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BULLETIN 104

OIL AND GAS IN EASTERN KANSAS

By

JOHN MARK JEWETT

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CONTENTS

PAGE

ABSTRACT 9
INTRODUCTION 9
Purpose and scope of report 11
Previous publications 15
Other mineral resources of eastern Kansas 16
Acknowledgments 17
HISTORY OF OIL AND GAS DEVELOPMENTS IN EASTERN KANSAS 18
SECONDARY RECOVERY OF OIL 27
PETROLEUM GEOLOGY OF EASTERN KANSAS 35
Stratigraphy 36
Outcropping rocks 36
Quaternary and Tertiary deposits 36
Cretaceous rocks 37
Igneous rocks 37
Permian and Pennsylvanian rocks 37
Mississippian rocks 40
Buried rocks 42
Cretaceous rocks 43
Permian and Pennsylvanian rocks 43
Mississippian rocks 51
Devonian and Silurian rocks 52
Ordovician and Cambrian rocks 52
Pre-Cambrian rocks 56
Structural geology and structural provinces 59
Pre-St. Peter structural provinces 59
Post-St. Peter pre-Chattanooga structural provinces 61
Chautauqua arch 61
North Kansas basin 63
Mississippian and later structural provinces 63
Nemaha anticline 63
Forest City basin, Bourbon arch, and Cherokee basin 64
Salina basin 66
Sedgwick basin 66
Prairie Plains monocline 67
Minor structural features 67
Some representative oil fields in eastern Kansas 68
Big Lake field, Miami County 69
Bush City field, Anderson County 70
Coffeyville field, Montgomery County 71
Davis Ranch pool, Wabaunsee County 72
Elbing field, Butler and Marion Counties 73
Hittle field, Cowley County 73
Virgil field, Greenwood County 75
INDEX OF OIL-FIELD NAMES FOR PRODUCING ROCKS 76
ALLEN COUNTY 91
ANDERSON COUNTY 96

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PAGE
Atchison County 104
Bourbon County 107
Brown County 112
Butler County 117
Chase County 134
Chautauqua County 143
Cherokee County 149
Clay County 152
Coffey County 159
Cowley County 165
Crawford County 182
Dickinson County 186
Doniphan County 190
Douglas County 193
Elk County 202
Franklin County 208
Geary County 213
Greenwood County 218
Jackson County 230
Jefferson County 234
Johnson County 239
Labette County 245
Leavenworth County 252
Linn County 265
Lyon County 271
Marion County 278
Marshall County 285
Miami County 288
Montgomery County 295
Morris County 303
Nemaha County 308
Neosho County 313
Osage County 319
Pottawatomie County 326
Riley County 330
Shawnee County 336
Wabaunsee County 340
Washington County 348
Wilson County 351
Woodson County 356
Wyandotte County 363
Index 393

ILLUSTRATIONS

PLATE PAGE
1. View on the Trapshooter lease, El Dorado oil field, July 1917 122

FIGURE
1. Map of eastern Kansas showing location of eastern Kansas counties and oil-producing areas 10

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FIGURE		PAGE
2.	Map of eastern Kansas showing locations of secondary recovery projects operated in 1952	28
3.	Generalized section of outcropping lower Permian rocks in Kansas	38
4.	Generalized section of outcropping Virgilian rocks in Kansas	39
5.	Generalized section of outcropping Missourian and upper Desmoinesian rocks in Kansas	40
6.	Generalized section of outcropping Cherokee rocks in Kansas	41
7.	Generalized sections of subsurface rocks in three eastern Kansas areas	42
8.	Map of Kansas showing thickness of Pennsylvanian and Permian rocks	43
9.	Map of eastern Kansas showing the approximate configuration of the upper surface of Pre-Cambrian rocks	58
10.	Sketch map of Kansas showing inferred post-Devonian pre-Mississippian areal geology	60
11.	Sketch map showing main structural elements in Kansas during Mississippian time	61
12.	Sketch map showing early Pennsylvanian structural provinces in Kansas	64
13.	Diagram of geologic conditions in a part of the "Big Lake" oil field, Miami County	69
14.	Map of a part of Anderson County showing location and shape of the Bush City oil field and diagrammatic cross sections showing geologic conditions in the field	70
15.	Diagram of geologic conditions in the Elbing oil field, Butler and Marion Counties	73
16.	Map of the Hittle oil field, Cowley County, showing structure of the surface rocks	74
17.	Diagram of geologic conditions in the Virgil oil field, Greenwood County	75
18.	Map of Allen County	94
19.	Map of Anderson County	101
20.	Map of Atchison County	107
21.	Map of Bourbon County	111
22.	Map of Brown County	115
23.	Map of Butler County	125
24.	Map of Chase County	138
25.	Map of Chautauqua County	146
26.	Map of Clay County	156
27.	Map of Coffey County	163
28.	Map of Cowley County	171
29.	Map of Crawford County	185
30.	Map of Dickinson County	189
31.	Map of Doniphan County	192
32.	Map of Douglas County	197
33.	Map of Elk County	206
34.	Map of Franklin County	212
35.	Map of Geary County	216
36.	Map of Greenwood County	222
37.	Map of Jackson County	232
38.	Map of Jefferson County	236

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FIGURE PAGE
39. Map of Johnson County ... 243
40. Map of Labette County ... 249
41. Map of Leavenworth County ... 255
42. Map of Linn County ... 270
43. Map of Lyon County ... 276
44. Map of Marion County ... 278
45. Map of Marshall County ... 285
46. Map of Miami County ... 288
47. Map of Montgomery County ... 295
48. Map of Morris County ... 303
49. Map of Nemaha County ... 308
50. Map of Neosho County ... 313
51. Map of Osage County ... 319
52. Map of Pottawatomie County ... 326
53. Map of Riley County ... 330
54. Map of Shawnee County ... 336
55. Map of Wabaunsee County ... 340
56. Map of Washington County ... 348
57. Map of Wilson County ... 351
58. Map of Woodson County ... 356
59. Map of Wyandotte County ... 363

TABLES

TABLE PAGE
1. Recent oil and gas discoveries in eastern Kansas, 1949 through approximately the first half of 1953 ... 11
2. Oil production in eastern Kansas counties, 1889 through 1940 ... 20
3. Oil production in eastern Kansas counties, 1941 through 1952 ... 22
4. Data on secondary recovery projects in eastern Kansas ... 29
5. Depths to some stratigraphic horizons in the "Iola deep well," Allen County ... 93
6. Depths to some stratigraphic horizons in the Lambert et al. No. 1 Wiggin well, Anderson County ... 98
7. Depths to some key horizons in the Earl F. Wakefield et al. No. 1 National Life Insurance Company well, Atchison County ... 105
8. Data on wells drilled for oil and gas in Atchison County ... 106
9. Depths to some stratigraphic horizons in the Oklahoma Natural Gas Corporation No. 1 Stephenson well, Bourbon County ... 109
10. Depths in feet to some key horizons in six wells in Brown County ... 113
11. Data on wells drilled for oil and gas in Brown County ... 116
12. Depths to some stratigraphic horizons in the Deforrest Drilling Company No. 1 Nibel well, Butler County ... 120
13. Data on dry wildcat wells drilled in Butler County, 1949 through 1952 131
14. Depths in feet to some stratigraphic horizons in two Chase County wells 136
15. Data on dry wildcat wells drilled in Chase County, 1949 through 1952 141
16. Depths to some stratigraphic horizons in the Prairie Oil and Gas Company No. 9 Gordon Brown well, Chautauqua County ... 144
17. Depths to some stratigraphic horizons in two Cherokee County wells.. 150
18. Depths to some stratigraphic horizons in five Clay County wells ... 153
19. Data on wells drilled for oil and gas in Clay County ... 157

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TABLE		PAGE
20.	Depths in feet to some stratigraphic horizons in two Coffey County wells	161
21.	Data on dry wildcat wells drilled in Coffey County, 1949 through 1952	165
22.	Depths in feet to some stratigraphic horizons reached in the Phillips Petroleum Company No. 1 Eckhart well, Cowley County	167
23.	Data on dry wildcat wells drilled in Cowley County, 1949 through 1952	180
24.	Depths to some key horizons in the La Salle Oil Company No. 1 J. Gobl well, Crawford County	183
25.	Depths in feet to some stratigraphic horizons in two Dickinson County wells	187
26.	Data on dry wildcat wells drilled in Dickinson County, 1949 through 1952	190
27.	Depths to some horizons in the Jack Garden Construction Company No. 1 Ross Elliott well, Doniphan County	191
28.	Data on wells drilled for oil and gas in Doniphan County	193
29.	Depths in feet to some stratigraphic horizons in six Douglas County wells	196
30.	Data on wells drilled for oil and gas in Douglas County	198
31.	Depths to some key horizons in the Halstead and Company No. 1 Osborne well, Elk County	203
32.	Depths to some stratigraphic horizons in the B. O. Hollett No. 1 Koontz well, Franklin County	210
33.	Depths in feet to some horizons in three wells in Geary County	215
34.	Wells drilled for oil and gas in Geary County	217
35.	Depths to key horizons in the Burge, Trott et al. No. 1 Breitkrautz well, Greenwood County	219
36.	Data on dry wildcat wells drilled in Greenwood County, 1949 through 1952	228
37.	Depths in feet to some key horizons in five wells in Jackson County	231
38.	Data on wells drilled for oil and gas in Jackson County	233
39.	Depths to some stratigraphic horizons in the J. B. Apperson et al. No. 1 Bower well, Jefferson County	235
40.	Data on dry wildcat wells in Jefferson County (dry holes outside McLouth area)	237
41.	Depths at which some key horizons were reached in four wells in Johnson County	241
42.	Data on recent wells in Johnson County	244
43.	Depths in feet to some stratigraphic horizons in two Labette County wells	247
44.	Depths in feet to some horizons in two Leavenworth County wells	254
45.	Data on wells drilled for oil and gas in Leavenworth County	257
46.	Depths to some key stratigraphic horizons in the Holeman and Edwards No. 9 Pollman well, Linn County	267
47.	Data on dry wildcat wells drilled in Lyon County, 1949 through 1952	274
48.	Data on dry wildcat wells drilled in Marion County, 1949 through 1952	283
49.	Depths to some stratigraphic horizons in the B. B. Blair No. 1 Cox well, Marshall County	286
50.	Data on wells drilled for oil and gas in Marshall County	287

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TABLE PAGE

51. Depths to some stratigraphic horizons encountered in five wells in Miami County 291
52. Depths in feet to some stratigraphic horizons in three Montgomery County wells 297
53. Data on dry wildcat wells drilled in Morris County, 1949 through 1952 307
54. Depths in feet to some stratigraphic horizons in five Nemaha County wells 309
55. Data on wells drilled for oil and gas in Nemaha County 311
56. Depths in feet to some stratigraphic horizons in three Neosho County wells 315
57. Depths in feet at which some stratigraphic horizons were reached in two wells in Osage County 321
58. Data on wells drilled for oil and gas in Osage County 323
59. Depths in feet to some stratigraphic horizons in three wells in Pottawatomie County 327
60. Data on wells drilled for oil and gas in Pottawatomie County 329
61. Depths in feet to some stratigraphic horizons in five Riley County wells 333
62. Data on wells drilled for oil and gas in Riley County 335
63. Depths at which some key stratigraphic horizons were reached in three wells in Shawnee County 337
64. Data on wells drilled for oil and gas in Shawnee County 339
65. Depths to some key horizons in four wells in Wabaunsee County 343
66. Data on dry wildcat wells drilled in Wabaunsee County 345
67. Depths to some key horizons in the Gulf Oil Corporation No. 1 Baker well, Washington County 349
68. Data on wells drilled for oil and gas in Washington County 351
69. Depths in feet to some stratigraphic horizons in the No. 3 Marion Smith well, Wilson County 352
70. Depths to some stratigraphic horizons in the Reinhart and Donivan No. 1 Eades well, Woodson County 357
71. Depths to some stratigraphic horizons in the Benson-Ruf-Gabrel well, Wyandotte County 364
72. Data on wells drilled for oil and gas in Wyandotte County 367
73. Oil production in eastern Kansas counties, 1949 through 1952 ..... *In pocket*

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OIL AND GAS IN EASTERN KANSAS

by JOHN MARK JEWETT

ABSTRACT

Eastern Kansas as the term is used in this report includes 43 counties that lie wholly east of the 6th Principal Meridian, the line of division between east and west ranges in Kansas. Oil and gas were discovered in Kansas in 1860, in Miami County. It was not until 1923 that oil was found in western counties. The State first produced more than a million barrels of oil in 1904. Peak production in eastern Kansas, amounting to more than 45¼ million barrels, was reached in 1918. In 1952 the eastern counties produced 23,998,319 barrels of oil and more than 2,448,133 thousand cubic feet of gas. Oil production was reported in 28 counties.

The exposed consolidated rocks in eastern Kansas are Cretaceous, Permian, Pennsylvanian, and Mississippian in age. In general the exposed rocks dip gently to the west. Subsurface geologic conditions are complex because of the presence of several structural elements of which the Nemaha anticline is the most prominent.

Each of the 43 counties is treated separately. Brief descriptions of the surface and subsurface geology are included and oil and gas developments are discussed. Tables show annual oil production in the various counties and yearly production in the fields during the period 1949 through 1952. This report is a revision of "Oil and Gas in Eastern Kansas," published in 1945 and 1949 as State Geological Survey of Kansas Bulletins 57 and 77.

INTRODUCTION

In Kansas 43 counties lie wholly east of the 6th principal meridian, 97° 23′ 00″ west longitude, the line that separates east and west land ranges in the State. For convenience these counties are said to comprise "eastern Kansas" (approximately one-third of the State). The remaining part is designated "western Kansas" in Geological Survey oil and gas reports. Figure 1 is a map of Kansas showing locations of "eastern Kansas" counties.

For many years (after the middle or late 1920's) eastern Kansas was regarded as of minor importance as an oil-producing area. For the last several years, however, these eastern counties have received somewhat extraordinary attention. The reason for the change may be attributed to several factors. Improved methods

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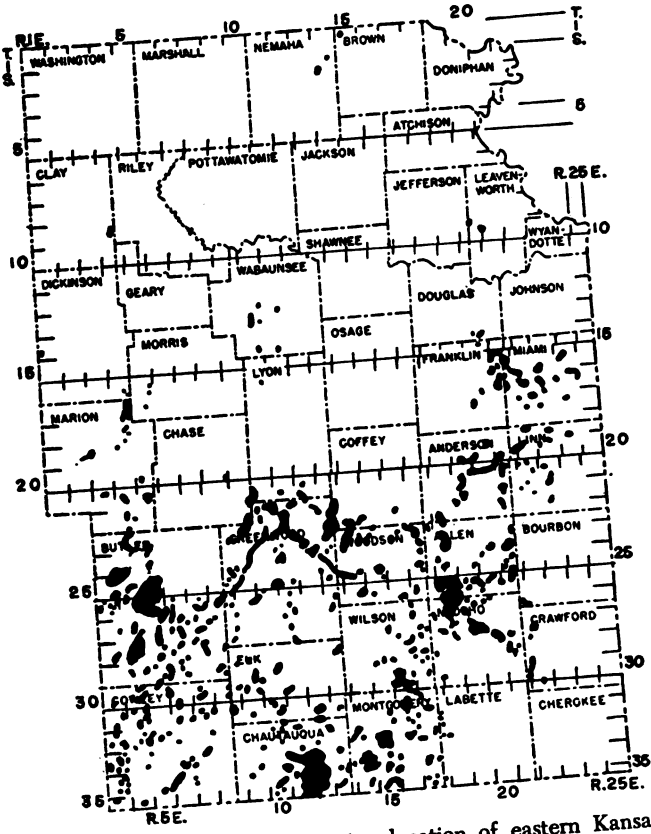

FIG. 1.—Map of eastern Kansas showing location of eastern Kansas counties and oil-producing areas.

of secondary recovery in fields that have been nearly depleted by primary production methods have brought many old fields back to the levels of "peak production." Successful well completions by newly developed methods in the known prolific zones as well as successful completions of producers in largely untested deeper rocks during the last few years have brought about the re-examination of the whole area. The renewed interest has resulted in investigations for favorable oil structures by surface mapping, by core drilling, and by geophysical methods. This has led to the drilling of an extraordinarily large number of wildcat wells in recent years and to important discoveries. Newly developed rock-fracturing methods are allowing the completion of many wells that would have been abandoned as dry holes under older methods.

