it has been impossible to divide the production of the two counties accurately.

The estimated "proved gas reserves" are figured from pressure decline curves carried to 10 pounds minimum pressure. The estimated "probable gas reserves" are considered as five times the proved gas reserves in view of future development that is probable in these two counties.

A summary, by fields, of the 1930 gas production and estimated reserves is given in the following Table B-9.

Table B-9. Gas production in 1930 and estimated gas reserves, by fields, in Wyandotte and Leavenworth counties

Field	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Bethel	38,251	1,146,937	5,744,686
Fairfax Airport	181,516	135,000	675,000
Dunlap lease	13,693	197,000	985,000
Telborn		16,804	84,020
	250,460	1,497,741	7,488,705

Details of the various fields are given in the following paragraphs.

Bethel pool. This gas producing area is located in T. 10 S., R. 23 E., Wyandotte County. It was opened in November, 1930, and produced only a small amount of gas in 1930. At present there are 58 active wells operating with an

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Northeastern Kansas District

WYANDOTTE AND LEAVENWORTH COUNTIES (continued)

average rock pressure of 140 pounds. The initial rock pressure was 165 pounds. The estimated proved gas reserves are figured to 10 pounds pressure.

The North field of Fairfax Airport in sec. 34, T. 10 S., R. 25 E. produced 181,516 M. cu. ft. of gas in 1930. The production is controlled by the Kansas City Independent Land Company. Gas is being sold for industrial purposes at the present time. From January, 1930, to October, 1930, it was sold to American Pipe Line Company. The rock pressure of well No. 6 in the center of the field was 65 pounds January, 1931, having dropped from 155 pounds. Reserves are estimated from the pressure decline curve of this well extended to 10 pounds.

The Dunlap and McKee leases of the Arrow Oil & Gas Company in sec. 8, T. 11 S., R. 23 E., Wyandotte County, have three wells of small flow. The rock pressure has declined from 136 pounds to 112 pounds and the reserves are estimated from the extension of the curve to 10 pounds pressure.

The Welbern district in T. 10 S., R. 24 and 25 E., Wyandotte County, was opened January, 1931, and at present is producing from 13 wells. The gas is purchased by the Empire Oil & Gas Company. Production is from sands in the Pleasanton formation and sands in the Cherokee shale. The rock pressure has dropped from 162 pounds to 87 pounds and reserves are figured to 10 pounds.

Reserves of this district are figured either from an extension of the pressure decline curve to a pressure lower than that used in the proved reserves estimated or on the basis of relative developments. Often the proved and probable reserves are given as individual items as further drilling is anticipated.

A summary of the number of wells, 1930 gas production, and estimated reserves of the counties of this district are given in Table C-1.

Supplement C

EAST CENTRAL KANSAS DISTRICT

EAST CENTRAL KANSAS DISTRICT

TABLE C-1. SUMMARY AND DETAILED DATA ON GAS PRODUCTION AND RESERVES

EAST CENTRAL KANSAS DISTRICT

General statement. The East Central Kansas District includes the following counties: Butler, Chase, Chautauqua, Cowley, Elk, Greenwood, Marion, Morris, and that part of Sumner County lying east of the 6th principal meridian.

The chief producing horizons are the "chat" or Mississippi "line", Murgens, and Bartlesville sands in the Cherokee shale, sands in the upper Kansas City formation, sands in the Lawrence shale, and sands in the Shawnee and Wabaunsee formations. The "chat" and upper Kansas City sands furnish the major part of the gas in the East Central Kansas district. The gas fields have often been developed in connection with the oil fields in this district and the production is usually from well defined anticlines. A total of about 450 wells in this district produced 7,030,946 M. cu. ft. in 1930, with an average production of 15 M. cu. ft. per well for that year. Approximately 38 per cent of this production came from the chat. This district produced 21 per cent of the total gas produced in Kansas for the year 1930.

The estimated "proved gas reserves" are in each case based on pressure decline curves. The curves were carried down to a minimum pressure ranging from 10 to 250 pounds, depending on the field conditions. The estimated "probable gas reserves" of this district are figured either from an extension of the pressure decline curve to a pressure lower than that used in the proved reserve estimates or on the basis of future developments. Often the proved and probable reserves are given as equivalent when no further drilling is anticipated.

A summary of the number of wells, 1930 gas production, and estimated reserves of the counties of this district are given in Table C-1.

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East Central Kansas District

Table C-1. Gas production in 1930 and estimated gas reserves, by counties, East Central Kansas District.

County	No. wells	Production in 1930 M. cu. ft.	Estimated proved reserves, M. cu. ft.	Estimated probable reserves, M. cu. ft.
Butler	56	437,504	3,500,000	3,500,000
Chase	16	134,443	618,000	868,000
Chautauqua	179	2,502,457	15,501,500	18,121,500
Cowley	90-100	1,606,893	3,955,000	4,815,000
Elk	105	1,803,019	11,708,000	14,395,000
Greenwood		144,352	360,000	360,000
Marion	3	55,828	1,547,000	1,954,000
Morris	5	69,170	250,000	275,000
E. Sumner	3	276,980	2,122,000	2,122,000
		7,036,946	39,651,500	46,410,500

Detailed data are given in the following pages on the various counties of the East Central Kansas district.

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East Central Kansas District

BUTLER COUNTY

The estimated "proved gas reserves" in the Augusta and Eldorado fields in Butler County have been estimated on past production rather than on pressure decline curves. In the Augusta field the pressures averaged 65 pounds in January, 1924, and now average 78 pounds. This building up of pressure indicates encroachment of water and contraction of the reservoir. Such a condition makes a pressure decline curve useless. A very similar condition is encountered in the Eldorado field where the pressure has built up from 73 pounds to 94 pounds since January, 1924, and indicates water advance or repressuring in parts of the field.

The estimated "probable gas reserves" are given as equivalent to the estimated proved reserves for these fields.

A summary of the 1930 gas production and estimated gas reserves by fields in Butler County is given in Table C-2.

Table C-2. Gas production for 1930 and estimated gas reserves of Butler County.

Field	No. of wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Augusta Field	25	121,638	1,000,000	1,000,000
Eldorado Field	31	316,166	2,500,000	2,500,000
	56	437,804	3,500,000	3,500,000

East Central Kansas District

BUTLER COUNTY (continued)

Detailed information regarding the fields in Butler County is found in the following paragraphs.

Augusta field. The gas development in the Augusta field is closely related to the oil development and a large percentage of the gas produced has been used in oil operations. Gas is found in sands in the Shawnee and upper Douglas formations, the producing areas being on the anticlines and very nearly co-extensive with the oil production. The field (including North Augusta) is located in Tps. 27 and 28, R. 4 E.

Production since January, 1924, from the properties of the Empire Gas and Fuel Co., which cover most of the field, has totalled 1,254,704 M. cu. ft. There has been very little drilling since that time though the number of wells has decreased from 26 to 15 on the above properties. Pressures in January, 1924 averaged 65 pounds and present pressures average 76 pounds. Building up of pressure during the last 3½ years indicates encroachment of water and contraction of the reservoir. Estimates of reserves are very uncertain due to the many unknown factors and unavailable data. Proved reserves from present wells are estimated at 1,000,000 M. cu. ft. Total production of the field to date has been about 40,000,000 M. cu. ft.

Eldorado field. The Eldorado field is located on the Eldorado anticline and the gas producing area covers about 6,500 acres in Twp. 25, Rs. 4 and 5 and Twp. 26, Rs. 4 and 5. Gas is found in five sands in the Shawnee and upper Douglas formations. Production began early in 1916. The original pressure averaged 393 pounds. Since January, 1924, the pressure has increased from 33 to 94 pounds, due to advance of water in the sands or to repressuring in parts of the field. Reserves are estimated at 2,500,000 M. cu. ft. though they may considerably exceed this. Total production to date has been about 20 billion cu. ft.

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East Central Kansas District

CHASE COUNTY

The estimated "proved gas reserves" of the Chase County fields is based in part on pressure decline curves and in part on past production figures. In the Lips field the pressure decreased rather uniformly from 450 pounds in 1927 to 150 pounds and the estimated "proved gas reserves" to 50 pounds pressure are 416,000 M. cu. ft. The estimated "probable gas reserves" to a minimum pressure of 25 pounds is 516,000 M. cu. ft. The Strong City field proved gas reserves are estimated from past production, with a large probable gas reserve suggested by undrilled locations and deeper sands.

The summary, by fields, of the gas production in 1930 and estimated reserves of Chase County is given in Table C-3.

Table C-3. Gas production in 1930 and estimated gas reserves by fields in Chase County

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Lips Field	13	104,626	416,000	516,000
Strong City Field	3	29,817	200,000	350,000
	16	134,443	616,000	866,000

Information regarding location, wells, producing horizons and reserves of the Chase County fields is found below.

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East Central Kansas District

CHASS COUNTY (cont'd)

Lips field. The Lips field is located in Twp. 18, Rs. 6 and 7 E. Gas is found in a sand in the Lawrence shale at about 1,100 feet. Development began in 1927. There are now 13 wells in the field, whose average pressure is 130 pounds. The pressure decline has been uniform and fairly rapid. The estimated reserves to 50 pounds are 418,000 M. cu. ft. and to 25 pounds, 518,000 cu. ft. Gas is taken by the Cities Service Gas Co. to Haysville.

Strong City field. The Strong City field is in secs. 18 and 19, T. 18, R. 8 E. There are three wells located on the crest of a major anticline which is thought to overlie one of the granite highs of the Hamaha Mountain range. Gas is produced from a sand in the Lawrence shale at about 500 feet, though it is found in several shallower sands and will probably also be found in the sands in the Admire shale. The 1930 production was 29,817 M. cu. ft. Production from the present wells has indicated a reserve of 200,000 M. cu. ft., while a larger probable reserve is suggested by undrilled locations and deeper sands. Gas is taken to Strong City by a local pipe line.

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East Central Kansas District

CHAUTAUQUA COUNTY

The estimated "proved gas reserves" of the Longton, Moline, Chaffin and Thompson fields in Chautauqua County were figured from pressure decline curves and those of the Empire, Niotaze and Berlin fields were estimated from past production and present field conditions. The Longton field proved reserves were figured with a minimum pressure of 60 pounds and the probable reserves with a minimum pressure of 40 pounds. The Moline field pressure decline curve was cut off at 50 pounds pressure and the estimated reserves figured at 635,000 M. cu. ft. The Chaffin field was figured on a 100 pound minimum pressure for estimated proved gas reserves and 40 pounds minimum pressure for the estimated probable gas reserves.

The Empire, Niotaze and Berlin fields showed an increase in rock pressure that is ascribed to water encroachment, so the reserves had to be estimated from past production and probable field conditions.

The following Table C-4 contains, by fields, the production for 1930, the estimated proved and probable gas reserves, and the number of wells in Chautauqua County.

Berlin Field. The Berlin field is in T. 22 N., R. 11 E. This is an old field and has produced a large volume of gas. There are now 57 wells producing. The 1930 production was 132,000 M. cu. ft. The pressure has increased during the last 18 months indicating an advance in the water flood. The present pressure is around 120 pounds. Reserves are estimated at 1,150,000 M. cu. ft. to 25 pounds pressure.

Chaffin Field. The Chaffin field is located in secs. 1, 2 and 13, T. 22 N., R. 11 E. Production is from the Mississippi line at about 1,000 feet. The initial rock pressure was 270 pounds and the present average pressure is 240 pounds. There are

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East Central Kansas District

CHAUTAUQUA COUNTY (continued)

Table C-4. Gas production in 1930 and estimated reserves by fields in Chautauqua County

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Berlin field	27	132,085	1,198,000	1,198,000
Chaffin field	9	213,000	800,000	992,000
Empire field	10	269,565	2,100,000	3,300,000
Longton field	113	1,706,126	10,400,000	11,628,000
Moline field	10	76,908	635,000	635,000
Miotaze field	5	64,221	250,000	250,000
Thompson field	5	40,612	118,500	118,500
	179	2,502,457	15,501,500	16,121,500

Specific information regarding the seven gas fields in Chautauqua County is given in the following paragraphs.