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Pool discoveries in eastern Kansas counties from 1949 through about the first half of 1953 are listed in Table 1. Data on oil production by counties are listed in Tables 2 and 3.

Purpose and scope of report.—This is the third edition of "Oil and Gas in Eastern Kansas." It supplements, in bringing statistical data on developments up to the close of 1952, the other two bulletins (Jewett and Abernathy, 1945; Jewett, 1949). Like the other reports it contains descriptions of the geology of oil and gas in each of the 43 counties in Kansas that lie east of the 6th principal meridian. This report contains a somewhat more detailed discussion

TABLE 1.—*Recent oil and gas discoveries in eastern Kansas, 1949 through approximately the first half of 1953*

Pool and location of discovery well	Name of discovery well	Producing zone	Depth to producing zone, feet	Month and year opened	Initial production per day, bbls.
		Butler County			
Bare 31-28-5E	White and Ellis Drlg. Co. No. 1 Bare	"Bartlesville"	2,778-2,789	June 1952	11
Brickley 2-27-7E	Dunne and Straight No. 1 Lucas	"Bartlesville"	2,636	Nov. 1951	35
Brickley Southwest 3-27-7E	K. T. Wiedemann No. 1 Lucas	"Bartlesville"	2,699-2,732	Sept. 1952	20
Butwick 7-26-3E	J. P. Gaty No. 1 Demoss	Mississippian	2,860-2,866	Apr. 1949	3,000 maximum
Butwick Northeast 7-26-3E	Penguin Petro., Inc. No. 1 Holder	Mississippian	2,804-2,840	Apr. 1949	50
Edgecomb 9-25-3E	Eckland Drlg. Co. No. 1 Nieman	Mississippian	2,759-2,760	Aug. 1951	25
Elbing East 27-23-4E	S. A. Springer No. 1 Mellor	Lans.-K. C.	1,799-1,805	May 1950	30
Four Mile Creek 5-28-3E	Wm. L. Graham and J. P. Gaty No. 1 Graham "A"	Simpson	3,069-3,072	Jan. 1951	2,068
Hartenbower 16-29-6E	McClure-Braden et al. No. 1 Hartenbower	"Peru"	2,404-2,480	Aug. 1950	30
Hartenbower South 16-29-6E	R. W. Holcomb No. 1 Price	Lans.-K. C.	2,060-2,072	June 1951	25
Hazlett North 30-23-5E	Rex and Morris Drlg. Co. No. 1 Ammeter	Mississippian	2,462-2,472	May 1949	35
Long 15-26-7E	Dilworth S. Hager No. 1 Reiserer	Mississippian	2,770-2,887	Aug. 1949	25
Muddy Creek 13-29-4E	Marhenke Drlg. Co. No. 1 Doyle	"Bartlesville"	2,813-2,830	May 1950	40
Murdock 23-25-3E	Wixson Drlg. Co. No. 1 Brainerd	Mississippian	2,709-2,719	Feb. 1952	10
Parsley 3-26-3E	Rex and Morris Drlg. Co. et al. No. 1 Parsley	Mississippian	2,695-2,716	Jan. 1949	45

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TABLE 1.—*Recent oil and gas discoveries in eastern Kansas, 1949 through approximately the first half of 1953, continued*

Pool and location of discovery well	Name of discovery well	Producing zone	Depth to producing zone, feet	Month and year opened	Initial production per day, bbls.
Pierce West 20-25-4E	Rex and Morris Drlg. Co. No. 1 Sparks	Mississippian	2,515-2,525	Mar. 1951	20
Rombold 4-26-3E	K. T. Wiedemann No. 1 Rombold	Mississippian	2,764-2,771	Sept. 1949	30
Whitewater 32-25-4E	Rex and Morris Drlg. Co. and E. H. Adair Oil Co. No. 1 McCullough	Viola	2,645-2,656	Apr. 1949	50
Whitewater North 29-25-4E	Rex and Morris Drlg. Co. No. 1 Johnson	Viola	2,700-2,702	Mar. 1951	35
	Chase County				
Bazaar 36-20-8E	Morrison Drlg. Co. No. 2 Norton	Lans.-K. C.	1,823-1,827	Mar. 1951	12
	Clay County				
Wakefield Northeast 15-9-4E	K. I. Turner No. 1 Tannehill	Mississippian	1,904-1,911	May 1951	6
	Coffey County				
Finnerty 12-21-13E	F. E. Lockhart and George Waite No. 1 Finnerty	"Burgess"	1,728-	July 1953	38
	Cowley County				
Arkansas City West 23-34-3E	Aylward Drlg. Co. No. 1 Land-Power	"Bartlesville"	3,291-3,295	April 1952	58
Bergkamp 6-35-4E	Smitherman-Cohen Drlg. Co No. 1 Bergkamp	"Bartlesville"	3,202-3,225	Feb. 1952	74
Bergkamp Northwest 6-35-4E	Flossmar Oil and Gas Co. No. 1 Maurer-Neuer	"Bartlesville"	3,208-3,211	Nov. 1952	25
Bogner 24-31-7E	Palmer Oil Corp. No. 1 Bogner	Mississippian	2,999-3,053	Mar. 1952	25
Brown West 14-31-7E	Kenner and High No. 1 Brown	Douglas	1,568-1,600	June 1951	2,000 M cu. ft. gas
Burden East 33-31-6E	The Texas Co. No. 1 Jarvis	Kansas City ("Layton")	2,194	April 1953	80
Cabin Valley 31-33-6E	Crest Petro., Inc. No. 1 Berry	"Layton"	2,188-2,197	June 1952	25
Canfield 13-34-3E	Aylward Drlg. Co. No. 1 Canfield	"Bartlesville"	3,375-3,379	May 1952	13
Centennial 12-33-3E	Laura Jane Oil Co. No. 1 Allen	"Bartlesville"	3,231-3,265	April 1953	25
Copeland 5-35-4E	Spencer and Tobias No. 1 Copeland	Mississippian	3,211-3,224	Dec. 1952	2
David Northwest 10-31-4E	McNeish and Gralapp No. 1 O'Hara	"Bartlesville"	2,930-	June 1953	50
Dutch Creek 35-31-4E	Helmerich and Payne No. 1 Stucky	"Bartlesville"	2,924-2,938	Dec. 1952	2
Enterprise Northeast 35-33-3E	Helmerich and Payne No. 1 Wright "F"	"Bartlesville"	3,335-3,347	Sept. 1952	443
Enterprise Southwest 3-34-3E	Drillers Production Co., Inc. No. 1 Godfrey	"Bartlesville"	3,360-	May 1953	42

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Ferguson Northwest 16-30-8E	A. H. Reneau No. 1 "A" Ferguson	Kansas City	2,200-2,211	Jan. 1950	45
Fussell 14-34-3E	Crest Drlg. Co. No. 1 Fussell	"Bartlesville"	3,348-3,360	Oct. 1952	50
Gibson South 32-34-3E	The Texas Co. No. 1 L. M. Bryant	"Bartlesville" now combined with Gibson	3,383-3,388	Feb. 1952	80
Grouse Creek 16-30-7E	K. T. Wiedemann No. 1 Lee	Mississippian	2,890-2,917	Aug. 1951	15
Harvey 23-34-3E	Martin and Cash Drlg. Co. No. 1 Harvey	"Bartlesville"	3,278-3,296	July 1952	2,382
Harvey Northwest 15-34-3E	Smitherman and Cohen No. 1 Oglesbee	"Bartlesville" now combined with Harvey	3,298-3,318	Oct. 1952	3,000 (maximum)
McKay 17-35-4E	Smitherman and Cohen No. 1 McKay	"Bartlesville"	3,314-3,315	Nov. 1951	138
Maddix 13-33-5E	Wentworth and Son No. 1 Maddix	Mississippian	3,084-	Jan. 1953	8
Mansur 25-31-6E	G. T. Lackey No. 1 Mansur	"Layton" and Kansas City	2,170-2,489	Sept. 1949	1,180 M cu. ft. gas
New Salem 21-31-5E	Earl F. Wakefield and Bridgeport Oil Co., Inc. No. 1 "B" Roberts	"Layton"	2,295-2,309	June 1949	1,500 M cu. ft. gas
Nigger Creek 22-34-3E	Crest Drlg. Co. and Natl. Coop. Ref. Assoc. No. 1 Morgan	"Bartlesville	3,281-3,302	Nov. 1951	35
Rahn Northeast 27-33-6E	Woods Drlg. Co. No. 1 Fry	"Bartlesville"	2,902-2,934	May 1949	120
Silver Creek 12-32-5E	McNeish and Gralapp et al. No. 1 Miller	"Bartlesville"	3,006-	Feb. 1953	75
Stayton 32-32-4E	K. T. Wiedemann No. 1 Stayton	"Bartlesville"	3,122-3,129	June 1949	12
Stayton South 5-33-4E	Laura Jane Oil Co., Inc. No. 1 Hoornbeck	"Bartlesville"	3,165-	June 1953	234
Turner West 25-32-5E	Coop. Ref. Assn. and E. F. Wakefield No. 1 Abildgard	Mississippian	3,054 (top)	Mar. 1952	16
		Greenwood County			
Burt 8-26-11E	Ward A. McGinnis No. 1 Eastman	Mississippian	1,865-1,878	June 1949	30
Eureka West 33-25-10E	Penn-Farr No. 1 Hughes	Mississippian	1,979-1,995	Sept. 1949	15
Honey Creek 32-26-11E	C. W. Darling No. 1 Johnson	Mississippian	1,871-1,876	Aug. 1950	30
Morris 28-24-13E	E. L. Edwards No. 1 Kimball	Mississippian	1,671-1,676	Sept. 1950	12
Tonovay West 33-25-11E	Harold Butler and L. E. Jones No. 1 Hall	Mississippian	1,948-1,977	June 1950	60
Verdigris 2-24-12E	Susmio Oil Co. No. 1 W. Jones	Mississippian	1,760-	Dec. 1952	7
Zimmermann 19-23-10E	Ward A. McGinnis No. 2 Zimmermann	"Bartlesville"	2,296-	Jan. 1953	25
		Lyon County			
Bradfield Northwest 13-21-10E	White and Ellis Drlg. Co. No. 1 Jones	Viola	2,527	June 1953	25
Bushong 26-16-10E	Stanolind Oil and Gas Co. No. 1 Cornwell	"Hunton"	2,950-2,967	April 1950	257

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TABLE 1.—*Recent oil and gas discoveries in eastern Kansas, 1949 through approximately the first half of 1953, concluded*

Pool and location of discovery well	Name of discovery well	Producing zone	Depth to producing zone, feet	Month and year opened	Initial production per day, bbls.
		Marion County			
Biscuit Hill 33-21-4E	W. R. Atkinson et al. No. 1 Brown	Mississippian	2 269-2 275	Mar. 1952	3
Cedar Creek 31-20-5E	R. Gear No. 1 Robinson	Viola	2,563½-2,566	June 1950	18
Durham 34-18-2E	Anderson-Prichard Oil Corp. No. 1 "A" Scully	Viola	2,899-	Mar. 1953	202
Edmonds 31-22-4E	K. T. Wiedemann No. 1 Edmonds	Mississippian	2,471-	Mar. 1953	25
Lehigh North 23-19-1E	Anderson-Prichard Oil Corp. No. 1 Waseemiller	Mississippian	2,765-	Jan. 1953	2,500 M cu. ft. gas
Quarry Siding 16-19-4E	H. B. Ratzlaff et al. No. 1 Groening	Mississippian	2,302-	July 1953	22
Shank 12-22-3E	Aladdin Petro. Corp. No. 1 Burton	Mississippian	2,474-2,501	July 1952	75
		Morris County			
Burdick 15-17-5E	S. P. Loomis No. 1 Atkinson	Mississippian	2,232-2,277	Sept. 1949	25
Three Mile Creek 25-16-5E	Edward A. Koester and J. F. Mergen No. 1 Burns	Mississippian	2,208-2,252	June 1950	40
Three Mile Creek South 35-16-5E	R. Loriaux No. 1 Grass	Mississippian	2,183-2,207	Oct. 1950	60
		Nemaha County			
Sabetha 13-2-14E	Carter Oil Co. No. 1 Oreon Strahm	"Hunton"	2 826-2,834	Oct. 1950	319
Strahm East 26-2-14E	O. O. Wallace and Fred Hewitt No. 1 Edelman	"Hunton"	2,826-	June 1953	25
		Wabaunsee County			
Davis Ranch 33-13-10E	Carter Oil Co. No. 1 Davis	Viola	3,201-3,206	May 1949	2,580
Davis Ranch East 34-13-10E	Aladdin Petro. Corp. No. 1 Schutter	Viola	3,305-3,314	Jan. 1950	25
Mill Creek 2-13-10E	Skelly Oil Co. No. 2 Thowe	Viola	2,923-2,927	Sept. 1950	3,000
Newbury 11-11-11E	Skelly Oil Co. No. 1 Fearon	Simpson	2,901-2,904	Sept. 1950	254
Wheat 10-15-11E	Carter Oil Co. No. 1 Helen Wheat	Viola	3,230-3,234	May 1951	40
Woodbury 11-15-10E	Carter Oil Co. No. 2 Woodbury	Viola	3,323-3,328	Jan. 1951	108
		Woodson County			
Batesville Southwest 32-25-14E	C. W. Darling No. 1 Hare	Lans.-K. C.	677-692	June 1949	6
Steele 20-23-15E	Moreland and Harris No. 1 Steele	Mississippian	1,525-1 542	May 1952	15
Zlab 9-24-14E	White and Ellis Drlg. Co. No. 1 Zlab	Mississippian	1,655-1,656	June 1949	5½

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of the petroleum geology of eastern Kansas than was included in the preceding volumes of this series.

Previous publications.—For many years the State Geological Survey has published reviews of oil and gas developments and descriptions of petroleum geology of Kansas. Oil and gas production statistics were included in a series on the "Mineral Resources of Kansas" which were published for the years 1897 to 1903 inclusive (Haworth, 1898, 1899, 1900, 1902, 1903, 1904). The first comprehensive Survey publication on oil and gas was issued in 1908 (Haworth, 1908). The development of shallow oil and gas in eastern Kansas was greatly facilitated by the publication of Bulletin 3 (Moore and Haynes, 1917). This was followed by Bulletin 6; five parts were published during the interval from 1920 to 1927 (Moore, 1920, 1920a; Moore and Elledge, 1920; Moore and Boughton, 1921; Charles, 1927).

More recently the Survey has published a more continuous series of reviews of oil and gas developments in the State. The first of these was prepared by Kesler in 1928. The second, written by Folger for 1928 and 1929 and Hall for 1930, was issued in 1933. Koester (1934) prepared the report covering 1931 and 1932. Ver Wiebe prepared annual Survey publications on oil and gas developments in western Kansas counties for the years 1937 to 1946 inclusive (Ver Wiebe, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947). Since 1947 these annual development reports, by Ver Wiebe and others (1948, 1949, 1950, 1951, 1952, 1953), have covered the entire State.

Bulletin 57 (Jewett and Abernathy, 1945) reviews oil and gas developments in eastern Kansas counties up to 1943. Bulletin 77 (Jewett, 1949) is a revision of the earlier report, containing in addition development statistics to the end of 1948. Bulletin 20 (Ockerman, 1935) contains results of studies of samples and logs of several wells and information on oil and gas possibilities in Atchison, Brown, Doniphan, Douglas, Jackson, Jefferson, Johnson, Leavenworth, Shawnee, Wabaunsee, and Wyandotte Counties.