Berlin field. The Berlin field is in T. 38 S., R. 11 E. This is an old field and has produced a large volume of gas. There are now 27 wells producing. The 1930 production was 132,085 M. cu. ft. The pressure has increased during the last 116 months indicating an advance in the water flood. The present pressure is around 125 pounds. Reserves are estimated at 1,198,000 M. cu. ft. to 25 pounds pressure.

Chaffin field. The Chaffin field is located in secs. 1, 2 and 12, T. 32, R. 10 E. Production is from the Mississippi line at about 1,650 feet. The initial rock pressure was 675 pounds and the present average pressure is 340 pounds. There are

East Central Kansas District

CHAUTAQUA COUNTY (continued)

now ten wells in the field. The 1930 production totalled 213,000 M. cu. ft. Reserves are estimated at 800,000 M. cu. ft. to 100 pounds or 992,000 M. cu. ft. to 40 pounds. Gas is taken from the field through the lines of the Union Gas Corporation.

Lure field. This field is more than ten years old. It has produced 2,375,000 M. cu. ft. since January 1, 1924, with practically no loss in pressure. Water flood is constricting the gas body and the withdrawal rate has been adjusted to conform to the rate of water encroachment. Very high present pressure (same as in May, 1935) might indicate water flood has greatly reduced the reservoir and will shortly exhaust the field. The estimate of 2,100,000 M. cu. ft. reserve as proved is not on the basis of decline curve but it is a reasonable expectancy considering all of the conditions. A number of the producing wells have been abandoned. The producing sand is found at about 1,500 feet.

Longton field. The Longton field is one of the most important gas fields of southeast Kansas. Located on an anticline of considerable relief and extending over considerable area, it has proved to be a steady producer and has a larger reserve than any field in the district. The principal producing horizon is the top of the Mississippi lime. It is located in T. 31, R. 12 E., Elk County, and in T. 32, R. 11 and 12 E. and T. 33, R. 12 E. There are 113 wells in the field at present, the production in 1930 having been 1,706,126 M. cu. ft. The present average rock pressure is 240 pounds. Reserves are estimated from the pressure-production data and indicate a production of 10,400,000 M. cu. ft. to 80 pounds or 11,625,000 M. cu. ft. to 40 pounds final pressure. The Union Gas Corporation runs the gas.

East Central Kansas District

CHAUTAQUA COUNTY (continued)

Moline field (Including New Moline field). The Moline field is about six miles southwest of the town of Moline, and lies in sections 2, 3, 10, 11, 12 and 13, T. 32, R. 9 E. In January, 1924, this field had 10 wells with an average rock pressure of 213 pounds. Since that date the field has produced 693,000 M. cu. ft. Present average pressure is 170 pounds from 10 wells. The producing horizon is a sand in the upper Kansas City formation. Reserves from the pressure production data are indicated as 635,000 M. cu. ft. down to 50 pounds pressure.

Niotaze field. The Niotaze field is in secs. 4, 8, 9, 10 and 15, T. 34, R. 13 E. Production is from the Red Sand at about 450 feet. The wells are small and the initial pressure low, but it is well sustained. Production in 1930 was 64,221 M. cu. ft. Reserves are estimated at 250,000 M. cu. ft. Gas is taken by the Union Gas Corporation.

Thompson field. The Thompson field is located in secs. 5 and 6, T. 35, R. 12 E. The field was discovered in 1929. Production is found at about 1,600 feet. The wells are small though the pressure is fairly well sustained. There are five wells in the field and their total production for 1930 was 40,612 M. cu. ft. Reserves are estimated from the pressure-production data to be 118,500 M. cu. ft. down to 40 pounds pressure.

Supplement C

East Central Kansas District

COWLEY COUNTY

The various gas fields in Cowley County produced 1,606,893 M. cu. ft. of gas in 1930 and have an estimated "proved gas reserve" of 3,955,000 M. cu. ft. These reserves were estimated generally on pressure decline curves reduced to pressures controlled by field conditions. In the Cambridge field the minimum pressure used was 150 pounds because of probable water encroachment at fairly high pressure, whereas in the Eastman field a pressure of 20 pounds was used because of pumping stations in the field which could make gas available at low pressures. In the Winfield field the acre yield was estimated on past production data, and the reserves were figured on the basis of 750 M. cu. ft. per acre, although the probable yield will be 2,000 M. cu. ft. per acre.

The 1930 production and estimated reserves of the various fields in Cowley County are summarized in the following Table C-5.

Field	1930 Production (M. cu. ft.)	Estimated Reserves (M. cu. ft.)
Cambridge	275,000	275,000
Eastman	150,000	150,000
Winfield	181,893	1,530,000
Total	1,606,893	3,955,000

The details of the several fields in Cowley County are discussed in the following pages.

Cambridge Field— This field is located in sec. 11, T. 34 N., R. 7 E., about one mile northwest of the town of Cambridge. The wells were completed in 1924, being found gas in the upper Kansas City formation. Two of these had been abandoned, owing apparently to water which had controlled the accumulation. The pressure has not well maintained having increased over the last 10 years period, but water

Supplement C

East Central Kansas District

COWLEY COUNTY (continued)

Table C-5. Gas production in 1930 and estimated gas reserves, by fields, in Cowley County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Cambridge	1	12,245	60,000	60,000
Eastman	4	183,495	294,000	294,000
Hites	5	245,186	910,000	1,710,000
Leo Sturgeon	1	10,900	125,000	125,000
New Salem	11	106,223	300,000	360,000
State Home	9	304,847	343,000	343,000
West Arkansas City	1	94,000	180,000	180,000
West Burden	3	253,000	693,000	693,000
Winfield	5	41,564	150,000	150,000
Home Natural Gas Co.	50-60	355,463	900,000	900,000
		1,606,893	3,955,000	4,815,000

The details of the several fields in Cowley County are discussed in the following pages.

Cambridge field. This field is located in sec. 13, T. 34 S., R. 7 E., about three miles northeast of the town of Cambridge. Two wells were completed in 1923, having found gas in the upper Kansas City formation. One of these has been abandoned. A noseing structure here seems to have controlled the accumulation. The pressure has been well sustained having increased over the last 18 months period, but water

Supplement C

East Central Kansas Division

COWLEY COUNTY (continued)

encroachment will probably cut off the production at a high pressure. Reserves to 150 pounds are estimated at 60,000 M. cu. ft. The 1930 production was 12,245 M. cu. ft.

Eastman field. The Eastman field is three miles east of Wilmot in secs. 7 and 8, T. 31, R. 6 E. The producing sand is in the lower Cherokee and is commonly called the Bartlesville. The production is on a small anticline but is also influenced by lenticularity of the sand. Northward from the gas field the sand carries considerable oil. The first gas from the field was run in May, 1924. Production to date from 4 wells has been 2,000,000 M. cu. ft. The production in 1930 was 183,495 M. cu. ft. The initial pressure was 450 pounds. The present pressure is 60 pounds. Considerable gas was wasted in this field in the production of oil, and in addition large volumes have been and are now being taken as residue gas from casing head plants. The figure given above for past production is a small part of the gas taken out of the field, counting waste and residue gas. Reserves to 20 pounds are estimated at 294,000 M. cu. ft., this low pressure being practical because of the location of pumping plants in the field. Gas is taken by the Cities Service Gas Company.

Estes field. The estimated proved gas reserves in the Estes field on the basis of the five wells now producing is 910,000 M. cu. ft. The probable gas reserves estimated on the basis of several new locations is 1,710,000 M. cu. ft. Four more locations with reserves of 200,000 M. cu. ft. per location are probable. Baden estimates 15 locations with 359,000 M. cu. ft. per location. The ultimate yield per acre on the present producing wells is estimated at 3,200 M. cu. ft. each. The reduced figure on the four additional locations is based on an assumption that they are structurally less favorable than the earliest wells in the field.

East Central Kansas Division

COWLEY COUNTY (continued)

Le Sturgeon field. This field is located in sec. 16, T. 35, R. 4 E., three miles southeast of Arkansas City. Production is from a sand in the Shawnee group at about 1,800 feet. Two wells were completed and were put on the line in July, 1927. One of these wells has been abandoned. The initial pressure was 625 pounds and the present pressure is about 400 pounds. It is not a promising area, having produced only 10,900 M. cu. ft. during 1930. A number of dry holes have been drilled. Reserves estimated from pressure-production data are 125,000 M. cu. ft. down to 100 pounds.

New Salem field. The New Salem field is located in T. 32 S., R. 5 E. There are 11 wells producing from sands in the Adaire. The estimate from decline curve covers the drilled locations. The drilling plan allows 40 acres to each well. The ultimate yield per acre from the curve averages about 1,000 M. cu. ft., which is low for this sand. The ultimate may possibly be double that figure if withdrawals are not too heavy.

State Home field. The State Home field is in secs. 15 and 22, T. 32 S., R. 4 E., this being on the north edge of the city of Winfield. Several wells have been drilled in the city limits. Production is from the Kansas City formation and from sand in the lower Cherokee. Production during 1930 was 304,547 M. cu. ft. Most of this gas was taken by the Cities Service Gas Company but a portion (about 90,000 M. cu. ft.) was used in the City of Winfield. Complete production data are not available, but the total production to date is close to 4,000,000 M. cu. ft. The present pressure is around 100 pounds, and the reserves to 50 pounds are estimated at 343,000 M. cu. ft.

East Central Kansas District

COWLEY COUNTY (continued)

East Arkansas City field. This name is applied to small scattered production in T. 34, R. 3 E. There are three scattered gas wells, one each in sections 16, 18 and 21. Close-lying dry holes have been drilled but additional production will probably be found. Sand lenses control accumulation. The wells range from $1\frac{1}{2}$ to $5\frac{1}{2}$ million initial open flow and the producing sands, which are in the Shawnee and Douglas groups, range from 1,400 to 2,000 feet in depth. Production dates from April, 1926, and pressure has declined from 630 to 257 pounds average. Reserves are estimated at 180,000 M. cu. ft. to 40 pounds pressure with no allowance for additional locations.

West Burden field. The West Burden field is in secs. 16, 20 and 21, T. 31, R. 6 E., this being two miles southeast of the Eastman field. Production is from sand in the upper Kansas City formation. The first well was completed in November, 1929. Production in 1930 was 253,671 M. cu. ft. All of this was taken by the Cities Service Gas Company. The initial pressure was 600 pounds and the present pressure is 400. Reserves estimated from the pressure production data are 693,000 M. cu. ft. to 50 pounds pressure. A number of indicated proved locations are neglected due to a lack of specific geological data.

Winfield field. This field is located several miles southeast of Winfield in secs. 1, 2, 11, 12, 13 and 14, T. 33, R. 4 E. Five wells are now producing, gas being taken by the Cities Service Gas Co. The 1930 production for the field was 41,564 M. cu. ft. The producing sand is in the Admire shale and is encountered at a depth of about 600 feet.

The pressure of this field is very well sustained at about 60 pounds, though the average age of the wells is over 10 years. A large number of wells in the field have already been abandoned. The sand is lenticular, and this is the controlling

Supplement C

East Central Kansas District

COWLEY COUNTY (continued)

factor in the accumulation although the field lies on a major anticline. Dry holes with no sand are found on the structure, sometimes between producing wells and a short distance from them. In other parts of Cowley County the same sands are known to produce without being on structure. A number of undrilled locations in the pool appear to be proved but the lenticularity of the sand and the lowered rock pressure of the field tend to make these locations unattractive. An ultimate yield of 2 million cu. ft. per acre is thought to be average for the field and the present wells are allowed an estimated future yield of 30 million each, or 3/4 million cu. ft. per acre.