Oil and gas in individual eastern Kansas counties have been discussed in several Survey publications. Counties treated are: Allen and Neosho (Moore and Elledge, 1920), Wilson and Montgomery (Moore and Boughton, 1921), and Anderson (Charles, 1927). Reports on the El Dorado oil and gas field (Fath, 1921) and Cowley County (Bass, 1929) are important contributions and were es-

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pecially comprehensive at the time of publication. A report on the origin of "shoestring sands" in Greenwood and Butler Counties (Bass, 1936) also is an important contribution to oil geology in eastern Kansas. A later series of county oil and gas reports with maps showing locations and stratigraphic depths of holes includes reports for Labette (Abernathy, 1939), Linn (Jewett, 1940a), and Montgomery Counties (Abernathy, 1940). A report on the geology of the Davis Ranch pool, Wabaunsee County, was issued in 1951 (Smith and Anders).

Cooperative investigations of the State Geological Survey and the Mineral Fuels Division of the Federal Geological Survey under the supervision of Wallace Lee have yielded several very important contributions to the knowledge of oil and gas geology in eastern Kansas (Lee, 1941, 1943; Lee and Payne, 1944; Lee, Leatherock, and Botinelly, 1948). United States Geological Survey Oil and Gas Investigations, Preliminary Map 48 (Lee and others, 1946) shows the geologic development of the Forest City basin chiefly by means of maps showing thicknesses of various stratigraphic units.

In 1951 the Geological Survey introduced a series of reports treating the stratigraphy, economic geology, and ground-water geology of individual eastern Kansas counties. Reports have been published for Chase County (Moore and others, 1951a) and Lyon County (O'Connor, Goebel, and Plummer, 1953). Reports covering Osage, Elk, Wilson, Douglas, and Greenwood Counties are now in preparation.

There are many important papers on the geology of eastern Kansas oil fields in various publications other than those of the Geological Surveys. References are made elsewhere in this paper to several of them and other titles are in the bibliography at the end of this report.

Other mineral resources of eastern Kansas.—In addition to oil and gas in eastern Kansas there are the lead and zinc deposits of the Tri-State district which includes part of Cherokee County; practically all the State's minable coal beds (Whitla, 1940; Bowsher and Jewett, 1943; Schoewe, 1944; Abernathy, 1944, 1946; Abernathy, Jewett, and Schoewe, 1947); raw materials for cement manufacture which are utilized in several plants; large supplies of ceramic raw material; virtually unlimited supplies of limestone, sand, and gravel; gypsum mined and processed in Marshall County; and fairly large reserves of asphalt rock in several counties (Jewett, 1940). The

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larger stream valleys contain abundant shallow ground water, and large supplies of fresh water are available in deep rocks in the southeast part of the State (Moore and others, 1940; Jewett and Schoewe, 1942; Abernathy, 1943, 1948; Fishel, 1948; Davis and Carlson, 1952; Walters, 1953).

Acknowledgments—Thanks are expressed to the large number of oil and gas operators who for many years have voluntarily cooperated with the Kansas Geological Survey. As a result of this logs of a large percentage of the wells that have been drilled in Kansas and drill cuttings and cores from a large number of wells are in the Survey files.

T. A. Morgan, J. P. Roberts, D. C. Lilley, and H. A. Beverlin of the Conservation Division of the State Corporation Commission have supplied information on oil runs. Wallace Lee has supplied considerable data concerning pre-Pennsylvanian rocks.

Special thanks are expressed to officials of the following organizations and individuals who are supplying the Geological Survey with monthly reports of oil purchases in the various eastern Kansas counties and fields: A. J. Becker; Marvin E. Boyer; Cities Service Oil Company; Continental Oil Company; Cooperative Refinery Association; Joplin Refining Company; Virgil Gamble; Kanotex Refining Company; Kansas City Testing Laboratory; Joe Maclaskey; W. L. Maclaskey; M. F. A. Oil Company; Sinclair Oil and Refining Company; Skelly Oil Company; Skiles Oil Corporation; Standard Oil Purchasing Company; Stekoll Petroleum Company; and White Eagle Purchasing Company.

Many people engaged in various phases of the petroleum industry in eastern Kansas have been helpful in giving data to the Geological Survey. Among these are C. E. Armstrong, Chet Blackwood, B. F. Brundred, Mack C. Colt, John A. Edwards, Thomas W. Lee, Carl L. Pate, W. L. Stryker, Charles W. Studt, and Earl A. Whitworth.

The cooperation in collecting data on secondary recovery operations of Albert E. Sweeney, Jr. of the Interstate Oil Compact Commission and of the Kansas Secondary Oil Recovery Committee is gratefully acknowledged.

For several years before his untimely death, early in 1948, George E. Abernathy of the Kansas Geological Survey, was especially interested and active in matters regarding eastern Kansas oil and gas. One of his greatest desires was to aid the industry in every possible

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way. Many people remember the status of information concerning the eastern Kansas petroleum industry that existed some years ago; to Dr. Abernathy must go the credit for formulating and putting into execution plans that have made it possible to present the more or less clear picture that we now have.

HISTORY OF OIL AND GAS DEVELOPMENTS IN EASTERN KANSAS

In 1860, the year following the discovery of oil in northwestern Pennsylvania, oil was discovered near Paola in Miami County, Kansas. It is believed that the first well drilled for the purpose of obtaining oil in Kansas was a 4-inch hole drilled near Paola during June 1860 to a depth of 100 feet. A second 100-foot well was put down on Wea Creek about 8 miles to the south. The third well drilled in 1860 is reported to have discovered oil. It was known as the David Lykins well, in the SW¼ sec. 15, T. 17 S., R. 23 E., and was bored to a depth of 275 feet. According to Haworth (1908, p. 25): "It was supposed that it would yield one barrel of oil per day." The advent of the Civil War halted oil-drilling activities in Miami County and near-by areas. However, several wells that yielded small amounts of both oil and gas were put down near Mound City in Linn County soon after the first drilling near Paola. During the 1860's gas and probably some oil were found in Wyandotte County within the present city limits of Kansas City, and it is recorded that prospecting was done in Bourbon, Shawnee, and Cherokee Counties.

In 1873, a diamond-drill hole 737 feet deep was put down at Iola in Allen County. Gas from this well was used to light a sanatorium in which mineralized water from the same well was used for medicinal purposes. In 1884, Paola was supplied with gas piped from a newly opened field about 7 miles east of town, and an area nearly surrounding the town was being drilled. The heavy dark oil that was produced was sold as lubricating oil at a price ranging from $3.00 to $5.00 a barrel. In 1886 or soon afterward a small refinery was erected at Paola, and it is reported that in 1889 the Paola oil field yielded 500 barrels of oil. At about the same time gas produced in the vicinity of Fort Scott was utilized in that city. Gas was discovered in the vicinity of Independence, Montgomery County, as early as 1881, and in 1884 both oil and gas were found in a coal

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prospect hole at Independence. Development did not follow immediately. Wells drilled in Kansas City during this period produced gas for 20 years.

In the last decade of the last century and the first decade of the present century the oil and gas industry developed rapidly in eastern Kansas. An oil well near Neodesha in Wilson County was the first well "shot" in Kansas. The event took place on July 4, 1894, on the same day that natural gas piped into Neodesha from a near-by field was first ignited. Several oil wells were completed in the Neodesha field during that year, and the first oil conservation law in Kansas was enacted at about that time. The Iola gas field was opened in 1893 or early in 1894.

Gas development advanced rapidly in Montgomery County in 1892 and 1893. Gas was piped into Coffeyville in the fall of 1892 and into Independence and Cherryvale the following year. In 1894 or 1895 gas was piped into the village of Peru in Chautauqua County from a few near-by wells. In 1897 a number of gas wells were drilled in the area west of Humboldt in Allen County, and in August of the same year gas was piped into Humboldt.

Several oil wells were drilled in the Neosho River Valley east of Chanute in 1899, and the operator of the Chanute field began shipping oil to Omaha and Kansas City in 1900. Many oil wells were drilled in the Neosho River Valley in the vicinity of Chanute and Humboldt during the next three years. The Chanute district produced 165,000 barrels of oil in 1902, and it is reported that much more could have been marketed if there had been sufficient pipe lines. By 1903 Chanute had become an important oil and gas center and oil and gas fields extended in various directions for several miles. Gas was piped into Erie in Neosho County in 1903. In that year a local company reported that they had drilled 35 wells, of which 14 were gas wells, 7 were oil wells, and 14 were dry holes. Oil was discovered near Bolton in Montgomery County in 1903 and within two years this field, containing some wells that flowed at the rate of 1,000 barrels of oil a day, became the most important oil district in the State (Haworth, 1908, p. 37). There were about 200 wells in the field in 1905, but the larger producers had declined to about 40 barrels of oil per day. At the end of 1903 there were 151 producing oil wells in the Peru field in Chautauqua County. Kansas oil production in 1904 exceeded 4 million barrels.

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TABLE 2.—*Oil production in eastern Kansas counties, 1889 through 1940, in thousands of barrels*

	Allen	Anderson	Bourbon	Butler	Chautauqua	Chase	Coffey	Cowley	Crawford	Douglas	Elk	Franklin	Greenwood*	Labette	Linn	Lyon**	Marion***	Miami	Montgomery	Neosho	Wilson
1889	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	½	...	...	...
1890	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	½	...	...	½
1891	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	½	...	...	½
1892	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	½	...	...	1
1893	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	4
1894	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	1	2?	10
1895	7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	3	6	20
1896	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	4	6	21
1897	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12	8	15	63
1898	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	7	10	44
1899	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	6	8	40
1900	9	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	8	6	9	38
1901	25	...	...	...	11	...	...	...	...	...	...	...	...	...	...	...	...	8	6	10	38
1902	30	...	...	...	20	...	...	...	...	...	...	...	...	...	...	...	...	8	71	26	38
1903	90	...	...	...	140	...	...	...	...	...	10	...	...	...	...	...	...	10	192	30	40
1904	220	25	...	...	800	...	...	...	...	...	60	...	...	...	...	...	...	20	472	100	50
1905	185	30	...	...	700	...	...	...	...	...	150	40	...	...	...	...	...	100	2,406	330	100
1906	170	40	...	...	600	...	...	...	...	...	130	60	...	...	...	...	...	85	2,076	280	85
1907	150	40	...	...	550	...	...	...	...	...	120	80	...	...	...	...	...	80	1,650	280	80
1908	125	30	...	...	450	...	...	...	...	...	110	70	...	...	...	...	...	70	1,050	250	70
1909	80	25	...	...	300	...	...	...	...	...	80	55	...	...	...	...	...	50	782	180	50
1910	72	23	...	...	269	...	...	...	...	...	70	38	...	...	...	...	...	33	560	125	33
1911	93	21	...	...	348	...	...	...	...	...	63	33	...	...	...	...	...	30	500	110	30
1912	122	20	...	...	492	...	...	...	...	...	58	30	...	...	...	...	...	28	554	116	30
1913	228	19	...	...	756	...	...	...	...	...	54	32	...	...	1	...	...	31	650	147	43
1914	450	18	...	5	1,323	...	5	15	...	...	49	34	...	...	5	...	...	44	834	353	53
1915	398	17	...	110	1,207	...	7	14	...	...	46	107	...	...	15	...	...	115	1,365	700	80
1916	495	17	...	8,155	1,460	...	7	18	...	...	43	128	...	...	13	...	...	129	1,248	630	70
1917	650	45	10	31,269	1,769	...	7	29	†	...	46	278	2	...	15	...	...	283	1,500	690	76
1918	695	50	15	36,069	1,720	...	7	26	...	...	99	497	78	10	41	...	...	502	1,727	1,046	208
1919	540	50	12	24,060	1,300	...	6	22	...	...	105	545	390	14	62	...	...	540	1,675	1,070	290
1920	730	170	30	23,535	1,886	...	10	60	...	...	130	420	275	12	49	...	...	420	1,310	840	220
1921	645	240	26	21,787	1,520	...	30	70	...	...	405	635	380	30	85	...	3	630	1,520	1,120	350
1922	550	371	46	17,733	1,138	...	††	243	...	...	470	545	710	26	160	...	6	540	1,422	995	305
1923	507	391	47	14,221	1,013	...	††	629	...	...	284	208	3,376	23	155	14	5,363	236	786	394	147
1924	427	630	35	10,822	936	...	††	2,266	...	...	245	229	6,939	21	128	23	3,267	226	765	362	110
											268	237	9,383	23	153	21	2,333	225	1,117	300	99

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1925	556	824	13	9,659	864	...	††	7,039	...	...	513	208	13,360	15	103	56	1,662	186	1,136	277	126
1926	298	1,161	7	10,377	894	...	††	3,943	...	...	15	194	16,739	10	89	680	1,382	163	721	255	94
1927	241	832	7	10,518	872	3	108	3,304	...	24	895	165	12,664	12	87	715	1,155	753	579	222	84
1928	220	661	5	9,691	820	9	100	2,284	...	...	757	156	9,873	9	74	382	1,312	709	538	185	74
1929	187	583	7	9,272	998	6	90	2,065	...	...	716	135	7,577	7	71	323	1,399	365	545	183	64
1930	169	567	22	9,099	991	...	93	2,015	...	...	626	112	7,266	9	51	255	1,166	406	488	179	56
1931	187	329	19	7,769	579	...	29	1,885	...	...	757	103	5,564	3	59	155	874	389	312	176	58
1932	157	335	11	6,684	540	...	49	2,743	...	...	557	100	4,864	...	60	118	663	433	537	184	74
1933	187	329	19	6,461	579	...	29	1,147	...	...	344	100	4,313	...	39	95	538	403	412	170	60
1934	157	323	13	7,213	582	...	24	1,681	...	...	592	85	4,184	...	34	87	536	272	334	158	62
1935	161	281	7	6,712	560	...	35	1,622	...	...	581	78	4,089	...	39	81	509	284	280	177	89
1936	155	270	5	6,161	670	...	21	1,804	...	...	490	80	4,000	6	34	139	410	210	290	285	120
1937	165	265	5	5,989	825	...	20	1,963	...	...	400	83	4,007	7	39	133	348	230	340	430	145
1938	167	263	5	5,694	815	...	18	2,318	...	...	279	80	4,114	9	40	127	320	215	315	490	135
1939	222	260	9	5,063	867	...	15	2,131	...	...	245	70	3,793	10	35	121	377	213	305	630	130
1940	230	278	14	5,045	910	...	††	272	...	...	303	68	3,227	12	30	115	547	213	303	788	122

* Includes Woodson County production.
** Production previous to 1922 included with Greenwood County.
*** Includes Dickinson and Marion County production.
† Unrecorded production started in 1917.
†† Included with Greenwood County.