Home Natural Gas Company. The Home Natural Gas Co. is connected to 50 or 60 shallow wells, most of them in a field about 5 miles east of Winfield. These wells produce from sands in the Adaire shale and apparently the production bears no relation to structure, being controlled by sand lensing instead. This group of wells produced 355,463 M. cu. ft. in 1930. Estimated reserves are 900,000 M. cu. ft.

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East Central Kansas District

BLK COUNTY

The total gas production of Blk County fields in 1930 was 1,803,019 M. cu. ft. from 105 wells. The estimated "proved gas reserves" of 11,798,000 M. cu. ft. were figured from pressure decline curves cut off at various pressures according to the condition of the fields. The average minimum pressure was 40 pounds but 100 pounds was used in the Schrader and Webb fields because of water encroachment conditions. The "probable gas reserves" were usually estimated from additional locations instead of reduced minimum pressures.

The number of wells, 1930 production and proved and probable gas reserves of the several fields in Blk County are given in the following Table C-6.

Field Name	No. of Wells	1930 Production (M. cu. ft.)	Proved Gas Reserves (M. cu. ft.)	Probable Gas Reserves (M. cu. ft.)
...
...
...
Total	105	1,803,019	11,798,000	14,385,000

Detailed information regarding the fields in Blk County is given in the following paragraphs:

Blk County Field. The Blk County field is located about six miles east of Boardman, Blk. Co., Kan. It covers T. 20, R. 2 E., and sections 9 and 10, T. 20, R. 2 E. In January, 1924, there were 21 producing wells in the field and two years later there were 43 wells. At present there are 21 wells with an average pressure of 40 pounds. The producing sand is the so-called "Blk" sand in the upper Kansas City formation, found in this field at a depth of about 1,200 feet.

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East Central Kansas District

BLK COUNTY (continued)

Table C-6. Gas production in 1930 and estimated reserves by fields in Blk County

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Denton	31	258,926	952,000	952,000
Elco	24	349,468	2,100,000	2,400,000
Furgeson	11	167,775	1,220,000	1,220,000
Heck	3	54,483	200,000	200,000
Hogden	3	11,273	150,000	150,000
North Longton	18	361,363	2,523,000	3,023,000
Schrader	6	482,612	2,754,000	3,954,000
Webb	6	104,197	1,840,000	2,437,000
Rothgeb No. 1	1	12,902	59,000	59,000
	105	1,803,019	11,798,000	14,395,000

Detailed information regarding the fields in Blk County is given in the following paragraphs.

Denton field. The Denton field is located about six miles west of Howard, in secs. 21, 22, 26, 27, 28, 33, 34 and 35, T. 29, R. 9 N., and secs. 4 and 5, T. 30, R. 9 E. In January, 1924, there were 24 producing wells in the field and two years later there were 49 wells. At present there are 31 wells with an average pressure of 90 pounds. The producing sand is the so-called "Denton" or "Encill" sand in the upper Kansas City formation, found in this field at a depth of about 1,500 feet.

East Central Kansas District

ELK COUNTY (continued)

The production of the Denton field in 1930 was 250,926 M. cu. ft. and the total production to date is about 9,000,000 M. cu. ft. Reserves are estimated by the pressure production decline method at 952,000 M. cu. ft., the final pressure being 40 pounds.

Elco field. The Elco field is located four miles northeast of Grenola and lies in secs. 1, 11, 12, 13 and 14, T. 31, R. 9 E., and secs. 6 and 7, T. 31, R. 10 E. Production is from the so-called "Encill sand" at a depth of about 1,300 feet. In January, 1924, there were 22 producing gas wells in this field. At present there are 24 producing wells. Production from January 1, 1924, to date has been 3,900,000 M. cu. ft. Reserves are estimated at 2,100,000 cu. ft. from the present wells by pressure-volume data. Additional production north of the field is indicated by a well in sec. 31, T. 30, R. 10 E., which may be a one mile extension. Four additional locations, each with reserves of 75,000 M. cu. ft. are added for the estimate of the probable production.

Ferguson field. The Ferguson field is located five miles northwest of Grenola and lies in secs. 13, 14 and 23, T. 30, R. 8 E. In January, 1924, there were 12 producers in this field and one year later there were 16. At present there are 11 wells with an open flow capacity of 3,099 M. cu. ft. daily. The maximum open flow recorded was in July, 1924, when 15 wells totalled 29,050 M. cu. ft. The gas producing horizon is a sand in the upper Kansas City formation, called the "Encill" or "Denton" or sometimes the "Ferguson" sand. The depth is around 1,500 feet and the initial rock pressure 550 pounds. Production data prior to January, 1924, are not available but by extrapolating the pressure volume curve a production of more than 15,000,000 M. cu. ft. is indicated for the field up to this time. Production since January, 1924, has been over 2½ billion cu. ft. Reserves are estimated at 1,220,000 M. cu. ft. taken to 50 pounds pressure.

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East Central Kansas District

ELK COUNTY (continued)

Heck field. The Heck field is located about five miles northwest of Howard in secs. 17 and 18, T. 29, R. 10 E. It was discovered in 1926. A sand in the upper Kansas City formation, which is found at about 1,300 feet, produces the gas. The initial pressure was 360 pounds, the present pressure is 130 pounds. In November, 1927, there were six producing wells in the field; now there are but two. Production to date has been approximately 700,000 M. cu. ft. By using the Boyle's Law curve a future production of 200,000 M. cu. ft. is predicted, to a final pressure of 50 pounds.

Legsdon field. The Legsdon field is located about one mile east of Grenola in secs. 15, 16 and 22, T. 31, R. 9 E. It is situated on a small anticline and was discovered by Anderson Brothers, geologists of Wichita, Kansas. The first well was drilled during the summer of 1926. Gas was found in the sand in the upper Kansas City formation at a depth of about 1,400 feet. The original rock pressure was 510 pounds. Nine wells were drilled in the field and all but three have been abandoned, those remaining having been drilled in carefully and they are on the crest of the structure. The present pressure is 106 pounds. Total production to date has been about 1,000,000 M. cu. ft., while the production for 1930 was only 11,273 M. cu. ft., due to the high line pressure. In estimating reserves from this field projection of the curve to 40 pounds was thought to be permissible because of the condition of the remaining wells.

North Longton field. The North Longton field is located in secs. 2, 3, 10, 14, 15, 16 and 21, T. 30, R. 12 E., Elk County, Kansas. It is producing from the top of the Mississippian, anticlinal structure having caused the accumulation. The initial rock pressure was 530 pounds, the present pressure averaging 298 pounds.

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East Central Kansas District

BLK COUNTY (continued)

There are 18 wells in the field. Pressure-production data indicate a reserve of 2,523,000 M. cu. ft. to a final pressure of 80 pounds. The 1930 production was 361,383 M. cu. ft. Gas is taken from the field by the Union Gas Corporation.

Schrader field. The Schrader field is located in sec. 12, T. 31, R. 8 E., about two miles northwest of Grenola. It was discovered in November, 1928, by W. K. Mann of Arkansas City. The producing sand is in the upper Kansas City formation, the depth being 1,500 feet. There are six producers in the field and no dry holes within three-fourths of a mile from the producers. The average sand thickness is 30 feet, and the initial rock pressure was 550 pounds. Production from the field in 1930 totalled over 482,000 M. cu. ft. and the total production to date is approximately 1 billion cu. ft. The present rock pressure is over 400 pounds. Water has appeared in several of the wells which were drilled deep into the sand. Estimates of reserves are based on pressure decline data, with abandonment at 100 pounds pressure. Probable reserves include three additional locations, each with 400,000 M. cu. ft. reserve.

Webb field. The Webb field is located in secs. 11 and 14, T. 31, R. 10 E. Gas is found in the upper part of the Kansas City formation, at 1100 feet. The initial pressure averaged 400 pounds and the present pressure averages 255 pounds. Gas is taken by the Union Gas Corporation. Production in 1930 was 104,197 M. cu. ft. Estimated reserves to 100 pounds are 1,840,000 M. cu. ft., this having been secured by projecting the pressure production curve.

Rothgeb No. 1. This isolated well is located in the SW. $\frac{1}{4}$ of sec. 16, T. 30, R. 13 E. and was completed in 1926. Total production to date is 25,593 M. cu. ft. Reserves calculated from pressure decline are estimated at 59,000 M. cu. ft. to 85 pounds.

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East Central Kansas District

GREENWOOD COUNTY

The "proved gas reserves" are estimated to be 360,000 M. cu. ft., but lack of production data makes this estimate uncertain. The Buffalo Brick Plant took 144,352 M. cu. ft. through its lines from this area in 1930 and will probably continue to use an equal amount for the next two years.

The 1930 gas production and estimated gas reserves are given in the following Table C-7.

Table C-7. Gas production in 1930 and estimated gas reserves of Greenwood County.

Operator	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Buffalo Brick Plant	144,352	360,000	360,000

Production in T. 26, Rs. 12 and 13 in Greenwood and western Wilson counties is taken by the Buffalo Brick Company through their own lines to their plant at Buffalo. The sand in some of the wells is thought to be Bartlesville. Production in 1930 was 144,352 M. cu. ft. An estimate of 360,000 M. cu. ft. is placed on the recoverable reserves, this being admittedly inaccurate as no detailed data were available.

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East Central Kansas District

MARION COUNTY

The Marion gas field pressure decline curve cut off at 250 pounds gives a "proved gas reserve" of 1,547,000 M. cu. ft. and cut off at 100 pounds a "probable gas reserve" of 1,954,000 M. cu. ft.

The 1930 gas production and estimated gas reserves are given in the following Table C-8.

Table C-8. Gas production in 1930 and estimated gas reserves of Marion County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Marion	3	55,828	1,547,000	1,954,000

The Marion gas field in T. 19, R. 4 E. has three wells producing from the Mississippi "line" at about 2,400 feet. The rock pressure in June, 1927 was 765 pounds and was 750 pounds April, 1931. The 1930 production was 55,828 M. cu. ft. The pressure decline curve was extended to 250 pounds pressure for the estimated proved gas reserves and to 100 pounds for the estimated probable gas reserves.

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East Central Kansas District

MORRIS COUNTY

The gas reserves of the Wilsey field in Morris County are estimated from pressure decline curve to 10 pounds minimum pressure. The undrilled reserves are not estimated to their full extent but 25,000 M. cu. ft. are added to the proved gas reserves for a probable gas reserve figure.

The 1930 gas production and estimated proved and probable gas reserves are given in Table C-9.

Table C-9. Gas production in 1930 and estimated gas reserves of Morris County

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu.ft.	Estimated probable reserves in M. cu. ft.
Wilsey	5	69,170	250,000	275,000

The Wilsey field is located near the town of Wilsey in T. 16. R. 7 E., Morris County. Gas is coming from a sand in the Lawrence shale at about 1,200 feet. The accumulation is controlled by structure. In 1930 five wells produced 69,170 M. cu. ft. This gas was taken to Council Grove by the General Utilition Company. Reserves are estimated at 250,000 M. cu. ft. to a 10 pound final pressure. The undrilled reserve is not calculated, but is believed to be of some consequence.

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East Central Kansas District

EASTERN SUMNER COUNTY

The reserves of the Fadgett field in eastern Sumner County are figured from the pressure decline curve for the three producing wells. Cut off at 100 pounds the estimated proved reserves are 2,122,000 M. cu. ft. No future drilling is taken into account and the estimated probable gas reserves are given as the same as the proved gas reserves.

The 1930 gas production and estimated proved and probable gas reserves are given in Table C-10.

Table C-10. Gas production in 1930 and estimated reserves of eastern Sumner County

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu.ft.	Estimated probable reserves in M. cu. ft.
Fadgett	3	276,980	2,122,000	2,122,000

The Fadgett field, located in T. 39, R. 2 E., has three wells producing from the Mississippi "lime", at about 3,800 feet. The rock pressure dropped rather rapidly from an initial 1,150 pounds but the curve has flattened out and does not drop so rapidly at the present time. A minimum pressure of 100 pounds is used in figuring the proved gas reserves of this field.