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TABLE 3.—*Oil production in eastern Kansas counties, in barrels, 1941 through 1952*

County	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952
Allen	312,900	284,088	379,240	285,665	389,196	319,678	284,240	284,561	278,368	318,658	364,657	609,577
Anderson	336,304	501,768	486,603	374,535	289,674	318,041	325,390	371,131	402,420	543,857	553,830	576,882
Bourbon	3,897	6,912	45,354	35,595	16,107	24,692	31,660	11,188	15,374	24,342	36,792	56,984
Brown	.....	.....	.....	969	21,684	18,195	9,630	5,671	.....	.....	.....	.....
Butler	5,304,450	4,864,103	4,540,224	4,684,021	4,741,500	5,149,226	5,611,484	5,911,373	6,258,017	6,862,459	7,567,782	8,164,208
Chase	Included with Greenwood and Lyon Counties							19,685	36,918	37,594	31,430	30,629
Chautauqua	952,916	959,751	926,320	884,507	635,616	794,334	830,535	832,965	806,839	812,156	803,832	798,706
Coffey	20,956	19,968	17,912	15,836	15,286	14,258	12,970	85,172	85,551	107,394	90,088	85,651
Cowley	2,816,706	2,865,952	2,738,228	2,614,388	2,583,650	2,717,746	2,812,928	2,592,991	2,114,879	1,908,243	1,724,717	2,165,504
Crawford	36,309	26,942	26,207	34,249	31,661	49,829	60,792	67,059	61,324	59,592	50,938	47,097
Dickinson	.....	.....	3,047	21,489	14,242	11,520	34,398	23,449	202,070	162,132	115,525	108,313
Douglas	7,020	5,760	3,054	5,000	5,000	5,000	2,940	2,360	2,030	1,820	1,680	1,580
Elk	367,889	213,592	226,607	263,639	275,057	217,391	220,021	211,926	198,069	182,408	176,560	175,746
Franklin	85,319	159,400	142,745	131,658	133,942	196,218	188,745	237,650	257,087	280,449	265,327	406,698
Greenwood	3,263,647	3,362,191	3,324,714	3,547,828	3,730,234	3,890,119	4,149,372	4,776,611	5,189,838	5,375,676	5,932,510	6,834,217
Jefferson	19,672	78,824	162,371	56,609	92,192	94,941	120,902	108,652	75,485	50,532	13,436	1,494
Johnson	.....	1,127	1,321	.....	.....	.....	.....	.....	.....	.....	.....	.....
Labette	14,820	13,071	12,896	3,624	3,723	4,681	6,958	6,528	9,013	6,922	4,556	7,461
Leavenworth	13,020	22,964	.....	2,742	1,009	3,594	2,795	1,266	11,718	10,722	11,220	.....
Linn	26,195	24,529	38,845	56,169	70,758	85,368	73,163	60,201	47,290	56,739	83,429	62,136
Lyon	108,287	106,278	133,287	189,739	159,660	141,450	135,480	187,948	423,608	353,959	286,790	264,969
Marion	840,640	979,397	815,358	818,980	773,640	613,603	524,063	643,137	688,967	595,126	600,088	567,290
Miami	199,185	235,402	218,898	197,510	241,599	338,721	290,806	327,326	370,504	602,780	519,645	591,153
Montgomery	311,523	377,376	367,332	317,815	362,328	815,013	890,426	945,616	878,367	785,932	625,460	677,863
Morris	Previous production included in Marion County					1,320	390	407	1,301	23,328	65,901	47,860
Nemaha	.....	.....	.....	.....	.....	.....	.....	1,000	3,312	13,163	45,108	34,223
Neosho	722,859	703,408	674,037	343,020	343,976	374,855	435,158	484,753	514,570	616,792	566,080	645,001
Wabaunsee	.....	.....	.....	.....	.....	.....	.....	.....	46,659	363,814	379,130	333,294
Wilson	106,247	86,157	55,714	75,745	79,088	90,356	77,281	69,976	64,944	71,005	68,974	67,271
Woodson	287,081	263,830	253,263	352,777	314,672	412,085	404,026	441,771	614,030	624,366	619,760	631,511
Miscellaneous	.....	.....	.....	33,722	44,062	.....	.....	34,639	.....	.....	.....	.....
Total	16,157,842	16,162,790	15,593,577	15,347,831	15,369,556	16,702,094	17,538,160	18,744,327	19,658,552	20,851,960	21,605,245	23,993,318

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By 1910, fifty years after the discovery of oil in the mid-continent region at Paola, wells had been drilled in the majority of eastern Kansas counties and many shallow oil and gas fields had been developed. The oil and gas territory extended from Miami County on the north to the Oklahoma line in Montgomery and Chautauqua Counties. Gas had been discovered farther west in eastern Kansas at Longton, Elk Falls, Moline, Dexter, Winfield, Arkansas City, Augusta, and Elmdale in the first few years after 1900. There were oil refineries in Coffeyville, Neodesha, Chanute, and several other places, and many miles of pipe lines for both oil and gas had been laid. Many towns and cities were using natural gas, and the abundance of cheap gas had led to the establishment of numerous industries in southeastern Kansas. Gas was being used in cement plants, brick and tile plants, zinc and lead smelters, glass factories, and other industries.

During the first half century of Kansas oil and gas development, production was largely from rocks of Pennsylvanian age. Permian rocks, however, yielded significant quantities of gas in fields near Elmdale in Chase County; Dexter, Winfield, and Arkansas City in Cowley County; and Augusta in Butler County. The occurrence of oil seeps in Miami and northern Linn Counties attracted early prospecting for oil in the vicinity of Paola. After discoveries near these seeps, test holes were put down in nearly every county; and in the early part of the 20th century the eastern Kansas oil and gas territory, except the Nemaha anticline area, was more or less completely outlined. The first important application of structural geology to oil and gas finding in Kansas was probably that of Erasmus Haworth, J. W. Beede, and John Bennett, who worked in the early part of the present century. The relationships of oil and gas occurrence to lenticular sand bodies and to anticlinal structures were explained by Haworth (1908, pp. 161-179). After the finding of large amounts of oil and gas in anticlines and domes in the Nemaha anticline area in Butler County in 1914 and 1915, surface structure mapping led to the drilling of many wells.

The discovery of oil and gas in the El Dorado and Augusta fields in 1914 marked the beginning of large-scale oil and gas production in Kansas. Henceforth production of oil was measured in tens of millions of barrels, and gas production in tens of billions of cubic feet. The discovery of oil and gas in condemned pre-Pennsylvanian rocks and the acquisition of evidence demanding drastic revision of

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the earlier ideas of subsurface structure in eastern Kansas made the opening of the El Dorado field an important event. Its effect on Kansas oil production is shown by the increase in oil production during the period from 1915 to 1918. In 1915 oil output in Kansas was 2,823,487 barrels; in 1916 it was 8,783,077 barrels; in 1917 it was 36,536,125 barrels; and in 1918 it reached 45,451,017 barrels.

The discovery well in the El Dorado field is the Wichita Natural Gas Company No. 1 Stapleton, in the NE¼ SE¼ sec. 29, T. 25 S., R. 5 E. Commercial production estimated at 50 to 200 barrels per day was found in sandstone between 660 and 678 feet. The discovery well was later deepened and the "Stapleton pay zone" * was found at 2,465 feet. About 600 wells were producing in the El Dorado field at the end of 1916; most of them produced from the 660-foot sand. That year the daily output of the field was estimated at more than 12,000 barrels of oil (Fath, 1921, p. 21). During 1917 the productive limits of the field were fairly well outlined and in September the daily production exceeded 100,000 barrels of oil. During 1917 and 1918, 309 "Stapleton" gushers having initial capacities of more than 500 barrels were brought in; 205 of these had initial daily capacities of more than 1,000 barrels, and 5 had initial daily capacities of more than 15,000 barrels. The Gypsy Oil Company No. 5 Shumway well, in the SW¼ NW¼ sec. 11, T. 26 S., R. 4 E., flowed at the rate of 19,000 barrels per day; the Empire Gas and Fuel Company No. 3 Shriver well in the NW¼ sec. 14, T. 26 S., R. 4 E., was reported to have flowed at the rate of 23,000 barrels of oil per day (Fath, 1921, p. 23). In the El Dorado field large quantities of gas were found in five "sands" in Shawnee and Douglas rocks on the higher parts of the domes.

Soon after the El Dorado oil and gas fields were opened, important "Bartlesville sand" shoestring pools were found in areas not far east of the Nemaha trend. The Smock-Sluss, Weaver, and Fox-Bush pools of Butler County and the Sallyards pool of Greenwood County were discovered in 1917 (Bass, 1936, p. 60). Many oil and gas pools were found in eastern Kansas in the 1920's. Mississippian, Viola, "Wilcox" (St. Peter), and Arbuckle production became established, and the importance of subsurface geologic studies became evident.

Acidizing of limestone reservoir rocks was practiced and greatly increased production in areas where oil was produced from limestone

* For explanation of oil field names of subsurface formations, see pages 76-90.

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in eastern Kansas, especially in the late 1920's and early 1930's. Repressuring by air and application of vacuum were widely employed as means of increasing oil recovery. Secondary recovery by water-flooding was practiced in several small projects long before officially recognized floods were initiated in 1935. (Water-flooding is discussed under a separate heading in this report.)

Discovery of oil in Viola rocks in Wabaunsee County in the deepest part of the Forest City basin or in the trough east of the Nemaha anticline early in 1949 was the most important event in eastern Kansas oil development in many years. "Hunton" production had been established in more or less similar geologic settings in 1944 in the Livengood field, Brown County, and in 1948 in the Strahm field, Nemaha County (Jewett, 1949, pp. 100, 251), but the significance was not appreciated fully. However, The Carter Oil Company No. 1 "A" Davis well in sec. 33, T. 13 S., R. 10 E., Wabaunsee County, with a daily potential of 2,580 barrels of oil from a Viola reservoir, caused earlier predictions of the possibilities in the deeper rocks in this little-explored structural area to be re-evaluated. Somewhat feverish activity began, including surface mapping, investigations by core-drilling, and seismograph studies by several major companies. A rather disappointing string of dry holes followed, but as wildcatting found a somewhat more sane basis, the optimism that prevailed immediately after the Davis Ranch discovery was proved justifiable. In 1950 three other Viola fields were opened in Wabaunsee County; a "Hunton" pool was found in Lyon County, and a "Hunton" field was opened in Nemaha County. In 1951 a Viola and a Simpson pool were opened in Wabaunsee County; and in Clay County, west of the Nemaha anticline, an old Mississippian field was revived and a new one opened. During this period of renewed interest in eastern Kansas several other Mississippian limestone and Pennsylvanian sandstone pools were discovered (Jewett, 1951).

Developments of oil and gas in other parts of Kansas and in other states has had a pronounced effect on the industry in eastern Kansas. As early as 1888 gas was discovered in Rice County; and in 1904 at Lyons in Ellsworth County. These discoveries marked the beginning of enormous—although long delayed—gas production in western Kansas. In 1919 oil was found in the Sedgwick basin in Harvey County, when the first western Kansas oil field, the Walton, was opened. The event, however, that had the greatest

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effect in drawing interest from eastern to western Kansas was the discovery of oil in 1923 on the Barton arch in Russell County. Drilling that followed in that part of the State revealed unsuspected structural conditions and paved the way for finding the vast reservoirs of oil in west-central Kansas. The more important events in oil and gas development in Kansas are listed below.

Some of the more important events in oil and gas development in Kansas

1860	Discovery of oil and gas near Paola in Miami County
1865 about	Discovery of oil and gas near Mound City in Linn County
1873	Discovery of gas at Iola in Allen County
1881	Discovery of gas at Independence in Montgomery County
1884	Gas piped into Paola from field about 7 miles east of town Oil discovered at Independence in Montgomery County
1886 about	First oil refinery in Kansas at Paola
1888	Gas discovered in Rice County
1889	Paola oil field produced 500 barrels of oil
1892-1893	Extensive gas development in Montgomery County
1893	Iola gas field opened
1894	Important oil development in Wilson County, first well "shot" in Kansas
1894-1895	Extensive gas development in Chautauqua County
1897	Extensive gas developments in Allen County
1899	Beginning of extensive oil developments in Neosho County
1900-1910	Extension of oil and gas developments over a wide area from Miami County to Montgomery County; gas discovered in Elk, Cowley, Chase, and Butler Counties; application of structural geology to oil and gas finding in eastern Kansas.
1903	Discovery of the Bolton oil pool in Montgomery County; State's first 1,000 barrels daily wells
1904	Discovery of gas at Lyons in Ellsworth County
1914	Discovery of Augusta and El Dorado pools
1915	Nemaha anticline recognized as a large structural feature affecting oil and gas accumulation
1916	Discovery of oil in Mississippian rocks in the Virgil field, Greenwood County
1917	Beginning of large-scale oil production in the State Discovery of important "shoestring" pools in Butler and Greenwood Counties
1918	Kansas annual oil production reached 45¾ million barrels
1919	Oil discovered in Sedgwick basin in Harvey County
1922	Gas discovered in Seward County
1923	Discovery of oil on Barton arch in Russell County
1925	Discovery of oil on Barton arch in Rice County
1926	Recognition of Barton arch as an important structural element
1927	Important developments in Reno and Rooks Counties
1930	Important developments in Ellsworth and Barton Counties
1935	Beginning of regulated water-flooding in Chautauqua, Greenwood, and Linn Counties
1943	Kansas oil production reached 100 million barrels annually Beginning of important oil production in the Salina basin
1949	Discovery of Davis Ranch pool, Wabaunsee County; beginning of renewed exploration and discoveries in pre-Mississippian rocks in western part of Forest City basin
1951	Discovery of oil in northwest Kansas in Cheyenne County
1952-1953	Beginning of widespread application of new rock fracturing methods of well completions.

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In the latter part of the 1920's and early 1930's there was little interest in exploration in eastern Kansas although a few important discoveries were made. Late in the '30's seemingly favorable structures in the Forest City Basin in northeastern Kansas attracted attention but in general tests were disappointing. The synclinal western margin of the basin was not actively explored until the Davis Ranch discovery in 1949.

SECONDARY RECOVERY OF OIL

Repressuring of oil sands by water injection is now being practiced widely in eastern Kansas. This method of supplying energy to move oil into wells is reported to have been first practiced in Kansas in 1935 (Grandone, 1944, p. 1) but small water-flooding projects were in operation long before that time.

Water-flood projects were started in Greenwood, Chautauqua, and Linn Counties in 1935, the year in which the Kansas legislature enacted a law authorizing water flooding. Water was injected into Pennsylvanian "shoestring sands" at depths ranging from 400 to 1,950 feet.

The first beneficial water floods in Kansas were accidental as they had been earlier in New York and Pennsylvania. It was noticed that when water leaked from old wells through corroded casing into oil sands, near-by wells showed an increase in oil production. This led to purposeful floods 30 or more years ago. One of the earliest projects was in the Stanton field, Miami County, where the producing sand is still being repressured by water.

In the late 1930's interest in water flooding spread rather rapidly through the old stripper fields (Fancher and Barnes, 1936; Weirich, 1937) but this means of repressuring may be regarded as still having been in the experimental stages then. A few years later, however, rather extensive studies of the engineering and geologic problems involved were taking place. Several engineers, experienced in Pennsylvania water-flooded oil fields, came to eastern Kansas.

At about the beginning of World War II successful water-flood projects were in operation in nearly all the oil-producing counties in eastern Kansas. Some of the fields in which water was injected had been drilled in the early 1900's; most of these earliest organized projects are still active.

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Of secondary oil recovery methods (which include repressuring by air, natural gas, nitrogen, and vacuum) water flooding alone is being widely practiced in eastern Kansas. In counties in which oil production is largely or wholly from Pennsylvanian sandstones a large part of the yield is produced by water flooding, and it is predicted that more and more acres in old fields will be repressured.

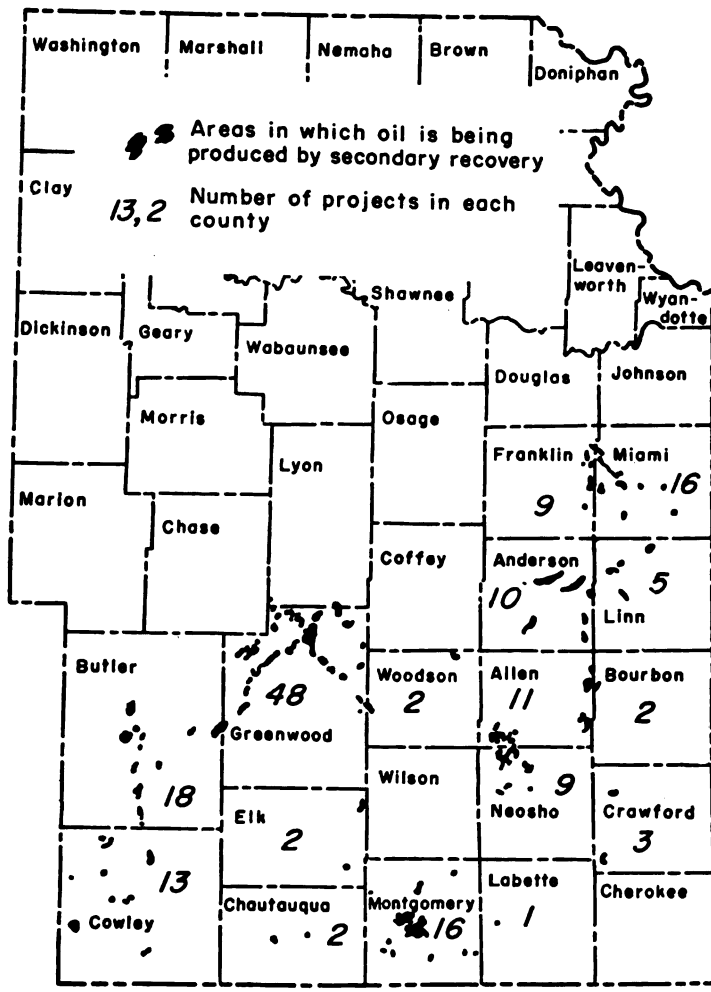

FIG. 2.—Map of eastern Kansas showing locations of secondary recovery projects operated in 1952. Projects are listed alphabetically by counties in Table 4.

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Attention is called to the maps in this report of various counties showing outlines of oil fields and, in several places, the relatively small areas in which oil was produced last year. Few water-flood projects have been abandoned and most of the seemingly abandoned fields and parts of fields may be regarded as potential areas of repressuring.

Repressuring by water consists of injecting fresh or salt water through injection wells into oil-bearing formations. Water is forced into the rocks under sufficient pressure to dislodge oil from the pores in the rock and to drive it into producing wells. The oil wells may be pumped or water pressure may be sufficient to cause the oil wells to flow. Many operators expect the average life of water-flooding projects in eastern Kansas to be about 15 years, and it is believed that the amount of oil recovered by this means in most fields will be about the same as that produced by primary methods.

Successful water flooding requires the solution of engineering problems but geological information is essential. Water-flooding projects and some of the problems associated with them have been discussed recently in several trade journals. Water flooding in Kansas has been discussed by Weirich (1937), Grandone (1944), Abernathy and Jewett (1946), Abernathy (1948), Jewett (1948),

TABLE 4.—*Data on secondary recovery projects in eastern Kansas*

Field	Operator	Location	Year started	Total developed acres	Producing formation	No. active wells	Medium of injection and source
			Allen County				
Bronson-Xenia	Mack C. Colt	24-21E	1951	36	"Bartlesville"	24	Arbuckle water
Elsmore Shoestring	Fees and Hoyt	26-21E 25-21E	1941	170	do	48	Stream and Arbuckle water
do	Pavlicek Bros.	26-21E	1944	..	do	..	Salt water
Elsmore West	Eureka Gas and Oil Co.	25-21E	1950	80	do	19	Mississippian water
do	Robt. T. Hansen	25-21E	1953	..	do	3	do
Humboldt-Chanute	Deep Rock Oil Corp.	26-18E	1938	323	do	156	Stream water
do	M. P. Darby	26-18E	1952	..	.....	..	.....
do	Hauser Oil and Gas Co.	26-18E	1951	20	"Bartlesville"	7	Fresh water from 850'
do	Jake L. Hamon	26-18E	1951	..	do	..	Arbuckle water
do	Donald P. Oak	26-18E	1951	..	.....	..	.....
do	Carl Weiner	26-18E	1942	320	"Bartlesville"	114	Mississippian water
Totals				949		371	
			Allen and Bourbon Counties				
Bronson-Xenia	Davis and Crowder	24-21E	1940	..	do	..	Arbuckle water
Davis-Bronson	Mack C. Colt	24-21E	1937	..	do	..	do
			Allen and Neosho Counties				
Humboldt-Chanute	M. F. A. Oil Co.	26-18E 27-18E	1947	..	do	..	.....

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TABLE 4.—*Data on secondary recovery projects in eastern Kansas, continued*

Field	Operator	Location	Year started	Total developed acres	Producing formation	No. active wells	Medium of injection and source
		Anderson County					
Bush City Shoestring	Deep Rock Oil Corp.	21-21E	1943	337	"Squirrel"	145	do
do	do	21-21E 21-20E	1939	622	do	263	do
do	Kewanee Oil Co.	20-21E 21-21E	1944	346	do	160	do
Centerville	Schermerhorn Oil Corp.	21-21E	1947	275	"Bartlesville"	60	Mississippian water
Colony-Welda	W. S. Fees	22-19E	1947	30	"Squirrel"	15	Arbuckle water
do	do	22-19E	1949	320	do	84	do
Garnett Shoestring	Brundred Oil Corp.	20-20E 21-20E 21-19E	1936	296	do	168	Mississippian water
Greeley	Stith and Buster	19-21E	1948	35	"Peru-Wayside"	17	Fresh (shallow wells) and produced
Kincaid	Texas Consolidated Oils	22-21E 23-21E	1946	310	"Bartlesville"	36	Arbuckle water
Selma	Mack C. Colt	22-21E	1942	..	do	..	do
Totals				2,571		948	
		Butler County					
Blankenship	Franco-Central Oil Co.	26-8E	1951	80	do	17	Douglas water
do	Sohio Petro. Co.	26-8E	1949	140	do	17	Arbuckle water
El Dorado	Cities Service Oil Co.	25-5E	1951	566	"El Dorado"	56	do
do	do	25-5E	1947	721	do	68	do
do	do	26-5E	1950	20	Simpson	1	Douglas water
do	do	26-5E	1948	980	do	102	Stream and Arbuckle water
do	Magnolia Petro. Co.	26-5E	1951	148	do	61	Arbuckle water
do	Skelly Oil Co.	26-5E	1950	30	"Wilcox sand"	3	Produced
Fox-Bush	Cooperative Ref. Assn.	29-5E	1947	10	"Bartlesville"	2	Fresh (Wreford, Neva lss.) and produced
do	do	29-5E	1944	120	do	10	Produced salt water
do	Magnolia Petro. Co.	28-5E	1951	156	do	45	Arbuckle, Kansas City, & Douglas
do	Morrison Prod. Co.	28-5E 29-5E	1942	830	do	14	Arbuckle
Haverhill	Cities Service Oil Co.	27-5E	1950	..	do	..	Fresh water from shallow wells
do	Morris Sitrin	27-5E	1952	..	.....	..	.....
Kramer-Stern	The Texas Co.	27-6E	1952	..	.....	..	.....
Smock-Sluss	L. A. Seidenfield	26-5E	1951	80	"Bartlesville"	1	Produced salt water
do	The Texas Co.	27-5E	1951	40	do	6	do
Young	El Dorado Refg. Co.	26-7E	1952	..	.....	..	.....
Totals				3,921		403	
		Butler and Greenwood Counties					
Blankenship	Tide Water Assoc. Oil Co.	26-8E	1949	336	"Bartlesville"	49	Arbuckle water
		Chautauqua County					
Peru-Sedan	Sinclair Oil and Gas Co.	33-11E	1935	210	"Peru"	..	.....
do	G. B. and C. E. Suppes	34-12E	1952	20	do	16	Produced salt water
		Cowley County					
Bruce	Shawver Petro. Corp.	30-4E	1952	..	.....	..	.....
Eastman	The Texas Co.	30-6E 31-6E	1929	413	"Bartlesville"	19	Produced gas and salt water
Frog Hollow	The Carter Oil Co.	32-5E	1952	70	do	5	Produced salt water
Hittle	The Texas Co.	31-4E	1945	30	"Layton"	2	Arbuckle water
Rahn	B. B. Blair	34-6E 34-5E	1951	..	"Bartlesville"	6	Water well
do	Continental Oil Co.	34-5E	1952	..	.....	..	.....
Rainbow Bend	Mead Production Co.	33-3E	1952	..	.....	..	.....

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Rainbow Bend	Sunray Oil Corp.	33-3E	1952	374	"Bartlesville"	40	Fresh water (river sand) and produced gas and salt water
Rock	Cooperative Ref. Assn.	30-4E	1952	40	do	5	Brackish fresh water from wells
do	Stelbar Oil Corp., Inc.	30-4E	1951	400	do	24	Fresh water from wells
Weathered	Frost and Bennett	31-3E	1946	..	"Stalnaker"	..	Produced water
Winfield	Gulf Oil Corp.	32-4E	1948	15	"Bartlesville"	3	"Layton" and produced water
do	Sinclair Oil and Gas Co.	32-4E	1948	..	do	..	Produced water
Totals				1,342		104	
		Crawford County					
McCune	Donald P. Oak	30-22E 31-22E 31-21E	1952	..	.....	..	.....
Walnut Southeast	Deep Rock Oil Corp.	28-22E	1951	..	"Bartlesville"	..	Arbuckle water
do	E. M. Marshall	28-22E	1941	..	do	..	Stream and Arbuckle water
		Elk County					
Longton	Union Gas System, Inc.	31-12E	1947	53	"Longton shallow sand"	..	Fresh water from shallow wells
New Albany	A. E. Basinger	29-13E 28-13E	1937	..	"New Albany"	..	.....
Totals				53		..	
		Franklin County					
Paola-Rantoul	Barnett Oil Co.	17-21E	1949	75	"Squirrel"	21	Fresh (stream) and produced
do	Brundred Oil Corp.	16-21E	1950	201	do	74	Mississippian water
do	Deep Rock Oil Corp.	16-21E	1951	144	do	45	Arbuckle
do	do	16-21E	1948	120	do	48	do
do	Williams Oil Co.	18-21E	1949	254	do	49	Fresh water (lakes)
do	.....	18-21E	1942	40	"Squirrel"	10	Brine, shallow wells and produced
do	Hoyt Oil Co.	17-21E	1941	340	"Peru," "Squirrel" and "Bartlesville"	176	Fresh water (river)
Totals				1,174		423	
		Franklin and Miami Counties					
Paola-Rantoul	Brundred Oil Corp.	17-21E	1943	681	"Squirrel"	299	Stream & produced
do	Sack-Brundred	16-21E	1951	74	do	42	Arbuckle water
Totals				755		341	
		Greenwood County					
Atyeo	Cities Service Oil Co.	22-10E	1952	120	"Bartlesville"	16	Arbuckle water
Browning	Sinclair Oil and Gas Co.	22-10E	1949	170	do	70	Fresh (stream) and Douglas water
Burkett	Phillips Petro. Co.	23-10E 23-11E	1942	665	do	86	Douglas water
DeMalorie-Souder	L. B. Campbell	22-10E	1952	40	do	3	Produced salt water
do	Cities Service Oil Co.	22-11E	1952	56	do	5	Verdigris R. and produced
do	Mid-Continent Petro. Corp.	22-11E	1946	160	do	9	Fresh, Douglas, and produced water
do	Phillips Petro. Co.	22-10E	1949	398	do	43	Douglas water & gas
do	do	22-10E	1949	25	do	3	Douglas water
do	George Sheehan	22-11E	1952	..	do	4	Douglas water fresh
Fankhauser	Cities Service Oil Co.	22-12E	1950	70	do	5	Produced salt water
do	Sunray Oil Corp.	22-12E	1949	246	do	27	Douglas and produced water
do	do	22-12E	1950	62	do	5	do
Hamilton	Associated Resources Corp.	24-12E	1951	30	do	4	Douglas water
do	Cities Service Oil Co.	23-11E	1947	200	do	29	Stream, produced, & Douglas water
Lamont	do	22-12E	1949	507	do	54	Verdigris R. and Douglas
Madison	Cities Service Oil Co.	22-11E	1948	745	do	38	Verdigris R. and Arbuckle
do	Magnolia Petro. Co.	22-11E	1949	65	do	6	Douglas water

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TABLE 4.—*Data on secondary recovery projects in eastern Kansas, concluded*

Field	Operator	Location	Year started	Total developed acres	Producing formation	No. active wells	Medium of injection and source
Pixlee	Barbara Oil Co.	22-10E	1947	100	"Bartlesville"	20	do
Polhamus	Sohio Petro. Co.	24-9E 25-9E	1949	200	do	30	do
Quincy	Alf M. Landon	25-13E	1951	20	do	3	Fresh water from well
Sallyards	Ohio Oil Co.	25-9E	1946	205	do	34	Douglas water
do	do	25-9E	1951	79	do	8	do
do	do	25-9E	1951	55	do	9	do
Scott	Phillips Petro. Co.	23-8E 23-9E	1945	200	do	39	do
Seeley-Wick	Cities Service Oil Co.	23-11E	1946	260	do	26	Wells and produced
do	Magnolia Petro. Co.	23-11E	1943	555	do	63	Douglas water
do	Phillips Petro. Co.	23-11E	1950	214	do	56	do
do	do	23-11E	1948	170	do	30	do
do	do	22-11E 23-11E	1937	255	do	24	do
do	do	22-11E	1937	280	do	34	do
do	do	22-11E	1943	80	do	10	do
do	Skelly Oil Co.	22-11E	1943	506	do	40	1,000' salt water sand
Teeter	Cities Service Oil Co.	23-9E	1947	690	do	47	Lake, water, produced & Arbuckle
do	Kirkpatrick and McGuire	23-9E	1951	50	do	4	Douglas water
do	Ohio Oil Co.	23-9E	....	..	.....	..	.....
do	Skelly Oil Co.	23-9E	1944	30	"Bartlesville"	3	Salt water sand
Thrall-Aagard	Arkansas Fuel Oil Co.	24-9E	1944	84	do	10	1,200' salt water sand
do	Ohio Oil Co.	23-10E 24-10E	1948	366	do	44	Arbuckle water
do	do	24-9E	1944	98	do	12	Douglas water
do	Phillips Petro. Co.	24-9E	1937	48	do	3	do
do	do	24-9E 24-10E 23-9E	1952	108	do	16	Arbuckle water
do	do	24-9E	1938	110	do	16	Douglas water
do	do	24-9E	1945	80	do	11	do
do	Sinclair Oil and Gas Co.	23-10E	1949	644	do	80	Douglas and surface pond
Virgil	Alf M. Landon	24-12E	1951	30	do	33	Arbuckle & Douglas
Virgil North	Sunflower Drilling Co.	24-13E	1952	..	.....	..	.....
do	Joe Phillips	23-13E	1952	..	.....	..	.....
Totals				9,076	.....	1,112	
Greenwood and Woodson Counties							
Quincy	Layton Oil Co.	25-13E	1950	50	"Bartlesville"	..	Arbuckle water
Labette County							
Price	Veeder Supply and Develop. Co.	33-18E	1952	30	"Bartlesville"	17	Mississippian ls. and shallow fresh water sand
Linn County							
Centerville	Fell and Wolf Oil Co.	21-22E	1936	250	"Squirrel"	..	Produced & stream
Goodrich-Parker	Deep Rock Oil Corp.	20-22E	1944	183	do	95	Arbuckle water
do	Ohio Oil Co.	20-22E	....	..	.....	..	.....
LaCygne-Cadmus	Allegany Oil Co.	20-23E	1941	10	"Peru"	3	Fresh 40' well
do	Deep Rock Oil Corp.	19-23E 20-23E	1942	80	do	38	Arbuckle water
Totals				523	.....	136	
Lyon County							
Atyeo	Barbara Oil Co.	21-10E	1948	30	"Bartlesville"	5	Arbuckle water
do	Ohio Oil Co.	21-10E	1947	280	do	39	do
Fankhauser	Phillips Petro. Co.	21-12E	1943	100	do	7	Douglas water
Totals				410	.....	51	

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Miami County

Block	J. E. D. Oil Co.	18-24E	1950	20	"Squirrel"	9	Pond (fresh water)
Paola Rantoul	Andrus and Bryner	17-23E	1947	40	"Peru"	19	Mississippian water
do	F. R. Colbert	17-21E	1941	70	do	30	Fresh 80′ well
do	do	18-23E	1945	45	do	28	Fresh city water
do	Davis and Balch Oil Co.	16-24E (revived)	1944	110	"Peru-Wayside"	47	Fresh (stream) and Arbuckle water
do	Deep Rock Oil Corp.	18-22E	1944	290	Hepler	97	Arbuckle water
do	do	17-22E	1945	618	"Peru"	196	do
do	Hart and Buster	17-22E	1951	..	"Squirrel"	19	do
do	N. Y. K. Oil Co.	16-21E	1950	30	do	26	Fresh creek
do	do	17-23E 16-23E	1941	145	"Peru"	152	do
do	Sack-Brundred	16-22E 16-21E	1947	147	do	114	Arbuckle water
do	do	17-22E	1949	153	do	100	do
do	Sheffer Drlg. Co.	17-21E	1939	92	do	67	Brine Mississippian
do	do	17-21E 17-22E	1950	80	do	27	Fresh river
do	The Spearow Co.	18-22E	1951	..	do	..	Air
do	E. A. Whitworth	17-24E	1951	25	Bandera Quarry	21	Fresh (stream) and return (Hertha) water
Totals				1,865		952	