Supplement D

WESTERN KANSAS DISTRICT

SUMMARY AND DETAILED DATA ON PRODUCTION AND RESERVES (CONTINUED)

SUMMARY AND DETAILED DATA ON PRODUCTION AND RESERVES

General statement. The Hugoton gas field in Stevens, Morton, Seward, Grant and Haskell counties is the largest gas field in Kansas. McPherson County with its four fields ranks second in importance in gas in Kansas. The other counties in western Kansas with gas production are Barber, Clark, Edwards, Harvey, Kingman, Reno, Rush and Sumner (west).

The development of the fields in western Kansas has been comparatively recent and many of the fields had no pipe line connections until 1929 and 1930.

The gas producing horizons vary from the Mississippi "lime" or chat to Big Blue group of Permian age. The Pennsylvanian basal conglomerate is one of the important gas horizons.

The estimated "proved gas reserves" are based on decline curves in Barber, Edwards, McPherson (except Canton field), Rush and Sumner counties. In the Hugoton field (Stevens, Morton, Seward, Grant and Haskell counties), they are estimated by the saturation method.

The estimated "probable gas reserves" in Barber, Edwards, McPherson, Rush and Sumner counties represent extension of the curves to lower pressures or economic limits. In Kingman and Reno counties, where the wells are new and productive limits undefined, reasonable acre-yield figures are assumed covering a conservative productive area outlined with the aid of what structural information can be secured.

Pipe line takings in the district are small, varying from 3.5 per cent to 10 per cent of the open flow capacity of the wells (excluding the Hugoton field). In the Hugoton field withdrawals by major pipe lines began only recently.

Supplement D

WESTERN KANSAS DISTRICT

SUMMARY AND DETAILED DATA ON PRODUCTION AND RESERVES (continued)

The 1930 production and estimated proved and probable reserves of Western Kansas are summarized by counties in Table D-1.

Table D-1. Gas production for 1930 and estimated gas reserves by counties in Western Kansas District

County	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Barber	8	4,194,695	19,642,000	21,980,000
Clark	1	71,878		
Edwards	4	440,850	235,000	460,000
Harvey	2	57,220		
Kingman	1			4,976,000
McPherson	55	6,026,034	52,788,000	108,903,000
Reno	5	20,762		16,400,000
Rush	3	1,017,219	11,050,000	12,400,000
Sumner (west)	3	208,455	1,120,000	1,400,000
Hugoton field	135	1,890,000	5,299,241.817	5,893,241.817
Total	217	13,927,023	5,384,076.817	6,069,760.817

* Includes Stevens, Norton, Seward, Grant and Haskell counties.

Detailed information on producing wells, gas horizons and reserves are given by counties in the following pages.

Supplement D

Western Kansas District

BARBER COUNTY

The Medicine Lodge field in T. 33 S., R. 13 W., Barber County, has eight producing wells at the present time. Because of variation in the volumes and pressures the data from each well were plotted to form an estimate of the gas reserves. The wells flow against a line pressure of 350 to 370 pounds but facilities have been arranged for lower pressures and the proved estimates are taken down to 200 pounds. The estimated probable reserves are taken down to 100 pounds pressure.

The 1930 production and estimated reserves are summarized in the following Table D-2.

Table D-2. Gas production in 1930 and estimated gas reserves of Barber County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Medicine Lodge	8	4,194,605	19,642,000	21,980,000

Detailed data concerning the Medicine Lodge field are given in the following paragraphs.

Medicine Lodge field. The producing wells are varied in volumes and apparently in pressures. One well has to date delivered two-thirds of the field total production. Individual curves on five of the wells, and a weighted average curve of the seven wells, have been made. Pressure data intermediate between original and present are not at hand. Only fifteen minute pressures are available.

Supplement D

Western Kansas District

BARBER COUNTY (continued)

The wells flow against a line pressure of 350 to 370 pounds. However, facilities have been arranged to permit lower pressures and as the curves have been taken down to 200 pounds.

753,000,000 cu. ft. of gas has been taken from four of the wells by an Oklahoma pipe line. The remainder has been delivered in Kansas. Deliveries to pipe line began in November, 1929. A gasoline plant is in operation in the field.

753,000 M. cu. ft. have been taken by Carlton Pipe Line Co. of Oklahoma, from four wells, in addition to gas delivered to the Kansas Pipe Line & Gas Company.

- Alexander #1
- Angel #1
- Carter #2
- Lytle #1

In constructing curves on these wells this amount of gas was prorated according to their present volumes and last month's takings, as follows:

		TOTAL
Alexander #1	68,490 M	437,632 M
Angel #1	57,075 M	376,428 M
Carter #2	479,430 M	3,710,523 M
Lytle #1	136,960 M	858,319 M

TOTAL ESTIMATE FOR INDIVIDUAL WELLS AT:

	<u>200#</u>	<u>100#</u>
Carter #2	12,500,000 M	13,400,000 M
Angel #1	765,000	815,000
Lytle #2	765,000	815,000
(Est. as equal Angel #1)		
Alexander #1	1,022,500	1,075,000
Lytle #1	1,775,000	1,900,000
Humblin #1	1,775,000	1,900,000
(Est. as equal Lytle #1)		
Alexander #1A	1,050,000	2,075,000
	<u>19,642,000 M</u>	<u>21,980,000 M</u>
Average Field Curve	18,000,000 M	19,200,000 M

Supplement D

Western Kansas District

CLARK COUNTY

The only production in Clark County is in the Watchorn field from one well, the Watchorn Oil and Gas Company Morrison #1. Due to existent conditions, it is considered inadvisable to try to estimate reserves. There is uncertainty as to future pipe line deliveries and future development.

The 1930 gas production for Clark County is given in Table D-3.

Table D-3. Gas production in 1930 in Clark County, Kansas.

Field	No. of wells	Gas production in 1930 in M. cu. ft.
Watchorn	1	71,878

Watchorn field. The original well, Morrison #1, in NE quarter of sec. 20, reported quite a few million feet of gas in the Pennsylvanian basal sand. This was not saved, however. The Stevens #1 in Center of NW of the NW sec. 21, was later drilled. 250,000 cu. ft. of gas was reported at 4927-70 and 20,000,000 cu. ft. at 5443-73. The original shut-in pressure was reported at 775 lbs. and present pressure at from 400 to 450 pounds.

According to data received from the office of the Watchorn Oil & Gas Company, the operators, the well has to date produced 155,396,000 cu. ft. of gas. It has been delivering gas to the line of the Public Service Company of Kansas, and has also been furnishing fuel for the drilling of Morrison #2, a deep test. The well is making fluid and has to be blown about once a week. Due to this and the fact that the drilling well is needing considerable fuel, deliveries to the pipe line ceased about July 25, this year. Before that time it is reported to have been delivering 25,000 cu. ft. per day.

Western Kansas District

CLARK COUNTY (continued)

The drilling well, Morrison #2, using rotary tools, passed up the gas horizon at the base of the Pennsylvanian. A little gas and oil was found at the top of the Viola, some place between 6490 and 6527.

Because of conditions it is deemed unwise to attempt to make any estimate of reserve for this field. One opinion was expressed to the effect that any additional pipe line deliveries are doubtful. There is no doubt considerable gas remaining, but due to the depth and consequent drilling expense it is doubtful whether additional developments can be expected for some time.

E.T.U. tests which should be on file at the chemistry department of the University are reported as from 1114-1134.

Area	No. wells	Production in 1930 in cu. ft.	Estimated proved reserves in cu. ft.	Estimated pro- bable reserves in cu. ft.
Secs. 29, 31, 32, T. 25, R. 17 W.	4	400,000	200,000	400,000

Details of the several wells in Edwards County are given in the following paragraphs.

There are four wells located in sections 29, 31, 32, T. 25, R. 17 W. The total original volume was 24 million cu. ft. and the original pressure was given as 1310 pounds. The first well had an original volume reported of 10 million and has produced more than two-thirds of all the gas taken from the field. Pressure and production are both down to a point where the smaller wells may be abandoned. All the wells are making oil and one is reported making water. The producing horizon is a permeable sand consisting of the zone of saturation is only 2 to 3 feet thick.

Supplement D

Western Kansas District

EDWARDS COUNTY

The "proved gas reserves" of the wells in Edwards County have been estimated from pressure decline curves. The pressure taken is 350 pounds as the wells are flowing against a line pressure of 350 to 370 pounds at present and probably no facilities will be provided for production at lower pressures. The estimated "probable gas reserves" have been figured to 100 pounds shut-in pressure. No probable reserve figure has been placed on indicated large potential area.

The 1930 gas production and estimated reserves of Edwards County are given in the following Table D-4.

Table D-4. Gas production in 1930 and estimated reserves in Edwards County.

Area	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Secs. 30, 31, 32, T. 25, R. 17 W.	4	440,850	235,000	460,000

Details of the several wells in Edwards County are given in the following paragraphs.

There are four wells located in sections 30, 31, 32, T. 25, R. 17 W. The total original volume was 24 million cu. ft. and the original pressure was given as 1310 pounds. The first well had an original volume reported of 15 million and has produced more than two-thirds of all the gas taken from the field. Pressure and production are both down to a point where the smaller wells may be abandoned. All the wells are making oil and one is reported making water. The producing horizon is a Pennsylvanian basal sandstone. The zone of saturation is only 2 to 3 feet thick.

Supplement D

Western Kansas District

ELWARS COUNTY (continued)

The wells flow against a line pressure of 350 pounds to 370 pounds. It is not known that facilities will be provided to permit depletion to a lesser pressure, and due to the small volume and great depth, it seems unlikely that any will be made.

In sec. 22, a well of 8 million original volume is shut in. The shut-in pressure is 1246 pounds. The gas is reported to be dry. The producing horizon is the same as in the wells to the southwest. The depth to the gas is 4,450 feet.

The reserve of these wells is small. However, the well to the east may indicate a potential producing area of some size. A fifteen minute pressure of 245 pounds is about average for the wells, but shut-in pressures of 600 pounds and 620 pounds was reported on two of the wells from other sources. 600 pounds was used in construction of the decline curve.

Supplement B
Western Kansas District

HARVEY COUNTY

The Halstead field in secs. 8, 11 and 14, T. 23 S., R. 2 W., Harvey County, has two producing wells. The production is from the Mississippi "lime". The 1930 production was 57,220 M. cu. ft. and the total production to January 1, 1931, has been 154,694 M. cu. ft. of gas. Reserves were not figured for this field.

Table 1-5. Gas production for 1930 in Harvey County, Kansas.

Field	No. of wells	Production in 1930 in M. cu. ft.
Halstead	2	57,220

Well	Estimated probable gas reserves in M. cu. ft.
Well #1 20-27-1921	4,976,000

Operator - Kelly Oil Company. Well completed January, 1931. Oil well in top of Lansing Gasco City group 3,326-3,341. Thirty-five Mbl. per hour. Well is shut in. The following amounts of gas are reported:

1920-1922	10,000 cu. ft.	
1923-1924	1,000,000 cu. ft.	200 lb. S. G.
1925-1926		Little Gas
1927-1928	6,110,000 cu. ft.	700 S.G. and 500 S.G.

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Western Kansas District

KINGMAN COUNTY

One well, completed January, 1931, by the Skelly Oil Company has a reported open flow of 15,000 M. cu. ft. The probable reserves are figured on the basis that 600 acres may be productive. For the upper gas sands, 2,005-2,020 feet and 2,133-2,142 feet, 25 feet of saturated sand, 15 per cent porosity, 75 per cent recovery and 720 pounds shut-in pressure are used. The probable reserves are 3,291,666 M. cu. ft. For the deeper gas sands, 3,385-3,390, 3,421, 3,426, and 3,438-3,441 feet, 10 feet of saturated sand, 15 per cent porosity, 75 per cent recovery and 925 pounds shut-in pressure are used. The estimated probable reserves are 1,684,204 M. cu. ft.

The reserves of the Kingman County well are given in Table 1-6.

Table 1-6. Estimated probable reserves for Skelly Oil Company
Miles No. 1, Kingman County.

Well	Estimated probable gas reserves in M. cu. ft.
Miles #1 30-27-10W.	4,976,000.

Operator - Skelly Oil Company. Well completed January, 1931. Oil well in top of Lansing Kansas City group 3,338-3,341. Thirty-five bbl. per hour. Well is shut in. The following showings of gas are reported:

1525-1530	10,000 cu. ft.	
1635-1645	2,000,000 cu. ft.	325 lb. R. P.
1775-1780		Little Gas
2005-2020	6,116,000 cu. ft.	700# R.P. 855 B.T.U.

Western Kansas District

KINGMAN COUNTY (continued)

2133-2142	9,200,000 cu. ft.	Cumulative
2475-2490	250,000 cu. ft.	
3030-3035	250,000 cu. ft.	
3125-		Show of oil
3365-3389	100,000 cu. ft.	
3369-3390	1,250,000 cu. ft.	435# R. P. 1½ hrs.
3421-	1,000,000 cu. ft.	700# R. P. 2 hrs.
3426-	750,000 cu. ft.	Additional
3438-3441	2,000,100 cu. ft.	

All gas above 12" casing at 1,992 is shut off. A total of 10,000,000 ft. is bradenheaded between the 12" casing at 1,992 and the 10" casing at 2,450. The rock pressure is 720 pounds and the B.T.U. is 868. Between the 10" casing at 2,460 and the 8" casing cemented 3,375 is found 1,000,000 ft. of gas of 1,000 pounds R.P. In cementing at 8" csg. at 3,375 the hole outside the pipe was filled with cement up to the 10" shoe at 2,460 and this gas shut off. A total of 5,000,000 cu. ft. was found below the 8" csg. at 3,375 with R.P. of 925 pounds. The oil was also found in the same horizon.

Not counting the gas cased off, this well has a reported open flow of 15,000,000 cu. ft. None of the gas has been utilized and the well remains shut in.

An analysis of gas from 2005-2020 is as follows: Oxygen 0.5 per cent, Carbon dioxide 0.2 per cent, Ethane 12.1 per cent, Methane 71.8 per cent, Residue 15.8 per cent. B. T. U. is reported as 855.

Supplement D

Western Kansas District

MCPHERSON COUNTY

The estimated "proved gas reserves" of the Galva, McPherson, Voshell and miscellaneous fields are derived as follows:

Galva field. Estimated by pressure decline to 50 pounds. However, the decline has not yet been sufficient to permit any degree of accuracy in this estimation. Only fifteen minute pressures are at hand and many of the wells have volumes too small to allow these to approach a true shut-in pressure.

McPherson field. Estimated by pressure decline to 50 pounds pressure. Data are considered adequate to insure a fair degree of accuracy.

Voshell field. Estimated by pressure decline to 350 pounds. Only fifteen minute pressures are available. All wells produce both oil and gas from two different horizons.

Miscellaneous fields. Estimated by pressure decline curve on one well to 50 pounds pressure. There are two other gas wells and three combination wells, of very recent completion, scattered through the Ritz oil field.

The "probable gas reserves" of the fields in McPherson County are estimated in the following ways:

Canton field. 2,160 acres are estimated productive. 17,000 M. cu. ft. per acre is the indicated average for the old McPherson field. Due to the larger original volumes in this field it is thought that this acre yield figure may be very conservative.

Galva field. The estimated productive area is 3,840 acres. 17,000 M. cu. ft. per acre.

McPherson field. The reserve is not thought to be in excess of that considered proven.

Supplement B

Western Kansas District

MCPHERSON COUNTY (continued)

Voshell field. Reduced to economic limit of 50 pounds. This is possible if connection is made to booster station.

Miscellaneous. Estimated combination wells from decline curves on older wells of approximately the same size and producing under similar conditions. Two of the three gas wells are recent completions.

A summary of the gas production in 1930 and estimated reserves of the fields in McPherson County is given in Table D-7.

Table D-7. Gas production in 1930 and estimated gas reserves, by fields, in McPherson County

Field	No. wells.	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Canton	8			36,000,000
Galva	14	3,370,797	48,000,000	65,000,000
McPherson	20	1,495,000	3,260,000	3,260,000
Voshell	10	947,103	553,000	1,643,000
Miscellaneous	3	215,134	975,000	3,000,000
Total	55	6,028,034	52,788,000	108,903,000

Detailed data on the gas fields in McPherson County are given in the following paragraphs.

Supplement D

Western Kansas District

MCPHERSON COUNTY (continued)

Canton field. At this time there are eight gas wells, located in secs. 16, 17, 20, 21. T. 19 S., R. 1 W., with a total open flow of 226,000 M. cu. ft. of gas, or an average of over 28,000 M. cu. ft. per well. This is an entirely new area and accurate estimates on reserves are out of the question. It is quite likely that from 2,000 to 3,500 acres will be productive. In the McPherson field the per acre recovery is estimated at 17,000 M. cu. ft., but the average of original open flow was only 9,000 M. cu. ft., or 1/3 of the average in the Canton area. It is quite possible, of course, that the high average initial volume will be reduced as the field is developed and lighter edge wells are drilled.

The producing horizon is the chat at the top of the Mississippi limestone. The average penetration of the chat is said to be 45 feet with the larger gas volume coming from the lower 20 feet. The gas has a high gasoline content, but no figures are available on this to date.

Salva field. This is the largest gas field in McPherson County, and is at present producing more gas than any other field in Kansas. (The Hugoton gas field may soon exceed it.) The first well was connected only two years ago this month (August) and one year ago only five of the now nearly fifty wells were making deliveries to pipe line. Production to date has been nearly 8 billion cu. ft. Present open flow capacity is over 600 million cu. ft. With the old McPherson field to the northwest and the new Canton field to the east, the combined open flow is 867 million cu. ft., or slightly greater than that of the Hugoton field. Three-fourths of the wells have been completed during the present year. The field limits are now fairly well defined. There are a number of combination oil and gas wells around the edges of the field.

Western Kansas District

MCPHERSON COUNTY (continued)

Original shut-in pressure of 1,000 pounds and present pressure of 865 pounds are used. Exact average of present pressure is difficult to ascertain due to the fact that only fifteen minute pressures are recorded. It is thought that pressure decline does not correctly indicate the ultimate yield of the field. Applying an acre yield of 17 million cu. ft. to present producing area gives an ultimate yield one-third greater than the decline curve shows.

McPherson field. This is the only field in McPherson County on which sufficient production and pressure data are at hand to enable the construction of what is believed to be an accurate production curve. These data are shown on a separate sheet. The field has produced to date over 10 billion cu. ft. It is thought ultimate total production will reach 13½ billion cu. ft. Indicated per acre yield is 17 million cu. ft. About 2½ million cu. ft. are still produced daily.

The original shut-in pressure was 975 pounds. Present average shut-in pressure is 375 pounds. This latter pressure is derived from fifteen minute pressures on individual wells. Eight of the wells on which the pressure is now low are connected to a booster station located in the field.

Woshell field. There are ten combination oil and gas wells located principally in the north end of the field. The oil comes from the "Viola" limestone and the gas is produced from the "Chat" through bradenheads.

The original shut-in pressure was 900 pounds. The present fifteen minute pressure average on the scattered wells is slightly more than 500 pounds. The gas from the wells passes into a 16 inch trunk line carrying a pressure of 350 to 370 pounds. Whether the wells will be depleted to a lower pressure

Supplement B

Western Kansas District

MCPHERSON COUNTY (continued)

through connection by separate line to the booster station located in the old McPherson field about fifteen miles to the northeast, depends on how the wells maintain their volumes. In this event, it is expected that the wells will be carried down to a fifty pound pressure. The B.T.U. is considerably higher than that of gas from surrounding fields.

Miscellaneous wells. There are six of these scattered wells located in the Ritz oil field. Three are combination gas and oil wells and have only recently been connected to the pipe line. Three are gas wells, two of which are also of recent completion. Although no reliable estimate of reserves can be made on these two wells. (Sellers #1 and Garrah #1, 31-19-17), under probable reserves an attempt has been made to estimate their production by pressure decline. The third gas well (Wedol #1, 12-20-27), has been making deliveries to pipe line for more than two years and has totaled more than one-half billion cu. ft. It is believed the decline curve on this well is fairly accurate. Since the three combination wells are new and of small volume, and only fifteen minute pressures are available, which are not believed to reflect their true shut-in pressures, under probable reserves their production has been established by assuming that they will approximate older wells of like volume and producing under apparently similar conditions.

Gas is found in the "Chat" in many of the wells of the Ritz Field, but unless of considerable volume is not saved.

Supplement D

Western Kansas District

RENO COUNTY

One gas well, three combination wells and two oil wells are located in sec. 1, T. 23 S., R. 4 W. The four wells producing gas are connected to a pipe line, but are of such recent completion and the producing area so poorly defined as not to permit reliable reserve estimates. The assumed production acreage in sec. 1, T. 23 S., R. 4 W. is 640 acres with 10 million cu. ft. acre yield. There is a shut-in gas well in sec. 23, T. 23, R. 4 W. The productive acreage is estimated as 1,000 acres with 10 million cu. ft. acre yield. The production acreage is estimated with the aid of what structure data could be obtained.

The 1930 production and estimated probable gas reserve of Reno County is given in Table 1-8.

Table 1-8. Gas production in 1930 and estimated gas reserves in Reno County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Sec. 1, T. 23 S., R. 4 W. Sec. 23, T. 23 S., R. 4 W.	5	20,762	16,400,000

There is one gas well and three combination gas and oil wells located in 1-23-4W. The former came in for a volume of about 24,000 M. cu. ft. and shut-in pressure of 1200 pounds, last November. It has produced 576,000 M. cu. ft. The producing horizon is the "Chat" at the top of the Mississippi limestone, found at a depth of 3250 feet. Three locations to the north of the gas wells are flowing oil wells producing from the same horizon.

In sec. 23 of the same township, a gas well was completed in the "Chat" found at 3266' to 3306'. The volume is 9,500 M. cu. ft. and the R. P. 1100 pounds.

This well is shut in.

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Western Kansas District

RUSH COUNTY

The "proved gas reserves" of the Rush County wells has been estimated by pressure decline curves to 200 pounds. Data on the Bison well permit a fair degree of accuracy. The two Otis wells are newer and pressure decline is not great. The estimated "probable gas reserves" are figured to 100 pounds shut-in pressure.

The 1930 production and estimated reserves of Rush County are given in Table 1-9.

Table 1-9. Gas production in 1930 and estimated gas reserves of Rush County.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
27-17-17W. 11-18-16W.	3	1,017,219	11,050,000	12,400,000

The Bison well, 27-17-17W., though producing from a reported three feet of pay, is shown by the pressure decline curve to have a long life expectancy. The rapid decline in the early stages of production is accounted for by excessive withdrawals at that time. Recent performance indicates that if withdrawals are only moderate (300,000 to 400,000 cu. ft. per day) the well has quite a large reserve. Though surrounded by dry holes it is evidently draining a rather large area.

The two wells located in 11-18-16W. have been connected to pipe line for 6 and 12 months and have delivered over one billion cubic feet of gas. The original volumes were large--15 and 37 million. The producing horizon (Pennsylvanian basal sand) is not more than 10 feet thick. The area is only defined by a dry hole to the north. It is possible that the reserve may be large.