Montgomery County

Caney	Alpine Oil and Gas Corp.	34-14E	1952	..	"Bartlesville"	8	Big Salt water
Coffeyville-Cherryvale	E. W. Hayes	34-17E	1946	..	"Peru"	..	City of Coffeyville
do	do	34-17E	1948	..	do	..	Arbuckle water
Jefferson-Sycamore	Gee Bee Oil Co.	34-15E	1952	160	"Wayside"	6	Fresh water (shallow sand)
do	Kirkpatrick and McGuire	33-15E	1952	12	"Bartlesville"	4	City of Independence
do	Layton Oil Co.	32-15E 31-15E	1948	185	do	38	Arbuckle water
do	do	33-15E	1946	165	do	18	City of Independence
do	Sohio Petro. Co.	33-15E	1946	360	do	27	Arbuckle water
do	Stekoll Petro. Co.	32-14E 32-15E 33-14E 33-15E	1945	1,700	do	334	City of Independence and return
Neodesha	Layton Oil Co.	31-16E	1952	56	do	10	Arbuckle water
Wayside-Havana	Alpine Oil and Gas Corp.	33-14E	1949	10	"Wayside"	18	Big Salt and return water
do	Consolidated Gas, Oil and Mfg. Co.	34-14E	1942	105	do	40	Pond, wells, and return
do	do	34-14E	1944	47	do	20	do
do	do	34-14E	1945	40	do	26	do
do	Forrest Oil Corp.	34-14E	1939	56	do	28	Big Salt, and oil sands
do	W. N. White	34-14E	1943	20	do	17	230′ salt sand
Totals				2,916		594	

Neosho County

Erie	Edwards-Purviance	28-19E 28-20E	1949	10	"Bartlesville"	17	130′ fresh water
Humboldt-Chanute	Belleair Oil Corp.	27-18E	1952	..	do	..	Mississippian water
do	Keas Drilling Co.	27-18E	1939	285	do	128	Gravel wells and return water
do	Kirkpatrick and McGuire	28-19E	1952	10	do	10	Mississippian water
do	do	27-19E	1952	15	do	12	do
do	M. F. A. Oil Co.	27-19E	1938	..	do	..	Arbuckle water
do	Pioneer Corp.	27-19E	1951	29	do	14	Lower Arbuckle water
do	Skiles Oil Co.	27-18E 27-19E	1938	980	do	472	Fresh water from stream
do	Fred Stipp	28-18E	1941	..	do	..	Fresh water from well
Totals				1,329		653	

Woodson County

Neosho Falls	Susmio Oil Co.	23-16E	1952	80	"Squirrel"	19	Kansas City water

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Sweeney (1948, 1949), Ver Wiebe and others (1948, pp. 21-27; 1949, pp. 23-27; 1950, pp. 26-35; 1951, pp. 30-33; 1952, pp. 24-27; 1953, pp. 28-30), and Powell and Eakin (1953).

In the greater number of Kansas projects salt water obtained from deep formations, especially Mississippian limestones and Ordovician (Arbuckle) dolomites, is used. Other sources of water supplies include shallow fresh-water wells in stream valley fills, comparatively shallow wells in Pennsylvanian sandstones, streams, ponds, and municipal water supplies. In some places water produced with oil from oil wells is utilized. Treatment of water that is injected is carefully controlled in accordance with laboratory data. Users of salt water from deep aquifers are not faced with seasonal fluctuations in quantity and quality of water. In general brines from deep rocks have fixed chemical composition and therefore the treatment required before injection does not need to be varied after it has been developed. Some Kansas operators inject salt water through closed systems and no chemical treatment is necessary.

Some water-flood operators inject water under pressure of 900 or more pounds per square inch at the well head; others are not increasing pressures due to gravity. Characteristics of the reservoir rocks and of the overburden obviously are factors. In some projects higher pressures are obtained in order to make oil wells flow.

Cores of oil-bearing formations commonly are studied in the laboratory before a lease is put under water flood. Data obtained are used in computing oil content in barrels per acre, oil and water saturation, porosity, and permeability. A commercial laboratory engaged in core analysis in Chanute, operated by highly competent chemists and engineers, is regarded as a great asset.

Grandone (1944, p. 19) has mentioned that the most important item affecting the cost of water flooding usually is that of drilling the required number of wells. Uniform spacing of wells is necessary for maximum oil recovery and ordinarily wells are arranged in the five-spot pattern of squares, each square having an oil well at each corner and a water input well in the center. A development consists of alternate rows of oil wells and water input wells, the number of wells of each kind being about equal. Although this five-spot pattern is approximated in Kansas, the natural pattern of pools, many of which are "shoestrings," does not everywhere permit geometrically perfect well arrangements.

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The importance of production of oil by secondary recovery methods in Kansas is demonstrated in Figure 2, which shows distribution of projects according to a recent survey. Table 4 shows data concerning reported projects in eastern Kansas counties.

PETROLEUM GEOLOGY OF EASTERN KANSAS

Oil reservoirs that have been discovered in eastern Kansas are included in several types of oil traps. The occurrence of more or less isolated sandstone bodies within less porous sediments accounts for the largest number of the known pools. Some sandstone reservoirs may occupy an entire sandstone lens. Examples are the "shoestring" pools of Greenwood and adjacent counties. In some places oil is found only in structurally high parts of the sandstone deposits which may be lenticular and "shoestringlike" or may be wide-spread enough to be called "sheetlike."

Nearly all the reservoirs in Pennsylvanian rocks are sandstones, most of which are relatively fine-grained. Structural highs that have accounted for oil or gas accumulation commonly are low and especially inconspicuous in the surface rocks. Some of the anticlines and domes, however, as in Cowley County, are rather pronounced. Oil and gas in Pennsylvanian rocks on the Nemaha anticline, as in the Augusta and El Dorado fields, Butler County, have accumulated because of structural conditions, although, of course, porous rocks are requisite. Reservoirs in the same fields in deeper rocks are similar except they are in weathered, porous zones in the beveled edges of several formations below disconformities. Production west of the Nemaha anticline in eastern Kansas is found under conditions that are best described as constituting both structural and stratigraphic traps. Pools in Mississippian and older rocks are with few exceptions in weathered rocks just below disconformities but structural conditions have had a part in bringing about accumulation.

The various kinds of oil and gas traps that are known in eastern Kansas are discussed under structural geology and structural provinces.

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STRATIGRAPHY

OUTCROPPING ROCKS

For the purpose of this report the rocks of eastern Kansas can be conveniently placed in seven units. Although these units contain in several instances rocks assigned to more than one system, they are characterized by uniformity of structural attitude and similarity of lithology. Four of these units crop out at the surface. They are Quaternary-Tertiary, Cretaceous, Permian-Pennsylvanian, and Mississippian. The other three units, which in Kansas are known only through information obtained by deep drilling, are Devonian-Silurian, Ordovician-Cambrian, and Pre-Cambrian.

The geologic map of Kansas (Moore and Landes, 1937) shows the areal distribution of outcropping rocks in Kansas. Classification and brief description of these rocks are given by Moore and others (1951).

Quaternary and Tertiary deposits.—The Pleistocene geology of Kansas is described in a recent comprehensive report by Frye and Leonard (1952). Glacial drift, lake deposits, wind-blown clay and silt, and alluvial material, mostly unconsolidated, occur as the mantle rock in much of eastern Kansas. Glacial drift, comprising materials ranging in size from clay particles to huge boulders, is confined to the northeastern part of the State, but outwash material was deposited at an undetermined distance south of the generally recognized "drift border." Wind-laid sediments and stream deposits dating back to the "Ice Age" are recognized in all eastern Kansas counties. Ice sheets invaded Kansas in early Pleistocene time in an area bounded on the west by a line a few miles west of Big Blue River, and on the south by a line several miles south of Kansas River. The glacial deposits consist of clay, sand, silt, gravel, and boulders of quartzite of various colors, granite, and other igneous rock. Glacial deposits do not form a continuous cover for there are numerous outcrops of Permian and Pennsylvanian rocks in the glaciated area.

Alluvium of Pleistocene age is found in the main stream valleys. These stream-laid deposits have a maximum thickness of 85 feet or more and consist of clay, silt, sand, and gravel. Sand and gravel predominate in the larger stream valleys. Chert gravels of probable Tertiary age occur as thin upland deposits at many localities. This material was deposited by eastward-flowing streams over wide

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valley floors that in part are preserved on divides between present stream valleys. Similar chert deposits of a somewhat younger age constitute alluvial terraces along some of the streams, especially in southeastern Kansas. The thickness of the upland flint deposits is generally less than 20 feet, but greater thicknesses are encountered locally.

Cretaceous rocks.—Cretaceous rocks of Gulfian and Comanchean age, chiefly clays and quartz sandstone, are present at the surface in Washington, Marion, Clay, Dickinson, Riley, and Marshall Counties. The thickness ranges from a featheredge to approximately 300 feet. Cretaceous rocks overlie beveled Permian beds that dip more steeply to the west than do the Cretaceous deposits.

Igneous rocks.—In Riley County there are five or more outcrops of pluglike masses of basic igneous rock of probable Cretaceous age. Locations of three of these are shown on the geologic map of Kansas and on the map of Riley and Geary Counties (Jewett, 1941, pl. 1). A granite dike of post-medial Pennsylvanian age cropping out in Woodson County is shown on the geologic map of Kansas (Moore and Landes, 1937). There is some doubt that the granite exposed there represents an igneous body that extends to depth in the locality. It has been reported that several holes drilled a few years ago in the vicinity of the outcrops revealed only the common Pennsylvanian sediments below the surface. There is some evidence of metamorphism in sedimentary rocks in near-by exposures. Basic igneous and metamorphic rocks crop out and occur below sedimentary rocks at shallow depths in another area in Woodson County, known as Silver City, a few miles southwest of the granite exposures.

Permian and Pennsylvanian rocks.—Although regarded as belonging in different geologic systems, the Pennsylvanian and Permian rocks in eastern Kansas are here treated together. The rock layers are essentially parallel and the Permian rocks are separated from the underlying Pennsylvanian beds by an unconformity that is conspicuous in only a few places. About 1,000 feet of Permian rocks classed as the lower part of the Sumner group (middle Permian) and the Chase, Council Grove, and Admire groups (lower Permian) (Fig. 3) are the surface consolidated rocks east of the Cretaceous outcrop in the western part of eastern Kansas. These rocks are largely marine shales and limestones. Detailed descriptions of these strata were given by Fath (1921), Bass (1929, 1936), Jewett (1941a,

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1945), Moore, Frye, and Jewett (1944), Moore and others (1951, 1951a), and O'Connor, Goebel, and Plummer (1953).

An area of Pennsylvanian outcrops occupies the approximate eastern one-fourth of Kansas and is continuous with an area of exposures of the same beds in Oklahoma, Missouri, Nebraska, and Iowa. The beds dip gently outward from the Ozark uplift in Missouri, and in eastern Kansas the direction of dip of the Pennsylvanian beds is generally westward. These rocks are composed largely of shale, sandstone, limestone, and coal beds. The total thickness of Pennsylvanian rocks is about 2,000 feet.

Outcropping upper Pennsylvanian rocks in Kansas comprising the Wabaunsee, Shawnee, and Douglas groups belong to the Virgilian Series; those comprising the Pedee, Lansing, Kansas City, and Pleasanton groups belong to the Missourian Series. The Des-

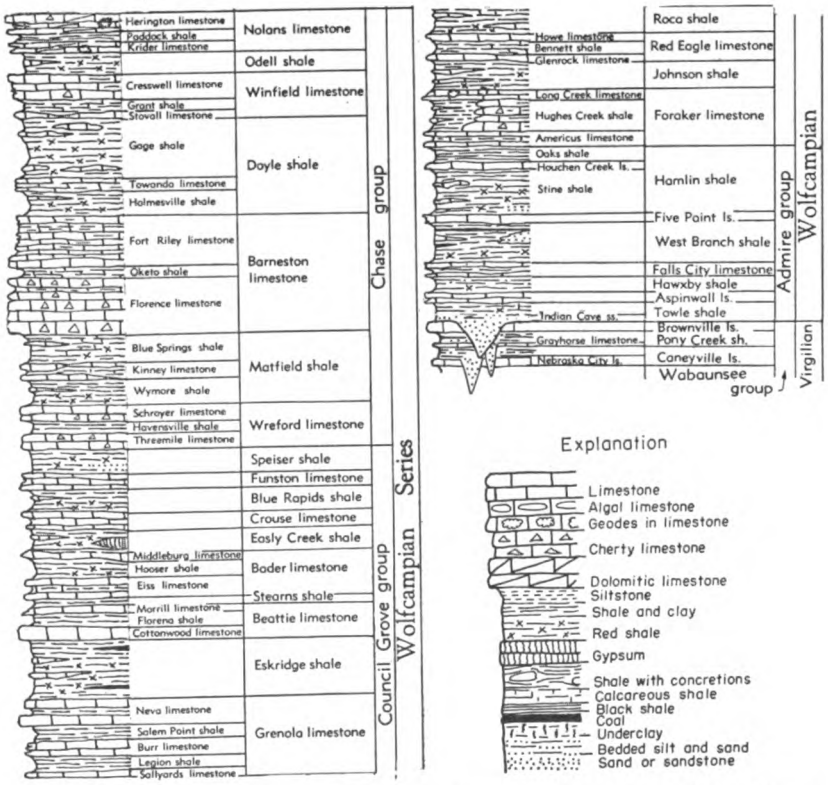

FIG. 3.—Generalized section of outcropping lower Permian rocks in Kansas.

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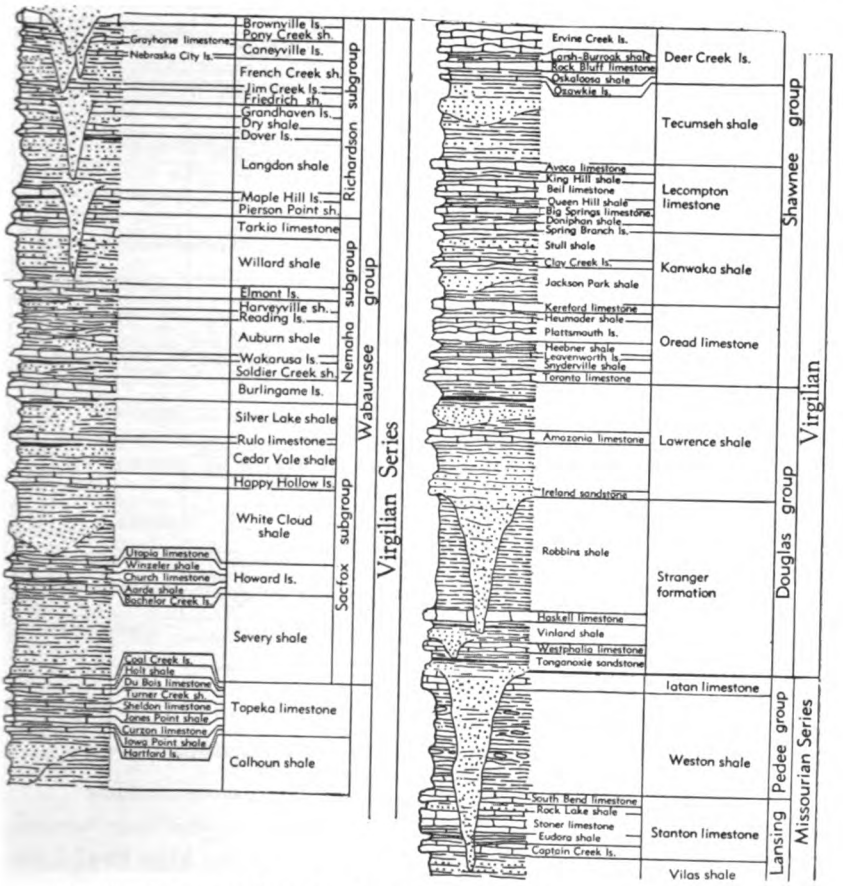

FIG. 4.—Generalized section of outcropping Virgilian rocks in Kansas.

moinesian Series in Kansas includes the Marmaton and Cherokee groups (Figs. 4, 5, and 6). The series boundaries are marked by more or less important regional unconformities, but the beds of the various stages are essentially parallel. Detailed descriptions of Pennsylvanian rocks are given by Moore (1936, 1949), by Moore, Frye, and Jewett (1944), and by Moore and others (1951). The outcropping rocks in the various counties are named and described briefly in the section treating individual counties.