Supplement D

Western Kansas District

SUMNER COUNTY (west)

The "proved gas reserves of the wells in Sumner County are figured from pressure decline curves of the three individual wells. The curve is projected to 150 pounds pressure. The "probable gas reserves" are estimated from the three curves projected to 100 pounds pressure.

The gas production in 1930 and estimated reserves are given for Sumner County (west) in Table D-10.

Table D-10. Gas production in 1930 and estimated reserves of the Anson field, Sumner County, Kansas.

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Anson	3	208,455	1,120,000	1,400,000

The four small wells of this field have produced to date 950,738 M. cu. ft. of gas. One well is now plugged. The original volumes were from one to three million. The exact original pressures are not available. The first well was completed in September, 1926, and the first pipe line connection made in February, 1928. The producing sand is in the Howard limestone horizon found at about 1,925 feet. The zone of gas saturation is, according to drillers' logs, only 5 to 10 feet thick.

Since from the pressure data available the decline is shown to be at a remarkably slow rate, it seems probable that a considerable area around the wells is being drained. The B.T.U. is low--said to be 700 to 750. The wells produce against a line pressure varying from 150 to 250 pounds.

Supplement D

Western Kansas District

HUGOTON FIELD (STEVENS, MORTON, SEWARD, GRANT, HASKELL COUNTIES)

The estimated "proved gas reserves" of the Hugoton field were figured by the volumetric method. The factors used are as follows: original rock pressure 440 pounds, thickness of saturated pay 45 feet, porosity 20 per cent. Recoverable gas figured on a 2 pound base and a recovery factor of 75 per cent. The Hugoton field is estimated at 750,000 acres with 651,000 acres proved territory and 99,000 acres of probable territory. In the proved territory the amount of recoverable gas per acre is estimated as 8,144,631 cu. ft. on 2 pounds base. In the probable territory the acre yield is estimated at 6,000,000 cu. ft. on a 2 pound base.

The gas production and estimated reserves of the Hugoton field are given in Table D-11.

Table D-11. Gas production in 1930 and estimated reserves in the Hugoton field (Stevens, Morton, Seward, Grant and Haskell Counties).

Field	No. wells	Production in 1930 in M. cu. ft.	Estimated proved reserves in M. cu. ft.	Estimated probable reserves in M. cu. ft.
Hugoton	135	1,890,000	5,299,241,817	5,893,241,817

Detailed data on the Hugoton field and estimation of reserves are given in the following paragraphs.

Original rock pressure used is 440 pounds. While perhaps more wells in the area record less than this pressure, yet a number attained it and it is thought to represent the original maximum pressure.

Western Kansas District

HUGGTON FIELD (continued)

The thickness of saturated pay used is 45 feet. This is obtained by averaging a large number of reported gas horizons on driller's logs, supplemented by study of well cuttings and one complete core.

The porosity factor used is 20 per cent. This is an average of porosity tests on fragments of pay dolomite from a number of wells. Also porosity of from 16 to 22 per cent have been found by others making estimates for the same district.

The estimated recoverable gas from the area is figured on a 2 pound base. This is base on which gas is almost universally sold from the wells in Kansas.

In reducing pressure from 440 to 2 pounds Wescott's tables have been used. In these tables an atmosphere has been taken as 14.4 pounds. No allowance has been made for the above average altitude of the area.

An arbitrary recovery factor of 75 per cent has been used. Recovery might even be greater than this. It will not be known for some time at just what minimum pressure the wells will produce.

* * * * *

43,560 sq. ft. per acre	X	45 ft.	(Pay thickness)	
			Equals - 1,960,200 cu. ft. per A.	
1,960,200	X	20% (porosity)	"	= 392,040 cu. ft. gas per A. @ 440#
392,040	X	27.7 (2# multiplier)		10,859,508 cu. ft. gas p. A. @ 2#
10,859,508	X	75% (recovery)		8,144,631 cu. ft. recov. gas p. A. @ 2#
8,144,631	X	651,000 acres (See map)		5,302,154,781.000 cu. ft. recov. gas in area outlined on map 2# base.

77) 530 30
77) 240

Supplement D

Western Kansas District

HUGGTON FIELD (continued)

Water accumulates in some of the wells when pulled to excess (30-40 per cent of open flow capacity). However, after being blown off none of the wells have failed to remain dry under proper (20-25 per cent) load. At least one of the wells produced up to 50 per cent of its open flow without showing any moisture. The best information is to the effect that no water trouble exists in the area.

On the Kansas side of the line there are at present reported 134 wells with an open flow capacity of 837,315,000 cu. ft.

Gas produced in the area to June 30, 1931.

Argus & Western Prod. Co.	
(For development (estimated))	1,150,000,000 cu. ft.
Delivered to Dodge City line.	1,390,590,000 cu. ft.
(By McKnabb et al wells)	
Delivered to Panhandle-Eastern Line.	
Texas-Interstate wells	125,702,000 cu. ft.
For development (estimated)	330,000,000 cu. ft.
Lamar line	106,672,000 cu. ft.
Other development fuel	<u>300,000,000 cu. ft.</u>
Total amount of gas taken from area	3,402,964,000 cu. ft.
Liberal field	<u>500,000,000 cu. ft.</u>
	3,902,964,000 cu. ft.

13 ✓
174

270
13,500 to Mar 31-32

SUPPLEMENT 2

Analyses of Gas
from
Medicine Lodge Gas Field

	A	B	C	E	G
Carbon dioxide	0.13%	0.04%	0.07%	0.10%	0.06%
Oxygen	0.00	0.00	0.00	0.00	0.00
Methane	77.90	81.98	80.75	80.95	77.72
Ethane	12.02	12.43	13.14	11.62	13.10
Residue	<u>9.95</u>	<u>5.61</u>	<u>6.04</u>	<u>7.33</u>	<u>9.10</u>
	100.00%	100.00%	100.00%	100.00%	100.00%
 B. T. U.	 998	 1046	 1047	 1022	 1010
 AIR present as received	 31.50%	 48.05%	 12.06%	 22.43%	 13.54%

A Alexander #1	C SE SE	13-33-13W
B Carter #2	C NE SE	11-33-13W
C Angell #1	C NW SE	14-33-13W
D Alexander #1	C NW NW	24-33-13W
E Lytle #1	NE NW SW	12-33-13W

Analyses of Gas
from
Edwards Gas Field

	A	B
Carbon dioxide	0.17%	0.21%
Oxygen	trace	0.00
Methane	84.25	85.95
Ethane	9.66	9.52
Residue	<u>5.70</u>	<u>4.32</u>
	100.00%	100.00%

B.T.U. 1024 1035

per cent
as received

A McCarty Well NE NW 31-25-17W
B Carrol #1 C SW 32-25-17W

SUPPLEMENT B

Analyses of Gas from Skelley Miles #1,
30-27-10W., Kingman County, Kansas

	<u>As rec'd.</u>	<u>Air free</u>
Carbon dioxide	0.09%	0.10%
Oxygen	1.25	0.00
Methane	63.20	67.20
Ethane	14.87	15.93
Residue	<u>20.49</u>	<u>16.77</u>
	100.00%	100.00%
Air percent as received	5.96%	0.00%
B. T. U.	902	959

A Early King #1 20-19-17
 B Harris & Hunt Overton #1 20-20-17
 C Early Fletcher #1 14-15-17
 D S & S Blair #1 20-19-17

SUPPLEMENT B

Analyses of Gas
from
Canton Gas Field

	A	B	C	D
Carbon dioxide	trace	0.07%	trace	0.26%
Oxygen	0.15%	0.00	0.00%	0.00
Methane	73.05	74.85	76.35	75.25
Ethane	18.44	20.66	19.12	19.28
Residue	<u>8.36</u>	<u>4.52</u>	<u>4.53</u>	<u>5.21</u>
	100.00%	100.00%	100.00%	100.00%
B.T.U.	1063	1118	1109	1099

Air present
as received 0.81%

- A Darby Kaegi #1 No NE 20-19-1W
- B Harrie & Haun Overman #1 NW NE SE 20-19-1W
- C Darby Fletcher #1 SW SW SW 16-19-1W
- D S & S Blair #1 NW 32-19-1W

Carbon dioxide	trace
Oxygen	0.15%
Methane	73.05
Ethane	18.44
Residue	<u>8.36</u>
	100.00%

B.T.U. 1063

Air present
as received

Carbon dioxide

SUPPLEMENT B

Analyses of Gas
from
Galva Gas Field

	A	B	C	D	E	F
Carbon dioxide	0.34%	0.68%	0.07%	0.14%	0.18%	0.16%
Oxygen	0.00	0.00	0.00	0.05	0.00	0.09
Methane	75.00	76.75	74.75	72.50	73.65	73.85
Ethane	18.38	18.67	20.66	21.10	21.20	19.72
Residue	<u>6.28</u>	<u>3.90</u>	<u>4.52</u>	<u>6.21</u>	<u>4.97</u>	<u>6.18</u>
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
B.T.U.	1083	1103	1118	1104	1112	1095
Air present as received	44.75%	65.92%	2.50%		1.25%	

A	McPherson O & G Co.	Decker #2	C NE 1/4 11-19-2W
B		J. W. Meyer #3B	C NE SE 14-19-2W
C	Wolf Creek et al.	Krehbiel #1	NE NW NW 25-19-2W
D	Joe Rusk	Johnson #1	C SE NW 10-19-2W
E	McPherson O & G Co.	Wallace #2	NW SW 12-19-2W
F	Browwood	Giffin #2	C SE SW 14-19-2W

	E
Carbon dioxide	trace
Oxygen	0.05%
Methane	74.55
Ethane	19.00
Residue	<u>6.36</u>
	100.00%

B.T.U. 1087

Air present
as received

G.-McBride Lovett #1 C NW SW 13-19-2W

SUPPLEMENT E

Analysis of Gas
from
Mepherston Gas Field

	A	B	C	D	E
Carbon dioxide	0.49%	0.65%	0.85%	0.09%	0.33%
Oxygen	0.00	0.20	0.09	0.72	0.56
Methane	74.25	74.83	74.53	75.75	74.08
Ethane	19.34	18.88	18.77	17.79	19.48
Residue	<u>5.92</u>	<u>5.44</u>	<u>5.77</u>	<u>5.59</u>	<u>5.61</u>
	100.00%	100.00%	100.00%	100.00%	100.00%
B. T. U.	1090	1089	1083	1079	1093

	F	G	H	I	J
Carbon dioxide	0.48%	0.14%	0.55%	0.22%	0.47%
Oxygen	0.55	0.23	0.18	0.00	0.00
Methane	75.20	73.81	73.92	74.96	73.15
Ethane	18.66	20.45	19.72	19.02	20.20
Residue	<u>5.11</u>	<u>5.37</u>	<u>5.63</u>	<u>5.80</u>	<u>6.18</u>
	100.00%	100.00%	100.00%	100.00%	100.00%
B. T. U.	1088	1106	1094	1091	1095

A	M. R. S. L. A. Anderson #1	NE SW SW 29-18-2W
B	M. R. S. L. A. Anderson #2	SW SE SW 29-18-2W
C	Tatloyd, Chindberg #1	NE NW NW 32-18-2W
D	Texas Co.	C NL NB NW 32-18-2W
E	G. F. C. Bentson #1	C NW SW 32-18-2W
F	Tatloyd, Clark #1	C NE SE 31-18-2W
G	Mepherston O & G Co. Larson #1	C NE SW 31-18-2W
H	Mepherston O & G Co., O.O. Anderson #1	C SE NE 31-18-2W
I	P. O. & G., O.O. Anderson #1	C NE NE 31-18-2W
J	Mid Co., Pet Johnson #1	C SE SE 30-18-2W

SUPPLEMENT B

Analyses of Gas from Voshell Gas Field

	A	B	C	D	E
Carbon dioxide	0.40%	0.21%	trace	0.19%	0.15%
Oxygen	0.00	0.00	0.00%	0.00	0.11
Methane	75.50	74.45	77.10	68.05	76.50
Ethane	18.93	19.75	18.30	29.14	20.07
Residue	5.17	5.58	4.60	2.62	3.17
Boiling value	100.00%	100.00%	100.00%	100.00%	100.00%
B.T.U.	1096	1101	1102	1201	1126
Air present as received	2.39%	33.06%	23.12%	54.00%	

A	Frairie O & G Co.	Krehbiel #4	SE NE SE	4-21-3W
B	McBride	Krehbiel #2	NE SW NE	4-21-3W
C	Sinclair	Morehouse #3	SE NE NE	4-21-3W
D	McBride	Krehbiel #1	SE SW NE	4-21-3W
E	Gatot et al	Kaufman #1	NW SW	15-21-3W
	Oxygen	0.00		
	Methane	75.50		
	Ethane	18.93		
	Residue	5.17		
		100.00%		
	B. T. U.	1116		

SUPPLEMENT B

Analysis of Gas from Palmer et al, Georing #1
1-23-4W, NW NW 22., Reno County

Air Free

Carbon dioxide	0.49%
Oxygen	0.00
Methane	73.75
Ethane dioxide	20.47
Residue	<u>5.29</u>
	100.00%

Heating value per cu. ft.

Cross 60 degree F-30 in.

B. T. U. 1105%

Air present as received 1.35%

McPherson Oil and Gas Co., Georing #1
SW SW 22, 1-23-4W.

Carbon dioxide	0.32%
Oxygen	0.00
Methane	71.00
Ethane	22.60
Residue	<u>6.08</u>
	100.00%

B. T. U. 1115

SUPPLEMENT B

Analyses of Gas
from
Rice Gas Field

	A	B	C
Carbon dioxide	0.17%	0.22%	0.00%
Oxygen	0.00	0.00	.10
Ethane	78.25	78.25	81.60
Carbon dioxide	10.45	0.22%	10.67
Oxygen	11.72	0.37	12.21
Methane	100.00	49.40	100.00
Ethane		5.26	
Residue		<u>44.75</u>	
		100.00%	

B.F.U.

592

A. McFadden #1 C. No. 29-18-6W.
 B. Shell #1 C. No. 29-18-6W.
 C. Jennings #1 C. No. 29-18-6W.

A McFadden, Shell, Jennings #1 SW NE NW 29-18-6W.

SUPPLEMENT B

Analyses of Gas
from
Lush Gas Field

	A	B	C
Carbon dioxide	0.17%	0.22%	0.09%
Oxygen	0.00	0.00	.18
Methane	75.65	72.25	21.82
Ethane	10.48	13.20	12.67
Residue	<u>13.70</u>	<u>14.33</u>	<u>15.24</u>
	100.00%	100.00%	100.00%
IB. T. U.	949	961	948

AA Tannen #1	C. SW. 11-18-16W.
IB Ethel #1	C. NW. 11-18-16W.
CC Lancinger Well	SE. NW. 27-17-17W.

SUPPLEMENT B

Results obtained from examination of sample of gas sent by
Nebraska Natural Gas Co., Salina, Kansas.

Carbon dioxide	0.18%
Oxygen	0.12
Methane	76.20
Ethane	16.88
Residue	<u>6.62</u>
	100.00%

Heating value, per cu. ft. gross, 60 degree F. 30 in.

B. T. U. 1067

A. Schaeffer 235 H. H. West & Co. Stafford Co.

Supplement B

Analysis of Gas from Stafford Gas Field

	A	B	C	D	E
Carbon dioxide	.80%	.69%	.80%	.80%	.80%
Oxygen	.30	.30	.30	.30	.30
Carbon dioxide	67.27	0.69%	68.45	68.27	68.21
Oxygen	16.00	0.00	16.30	16.00	17.30
Methane	1.42	47.34	1.87	1.40	1.40
Ethane	13.00	18.24	13.00	11.00	15.00
Residue	.700	33.73	.707	.700	.700
B.T.U. Gross	1040	100.00%	1000	1000	1040
Gasoline content	400 Gal.	411 gal.	400 Gal.	400 Gal.	410 Gal.

B.T.U. 799

A. Schaeffer #36 Mid West O & R Co. Stafford Co.

	A	B	C	D	E
Carbon dioxide	.80%	.80%	.80%	.80%	.80%
Oxygen	.30	.30	.30	.30	.30
Methane	67.20	68.14	68.20	71.20	68.10
Ethane	16.00	16.15	16.00	14.07	17.00
Propane Higher	1.42	1.40	1.87	1.47	1.40
Nitrogen	13.40	14.00	13.00	11.07	15.10
Specific Gravity	.704	.700	.705	.710	.700
B.T.U. Gross	1000	1000	1000	1000	1000
Gasoline content	400 Gal.	400 Gal.	400 Gal.	400 Gal.	400 Gal.

F. Sherwood #1 20 11-10-27, ...
 G. Valcek #1 20 07-20-28, ...
 H. Lattell #1 20 04-20-28, ...
 I. Crawford #1 20 04-20-27, ...
 J. Ross #1 20 03-01-27, ...

Analysis of Gas from ...

Carbon dioxide	.80%
Oxygen	.30
Methane	67.20
Ethane	16.00
Propane Higher	1.42
Nitrogen	13.40
Specific Gravity	.704
B.T.U. Gross	1000
Gasoline content	410 Gal.
Gas Reserve	400 Gal.
Volume	7,100,000 cu. ft.

SUPPLEMENT B

Summary Chemical Analysis
Hugoton Gas Field.

	A	B	C	D	E
Carbon dioxide	.00%	.00%	.20%	.15	.00
Oxygen	.20	.20	.20	.20	.20
Methane	67.27	64.29	68.65	69.67	66.21
Ethane	18.02	19.93	16.35	16.93	17.32
Butane Higher	1.42	1.42	1.57	1.40	1.46
Nitrogen	13.09	14.16	13.03	11.95	14.81
Specific Gravity	.729	.756	.723	.720	.744
B.T.U. Gross	1046	1050	1036	1044	1025
Gasoline content	405 Gal.	411 gal.	449 Gal.	400 Gal.	418 Gal.

A Kenney-See #1	SW 36-5-14, Texas Co.	425# R.P.	Volume 5,516,000 cu. ft.
B Balatin #1	SW 23-6-14, Texas Co.	430# R.P.	Volume 3,519,000 cu. ft.
C Jester #1	NW 7-34-38, Stevens	439# R.P.	Volume 7,259,000 cu. ft.
D Pride #1	SW 25-33-37, "	430# R.P.	Volume 7,039,000 cu. ft.
E Forward #1	NW 5-34-38, "	420# R.P.	Volume 5,726,000 cu. ft.

	F	G	H	I	J
Carbon dioxide	.20%	.10%	.10%	.20%	.00%
Oxygen	.20	.20	.20	.20	.40
Methane	67.90	69.14	68.68	71.29	65.45
Ethane	16.80	16.15	16.83	14.87	19.61
Butane Higher	1.42	1.48	1.57	1.47	1.42
Nitrogen	13.48	12.95	12.82	11.97	12.12
Specific Gravity	.724	.720	.725	.710	.736
B.T.U. Gross	1022	1034	1040	1033	1056
Gasoline content	405 Gal.	423 Gal.	449 Gal.	422 Gal.	409 Gal.

F Sherwood #1	SW 33-33-37, Stevens Co.	435# R.P.	Volume 11,096,000 cu. ft.
G Watson #1	NW 27-34-40, Morton Co.	430# R.P.	Volume 4,435,000 cu. ft.
H Littell #1	SE 24-34-40, "	429# R.P.	Volume 4,158,000 cu. ft.
I Crawford #1	SE 9-32-37, Stevens Co.	435# R.P.	Volume 11,062,000 cu. ft.
J Moon #1	NW 30-32-37, Stevens Co.	432# R.P.	Volume 11,605,000 cu. ft.

Average of the above ten wells

Carbon dioxide	.10%
Oxygen	.20
Methane	67.85
Ethane	17.25
Butane Higher	1.46
Nitrogen	13.14
Specific Gravity	.728
B.T.U. Gross	1038
Gasoline content	419 Gal. pr. million
Rock Pressure	431.3#
Volume	7,161,700 cu. ft.

SUPPLEMENT B

Summary Chemical Analyses
Hugoton Gas Field (continued)

U.S. Government Analysis Carpenter Well, Stevens County, 29-33-367.

Carbon dioxide	.15%
Oxygen	.13
Methane	69.68
Ethane	18.33
Nitrogen	11.60
Helium	.35

Fort Worth Laboratories and University of Kansas
Analyses of Hugoton Gas

	#1	#2
Carbon dioxide	.20%	.20%
Oxygen	.20	.20
Methane	67.90	68.62
Ethane	16.80	17.14
Nitrogen	14.90	13.94

Average Results

	<u>Others</u>	<u>Surfs</u>
Carbon dioxide	.20%	.10%
Oxygen	.20	.20
Methane	68.62	67.85
Ethane	17.14	18.71
Nitrogen	13.94	13.24

Note: All wells closed in

Supplement E

Analyses of Gas
from
Miscellaneous

	A	PLATE B
Carbon dioxide	trace	0.23%
Oxygen	0.00%	0.21
Methane	62.75	74.45
Ethane	23.56	19.27
Residue	<u>7.69</u>	<u>5.84</u>
	100.00%	100.00%

B.T.U. 1109 1092

A Jones-Lehman #1 SE NE 35-22-2W

B Boyle & Grosman-Smith #1

PLATE I

GAS FIELDS OF KANSAS

The fields of greatest actual and potential gas production are located in (1) southwestern Kansas, including Stevens, Morton, Stanton, Grant, Haskell and Seward counties, and (2) in central Kansas, McPherson County. Large gas production may be found along the "Ellsworth arch" in Ellsworth, Rice and Reno counties.

The eastern Kansas fields have produced for many years and are not of great importance in potential future yield. A considerable area not shown on this map has been productive of gas in the past.