Moore and Thompson (1949) have proposed division of Pennsylvanian rocks into three series—Kawvian (upper), Oklan (middle), and Ardian (lower). Units designated above as series are called

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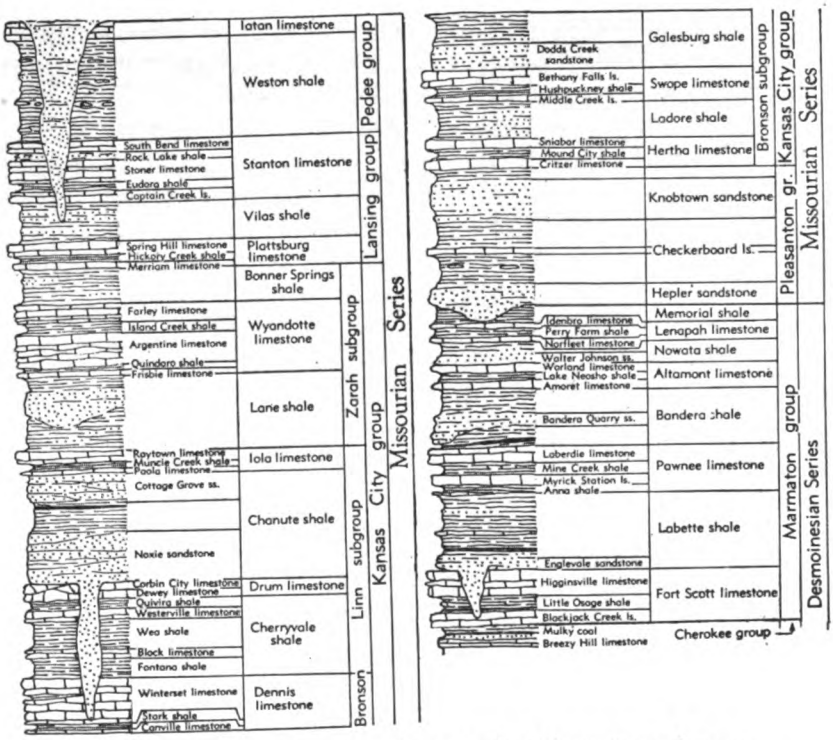

FIG. 5.—Generalized section of outcropping Missourian and upper Desmoinesian rocks in Kansas.

stages by them. The classification used in this report is in accordance with the interstate agreement adopted by the May 1947 Lawrence interstate conference (Moore, 1949, p. 8).

In Kansas, Permian and Pennsylvanian limestones, shales, and coal beds are generally persistent. These strata include many key beds suitable for structural mapping. A regional unconformity separates Pennsylvanian and underlying rocks. Throughout most of eastern Kansas Pennsylvanian strata lie upon various Mississippian formations; however, along the Nemaha uplift the beveled edges of older rocks, including Pre-Cambrian, are overlain by Pennsylvanian deposits.

Mississippian rocks.—Mississippian limestones of Osagian, Meramecian, and possibly Chesteran age crop out in the southeastern corner of Kansas (Fig. 6). The total thickness of exposed Mississippian limestones is about 50 feet.

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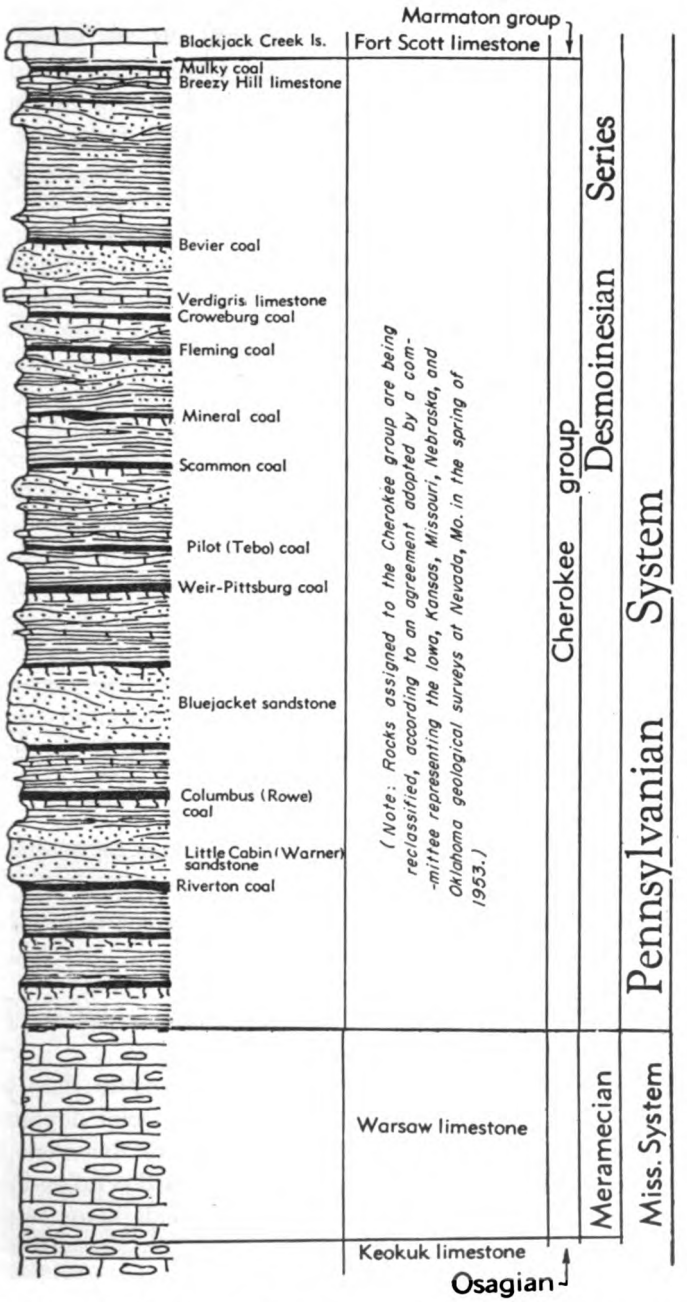

FIG. 6.—Generalized section of outcropping Cherokee and Mississippian rocks in Kansas.

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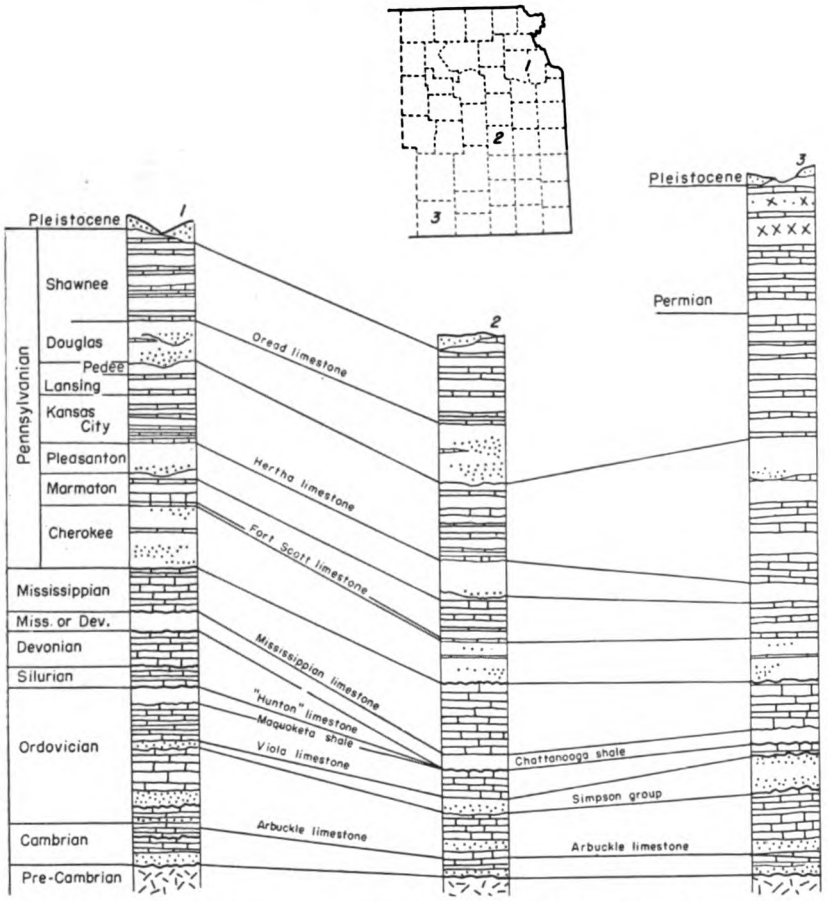

FIG. 7.—Generalized sections of subsurface rocks in three eastern Kansas areas.

BURIED ROCKS

Generalized sections of subsurface rocks in three parts of eastern Kansas are shown in Figure 7.

Rocks of Quaternary and Tertiary age constitute only a thin discontinuous mantle in eastern Kansas. The glacial deposits and deposits of alluvium in the river valleys obscure the more firmly consolidated rocks at many localities. Even on the uplands many wells penetrate a few feet of Pleistocene sediments before reaching consolidated rocks.

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Cretaceous rocks.—Eastern Kansas counties in which Cretaceous rocks occur are Washington, Marion, Clay, Dickinson, Riley, and Marshall. These rocks have a maximum thickness of about 600 feet in the eastern Kansas area. No oil or gas has been found in them in eastern Kansas.

Permian and Pennsylvanian rocks.—The uppermost consolidated rocks encountered in drilling in much of eastern Kansas are either Permian or Pennsylvanian in age. The thickest section of Permian and Pennsylvanian rocks in eastern Kansas is in southwestern Cowley County where they are more than 3,000 feet thick (Fig. 8). Permian rocks do not occur east of a line extending roughly from the north-central part of Brown County southward to the southeast corner of Cowley County. The Geological Survey's geologic map of Kansas (Moore and Landes, 1937) is a guide to the identification of the uppermost rocks in various places.

Permian rocks in eastern Kansas are classified as belonging to the Leonardian and Wolfcampian Series. Rocks of these two series are considered to be conformable and the boundary between them is regarded as being at the top of the Herington limestone member of the Nolans formation. The Leonardian Series includes the Nippewalla and Sumner groups, but the Nippewalla group and the upper part of the Sumner group are not present anywhere in the counties described in this report. The Sumner group includes the Ninnescah shale (absent in eastern Kansas) and the Wellington formation. The Wellington formation lies below the more com-

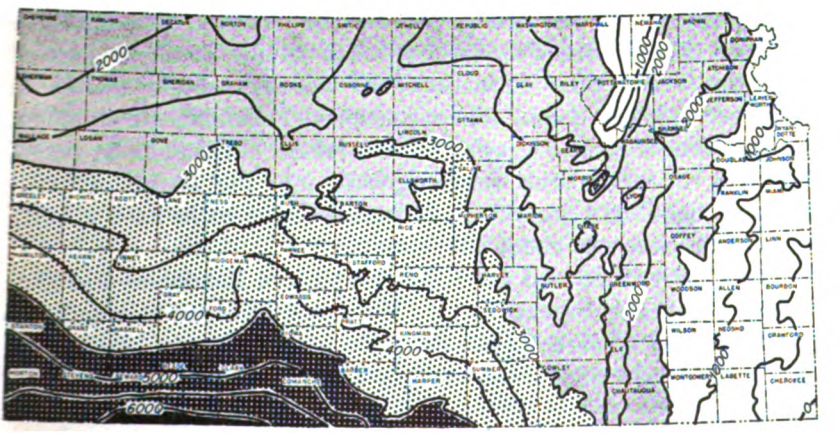

FIG. 8.—Map of Kansas showing thickness of Pennsylvanian and Permian rocks.

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monly red Permian sediments and above the Herington limestone. It is chiefly gray shale, but contains some red and green shale, thick salt deposits in central and western Kansas, impure limestone, anhydrite, and gypsum beds. The thickness of the Wellington is about 750 feet.

Lower Permian rocks (formerly called Big Blue) are remarkably persistent in thickness and lithology both in the area of their outcrop in eastern Kansas and in the subsurface. The series is about 750 feet thick and contains light-gray limestones, several of which are flinty, highly colored shales and siltstones, and a little sandstone in the lower part. These rocks yield gas in Cowley, Morris, and Chase Counties, and oil in Butler County. The Chase, Council Grove, and Admire groups comprise the Wolfcampian Series.

The Chase group includes the Nolans limestone, Odell shale, Winfield limestone, Doyle shale, Barneston limestone, Matfield shale, and Wreford limestone. Flint is abundant in the Stovall member of the Winfield limestone, in the Florence member of the Barneston limestone, and in the Wreford limestone. The shale formations are highly colored; reds, chocolate colors, and greens are prominent. The general thickness of the Chase group is approximately 370 feet.

The Council Grove group includes the Speiser shale, the Funston limestone, the Blue Rapids shale, the Crouse limestone, the Easly Creek shale, the Badger limestone, the Stearns shale, the Beattie limestone, the Eskridge shale, the Grenola limestone, the Roca shale, the Red Eagle limestone, the Johnson shale, and the Foraker limestone. Individual limestone formations and members are thinner than those in the Chase group. Flint is less plentiful, although there is much flint in the Foraker formation in the southern part of the State. The shale formations are somewhat more somber in color, but reds and greens are conspicuous. Fusulinids are abundant in both limestone and gray calcareous shale. It should be noted, however, that fusulinids range upward into the Barneston limestone of the Chase group. The Council Grove rocks have a fairly uniform thickness of about 320 feet.

The important oil and gas "sands" of eastern Kansas are included within the Pennsylvanian rocks. The group and series boundaries as recognized in outcropping Pennsylvanian rocks can be more or less exactly identified from drillers logs and by studies of well cuttings.

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The uppermost series of the Pennsylvanian is the Virgilian, which includes the Wabaunsee, Shawnee, and Douglas groups. The top of the Wabaunsee group, which is also the top of the Pennsylvanian System, is not readily identified in some drillers logs. However, the clastic basal Permian Admire contrasts somewhat with the more limy Wabaunsee rocks. Locally the Indian Cave sandstone in the basal part of the Permian may mark the boundary, and locally a transitional zone at the Permian-Pennsylvanian contact consists of red shales. Sandstones in the upper part of the Wabaunsee section may be miscorrelated with the Indian Cave. The average thickness of the Wabaunsee group in eastern Kansas is about 500 feet. Shale is the most common rock, but sandstone, which occurs in the thicker shale formations, and limestones are also important. In northeastern Kansas the Tarkio limestone, characterized by large fusulinids, is a fairly easily recognized marker bed about 175 feet below the top of the Wabaunsee but the Tarkio is thin or absent farther south. Locally, especially in some places north of Kansas River, the Tarkio and Maple Hill limestones may be rather easily mistaken one for the other. Other easily recognized rocks are the Burlingame limestone, at about the middle of the Wabaunsee, and the Howard limestone, about 75 feet above the base.

The Shawnee group is easily identified in well logs because it contains relatively thick limestone formations in the upper and lower parts and it is overlain and underlain by more clastic rocks. The average thickness of the group is about 350 feet. Throughout most of eastern Kansas the Shawnee group is a fairly compact unit consisting of four limestones and three separating shales. The limestone formations, including their shale members, range from about 30 to more than 50 feet in thickness. Lenticular and locally thick sandstone bodies are common in the upper parts of the shale formations. This group is thicker and contains less limestone in southern Kansas than in northern Kansas. The Topeka limestone occurs at the top and the Oread limestone at the base of the Shawnee group. The black slaty Heebner shale, a few feet above the base of the Oread limestone, is an excellent marker. Its presence is noticeable especially on radioactivity logs.