GAS FIELDS OF KANSAS

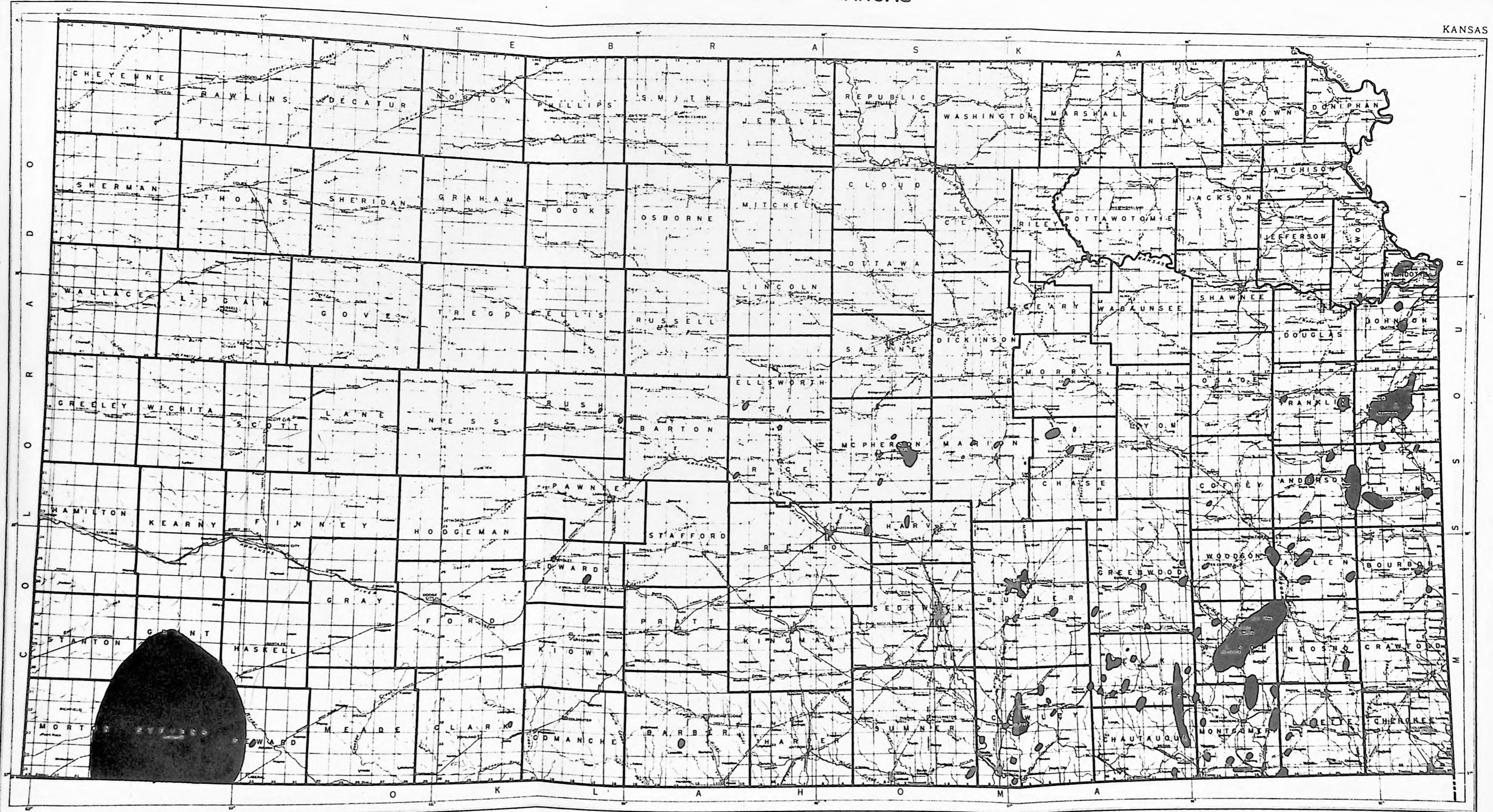


PLATE II

GAS PIPE LINES OF KANSAS

This map shows the location of existing gas pipe lines in Kansas and those in process of construction (represented by dashed line). Several of the lines are large trunk lines that connect the Amarillo gas field with eastern and northern markets, but most of these supply Kansas towns along their route.

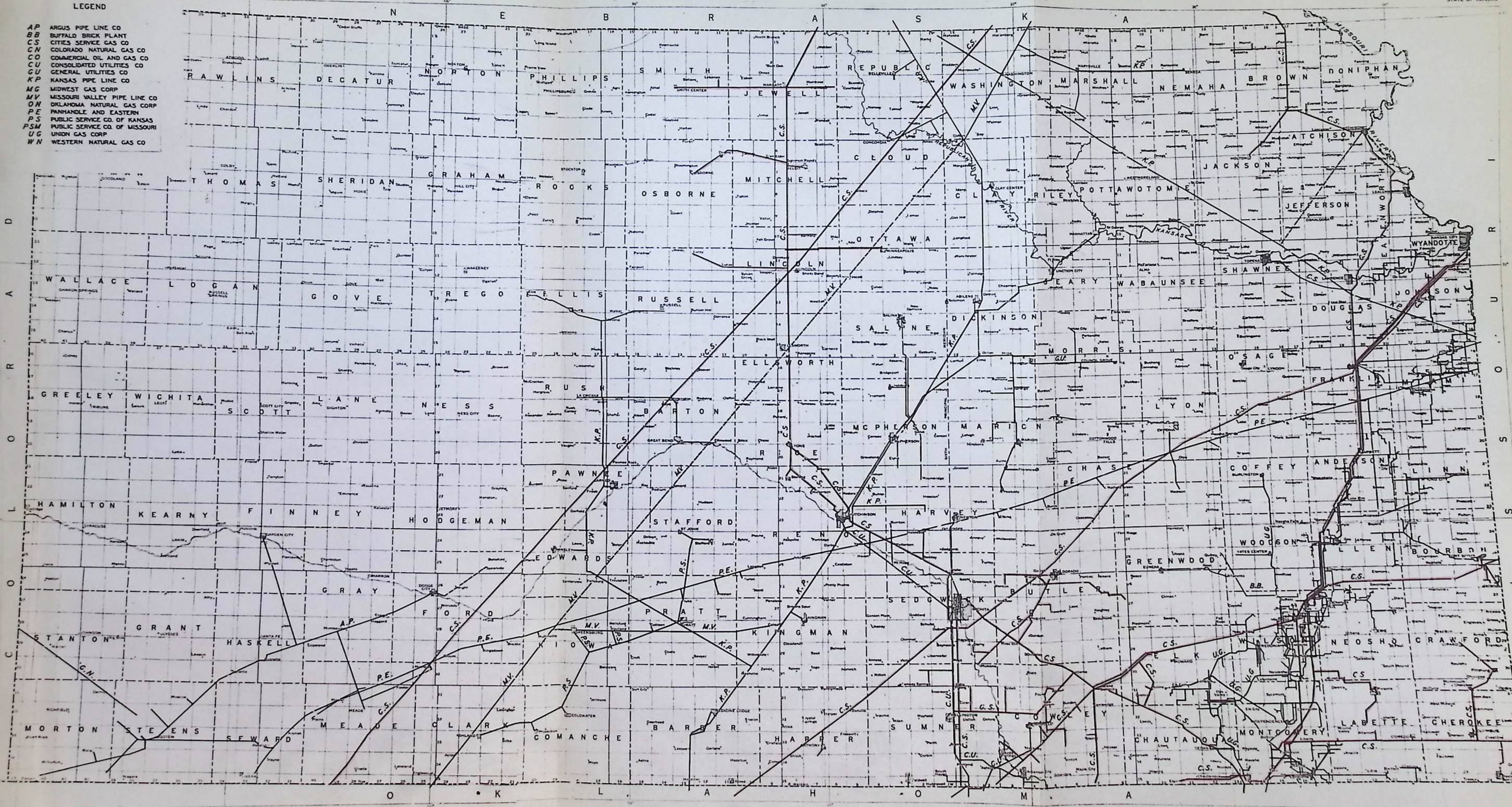
The Cities Service system is shown in red.

(Data mainly from J. Studebaker, Kansas Public Service Commission)

GAS PIPE LINES OF KANSAS

LEGEND

- AP ARGUS PIPE LINE CO
- BB BUFFALO BRICK PLANT
- CS CITIES SERVICE GAS CO
- CN COLORADO NATURAL GAS CO
- CO COMMERCIAL OIL AND GAS CO
- CU CONSOLIDATED UTILITIES CO
- GU GENERAL UTILITIES CO
- KP KANSAS PIPE LINE CO
- MG MIDWEST GAS CORP
- MV MISSOURI VALLEY PIPE LINE CO
- ON OKLAHOMA NATURAL GAS CORP
- PE PANHANDLE AND EASTERN
- PS PUBLIC SERVICE CO OF KANSAS
- PSM PUBLIC SERVICE CO OF MISSOURI
- UG UNION GAS CORP
- WN WESTERN NATURAL GAS CO



- ★ City
- ☆ County Seat
- Town
- Township
- ▭ Section
- ▬ Section Line
- ▬ Township Line
- ▬ County Line
- ▬ State Line

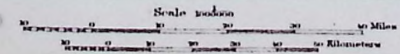
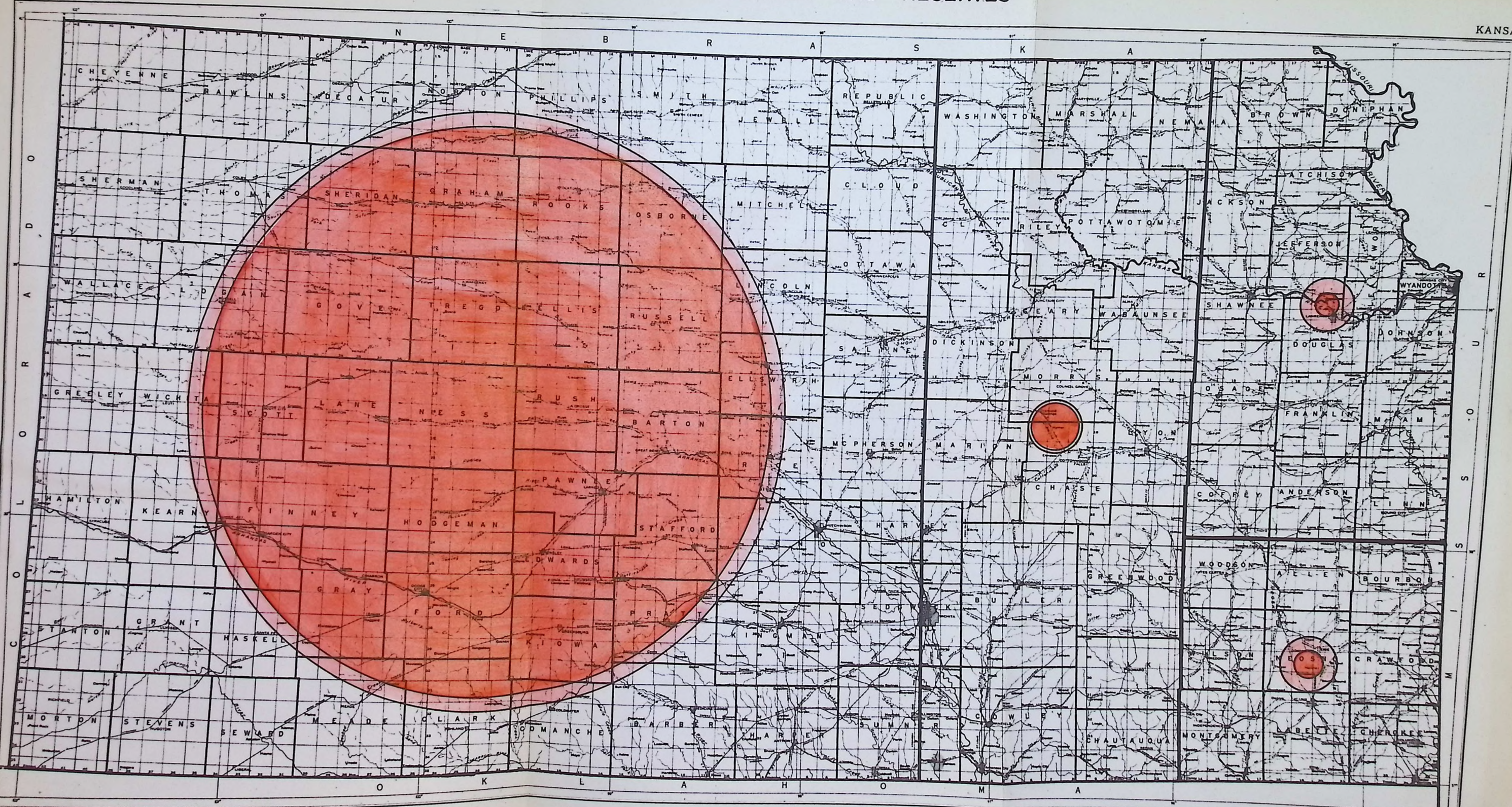
PLATE III

PROVED AND PROBABLE GAS RESERVES OF KANSAS

The area of the colored circles in each district represents the proved and probable reserves of natural gas as indicated in this report. The scale is uniform, and therefore a graphic comparison of the reserves of known fields in different parts of the state is given. The boundaries of the districts as here employed are shown by heavy lines.

The western Kansas Reserves far outweigh those of all of the other districts combined. See Table I for volume of the proved and probable reserves by districts. The smaller circle in each district represents the Proved Reserve, and the larger one represents the Probable Reserve.

PROVED AND PROBABLE GAS RESERVES



- ★ Town Center
- County Seat
- City
- Village
- Hamlet
- Precinct

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STATE GEOLOGIST