The Douglas group, consisting principally of shale, sandstone, and minor amounts of limestone and coal, underlies the Shawnee group. The thickness of the group, from the base of the Oread limestone to the regional disconformity that separates Virgilian and Missourian

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rocks, ranges from about 75 to 350 feet in the subsurface in eastern Kansas. A disconformity of wide extent occurs within the group and separates the Lawrence formation from the underlying Stranger formation. The basal part of the Lawrence formation is distinguished by the Ireland sandstone which consists of lenticular sand bodies. Locally the upper part of the Lawrence shale is silty and sandy. The Williamsburg coal occurs in the upper part, a few feet below the Oread limestone. A series of lenticular sandstone bodies, the Tonganoxie sandstone, occurs in the lower part of the Stranger formation. In many places the name Tonganoxie is applied to two or more sandstone beds separated by several feet of shale. Conglomerates occur locally in the basal parts of the sandstone deposits. Neither the Ireland nor the Tonganoxie sandstone is a continuous sand body; in places the lower limit of the Stranger formation cannot definitely be determined.

The Haskell limestone occupies a position near the top of the Stranger formation. Where the Haskell has not been removed by pre-Lawrence erosion it is a convenient "marker" to separate Ireland and Tonganoxie sandstones. Because of the erosional disconformities at the base of the Virgilian rocks, Douglas deposits are in contact with Missourian formations ranging downward from the Pedee group to the upper part of the Lansing group.

Sandstone comprises an important part of the Douglas (lowermost Virgilian) and a lesser part of the Pedee (uppermost Missourian) beds. An erosional break separates deposits of the two series and locally lower Virgilian sandstones fill channels cut into upper Missourian deposits. Hence two sandstones may be in direct contact or Virgilian sandstone may be in contact with Lansing beds.

The Missourian Series occurs below the Virgilian and includes the Pedee, Lansing, Kansas City, and Pleasanton groups. The Pedee group is locally absent, due to pre-Virgilian erosion, but in many places it is about 200 feet thick. It consists chiefly of clastic sediments that lie above the Stanton limestone and below the disconformity at the base of the Stranger formation. The Iatan limestone, about 10 feet thick, is designated as the uppermost formation of the group. It is probable, however, that locally some shale of Missourian age lies next above the Iatan limestone. The Weston shale, the basal formation of the group, consists chiefly of gray clay shale. Pedee rocks are difficult or impossible to detect in many drillers logs.

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The Lansing group is 75 to 275 feet thick in eastern Kansas and consists largely of limestone. It includes the Stanton limestone, the Vilas shale, and the Plattsburg limestone. In southeastern Kansas this group is thicker than farther north and contains more shale and sandstone. A few feet of black platy shale in the Eudora shale member of the Stanton limestone is a marker bed. In some areas it is difficult to differentiate the Plattsburg limestone from the Wyandotte limestone, in the upper part of the Kansas City group. South of T. 30 S., both the Lansing and upper part of the Kansas City group are largely clastic and consist of clayey and sandy shales and thin limestone beds.

The Kansas City group is composed of beds between the base of the Plattsburg (lowermost Lansing) limestone and the base of the Hertha limestone. The group is divided into three subgroups called Zarah, Linn, and Bronson (Moore, 1948). The Iola limestone (uppermost formation of the Linn subgroup) is identified rather easily in drillers logs in much of eastern Kansas. In some reports the lower part of this unit, comprising the Dennis to Hertha limestones, inclusive, is assigned to the "Bronson group" (Moore, 1932, 1936; Jewett, 1932, 1933, 1937, 1940a; Jewett and Newell, 1935; Moore, Frye, and Jewett, 1944; Jewett and Abernathy, 1945). The Bronson rocks now are regarded as a subgroup in the lower part of the Kansas City group.

The Kansas City group, like the Lansing, throughout much of eastern Kansas is largely limestone and the two groups are differentiated with some difficulty. South of T. 30 S., the upper two subgroups consist almost entirely of shale, silty and sandy shale, siltstone, and sandstone. Limestones in the Bronson subgroup, however, are more persistent southward. Flinty and oölitic limestones are characteristic of the Bronson rocks. Two thin black shale beds, one in the Dennis and one in the Swope formation, are subsurface marker beds in the Bronson rocks. The base of the Kansas City group (base of the Hertha limestone) is an excellent subsurface marker in most of eastern Kansas.

The Kansas City group is about 160 feet thick in the northern part of eastern Kansas and about 585 feet thick in the southern part. The thickness of the combined two upper subgroups ranges from about 75 to 385 feet and of the Bronson subgroup from about 85 to 200 feet. Southward thickening is due chiefly to increasing thicknesses of the clastic formations. It is convenient to group together the

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Lansing and Kansas City groups in much of eastern Kansas; the combined thickness ranges from about 250 to 700 feet.

The relatively thick Pleasanton assemblage of shale, sandstone, and very thin limestone beds lies below the Kansas City rocks and above the pre-Missourian and post-Desmoinesian disconformity. In eastern Kansas the thickness ranges from about 100 to 225 feet. "Big shale" is the drillers common term for the Pleasanton shale, and the term "Bourbon shale" has been used in some reports for the same rocks. In northeastern Kansas lenticular sandstone bodies in the upper part, called Knobtown sandstone, locally yield oil. The more persistent Hepler sandstone in the basal part of the group yields oil in Miami County. In some places, as in eastern Miami County, the disconformity at the base of the Bourbon rocks brings the Hepler sandstone in contact with rocks as low as the Bandera shale. The Checkerboard limestone, a well-known surface and subsurface marker in northeastern Oklahoma, extends into southern Kansas as a thin limestone a few feet above the Hepler sandstone. This limestone seemingly is present in eastern Missouri where it is known as the Exline limestone. It may not be continuous (on the outcrop) across eastern Kansas but is recognized in several places.

The Hepler sandstone, which is the northern extension of the upper part of the Seminole formation of northeastern Oklahoma, is absent, very thin, or perhaps only very locally present in eastern Kansas a few miles down dip from its persistent outcrop. Hence, Pleasanton beds cannot be differentiated from shale in the upper part of the Desmoinesian section in most of eastern Kansas, and the uppermost Desmoinesian limestone that is present commonly is the uppermost rock that can be differentiated from the Pleasanton.

Because the lower limestones of the Kansas City group are very thin or absent in southern Kansas, the term Coffeyville formation is used to designate beds between the base of the Dennis limestone (Hogshooter) and the Checkerboard limestone. The Coffeyville formation is stratigraphically equivalent to rocks that comprise most of the Bronson subgroup and the Pleasanton group. It may be noted, however, that at outcrops in southern Kansas the Pleasanton shale part of the Coffeyville formation is differentiated from the upper or Bronson part and that a limy zone in the position of the Swope formation separates the Ladore and Galesburg shales.

"Layton" and "Cleveland sands" are widely used terms for sandstone bodies in the Coffeyville formation. These, although broadly

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lenticular, are locally more or less sheetlike deposits of probable deltaic origin. The "Layton sand," at about 2,300 feet, yields oil in the Turner and Winfield fields, Cowley County. The name "Layton" is used in some places for one or more sandstones that are somewhat higher stratigraphically than Coffeyville rocks. The usage of these names is discussed more fully on subsequent pages of this report.

The Desmoinesian Series, comprising a total thickness of about 600 feet, includes the oldest Pennsylvanian rocks of eastern Kansas. The Marmaton group, consisting of about 250 feet of shale and limestone formations, is the uppermost group of the Desmoinesian. Along the outcrop of Marmaton rocks, which extends from Linn County southwestward to Labette and Montgomery Counties, the limestone formations are well developed and are differentiated into limestone and shale members (Jewett, 1941a). Because of the occurrence of important oil and gas reservoir rocks in this group and in the underlying Cherokee shale, identification of Marmaton formations in the subsurface is important. The group includes the Holdenville* shale, the Lenapah limestone, the Nowata shale, the Altamont limestone, the Bandera shale, the Pawnee limestone, the Labette shale, and the Fort Scott limestone.

The Lenapah limestone is about 30 feet thick in the southern part of eastern Kansas; elsewhere it is thin or locally absent because of local post-Desmoinesian erosion. The Nowata shale contains sandstone lenses, including the "Wayside sand," an important oil reservoir in southeastern Kansas and northeastern Oklahoma. The Altamont limestone, commonly less than 20 feet thick, occurs about 30 feet below the Lenapah limestone. The Bandera shale, consisting of gray and yellow clay shale and sandstone, occurs below the Altamont and includes the "Weiser sand." This formation ranges in thickness from 20 feet or less to about 100 feet. The Pawnee limestone is a persistently conspicuous pinkish limestone that ranges in thickness from about 20 to 60 feet in the subsurface in eastern Kansas. Two or more limestone members can be differentiated in many drillers logs. The Labette shale ranges in thickness from about 25 to 100 feet except in most of Cowley County and locally in Chautauqua County where only a few feet of this shale lies between the Pawnee and Fort Scott limestones. The

* Recent studies by the Oklahoma Geological Survey have shown that shale in some previous reports called Memorial is correlative with the Holdenville formation of Oklahoma.

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Labette consists of gray and black clay shale and gray silty and sandy shale, sandstone, thin beds of limestone, and thin coal beds. "Peru sand" is the common term for sand bodies in the Labette shale in the subsurface. The Fort Scott limestone is the lowermost Marmaton formation and immediately overlies the Cherokee shale. In most wells in eastern Kansas two limestones and a separating shale member can be identified; in some parts of southern Kansas four or more limestones are present. The thickness of the Fort Scott limestone ranges from about 25 to 100 feet. Many wells in eastern Kansas produce gas from black shale associated with the Fort Scott limestones. Production from this zone is often referred to as "Oswego" production.

The Cherokee shale,* which includes important oil and gas reservoirs in eastern Kansas, comprises beds below the Fort Scott limestone (lowermost Marmaton) and above the pre-Pennsylvanian rocks. The Cherokee shale is not of early Pennsylvanian age, but it is the oldest Pennsylvanian rock in eastern Kansas. It lies on Mississippian limestone formations in most parts of eastern Kansas, but it overlies pre-Mississippian rocks in the Nemaha anticlinal area. The thickness of Cherokee rocks ranges from a few feet along the Nemaha uplift to about 800 feet in the deepest part of the Forest City basin. The common thickness in eastern Kansas is about 350 or 400 feet.

The Cherokee consists of dark and light-colored clayey and silty shales, some important sandstones, and a minor amount of limestone and coal. The upper few feet is commonly black platy shale and this zone is an important "shale gas" reservoir in several eastern Kansas counties. Sandstone beds, called "Squirrel sand," commonly occur in the upper part of the Cherokee shale. These sandstones are gas and oil reservoirs in several eastern Kansas counties, especially Franklin, Linn, and Miami. The "Squirrel sand" where present is generally about 30 feet below the Fort Scott limestone. The thickness ranges from a few feet to as much as 80 feet (Lee, 1943, p. 83). The Ardmore limestone, commonly about 4 feet thick, is a convenient marker bed in the upper middle part of the Cherokee shale. In drilling it is generally encountered 80 to 100 feet below the top of the Cherokee.

* The Geological Surveys of Iowa, Kansas, Missouri, and Oklahoma have agreed to apply the names Krebs group to lower Cherokee rocks and Cabaniss group to the upper part. However, in this report these Pennsylvanian rocks below the Fort Scott limestone are referred to as "the Cherokee."

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"Burbank sand" is a term applied locally to sandstone in the middle part of the Cherokee, and the name "Bartlesville sand" is applied commonly to sand bodies in the middle and lower parts of the Cherokee. Sandstone that lies on or a few feet above the Mississippian limestone often is called "Burgess sand," but there are other names that have more or less local application.

Usage of names for sandstone bodies or for sandstone zones in the Cherokee rocks generally is well understood locally but of the several names in current usage most or all of them are applied to different formations. "Cattleman sand" is applied to sandstone bodies in Greenwood County that occur in the upper-middle part of the Cherokee section, 50 to 75 feet above what there is called "Bartlesville sand." The "Cattleman" occurs in more or less isolated lenses in a zone that may be correlative with that of the "Burbank sand" as the name is used in near-by places. In many places in eastern Kansas "Bartlesville sand" is applied to sandstones somewhat younger than the productive sandstone that is called Bartlesville in the Bartlesville-Dewy oil field (Washington County, Oklahoma). Possibly there is no "true Bartlesville" in eastern Kansas.

Names that are in common usage for various sandstones in Cherokee and other rocks are explained on pages 76 to 90.

Mississippian rocks.—Various Mississippian limestone formations ranging in age from Osagian or Kinderhookian through Meramecian are present throughout most of eastern Kansas (Lee, 1939; 1940; 1943, pp. 66-79). These rocks were removed by late Mississippian or early Pennsylvanian erosion from a large area along the northern part of the Nemaha anticline northward from the northern part of Chase County and from higher parts of the anticline northward as far south as Augusta in Butler County (Lee, 1939, pl. 1). The thickness of the Mississippian limestone formations in eastern Kansas ranges from a featheredge to more than 450 feet. Various kinds of limestone and dolomite are present and chert is characteristic of some of the formations. The distribution of various Mississippian formations in Kansas is shown by Lee (1940, pl. 8).

In most parts of eastern Kansas the Mississippian limestones are underlain by the Chattanooga shale of early Mississippian or late Devonian age. The Chattanooga shale and some younger beds (Northview shale and Compton limestone) were deposited above an extensive peneplain which had been developed on previously deformed rocks. The maximum thickness of the Chattanooga shale is

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about 260 feet, but the thickness commonly is not more than 50 feet. The Chattanooga shale is dark gray or black in southeastern Kansas, but it is lighter and greenish gray in the northern part. Sandstone is included in the basal part in some areas. Generally the Chattanooga contains plant spores and locally it is silty. In southeastern Kansas the Northview shale, which has a maximum thickness of about 28 feet, and the Compton limestone, which has a maximum thickness of about 60 feet (Lee, 1940, p. 31), occur conformably above the Chattanooga shale. The Northview and Compton are correlative with the Chouteau limestone of Missouri.

Devonian and Silurian rocks.—The terms "Siluro-Devonian" (Ockerman, 1935 p. 30, pl. 1) and "Hunton" limestone are commonly used to designate formations in eastern Kansas that occupy a position below the Chattanooga shale and above the Ordovician rocks. These are convenient names, but Lee (1943, pp. 43-59, fig. 3) has shown that there is an angular unconformity between Silurian and Devonian rocks in eastern Kansas and that several formations that crop out in Missouri and Oklahoma can be identified in the subsurface in Kansas. According to Lee (1943, p. 52), undifferentiated limestones and dolomites of Late Devonian age and the Cooper limestone, of Middle Devonian age, occur in eastern Kansas, and the Silurian rocks of the area consist of the Brassfield and Edgewood limestones which are correlative with the Chimneyhill limestone of Oklahoma (Lee, 1943, p. 45).

Devonian and Silurian rocks occur in eastern Kansas east and west of the northern part of the Nemaha anticline, and a small area in the southeastern part of Marion County is underlain by these rocks (McClellan, 1930; Ockerman, 1935, fig. 2). With the exception of the Nemaha anticlinal area, Devonian and Silurian rocks are present north and west of a line extending in a general east-west direction in or near T. 15 S. According to Lee (1943, pp. 45, 47), the greatest known thickness of Devonian rocks in eastern Kansas is about 250 feet and that of Silurian rocks is about 150 feet. The rocks are chiefly limestone and dolomite.

Ordovician and Cambrian rocks.—Maquoketa shale, Kimmswick limestone, Decorah shale, Plattin limestone, St. Peter sandstone, undifferentiated Cotter and Jefferson City dolomites, Roubidoux formation, undifferentiated Gasconade and Van Buren dolomites, and Gunter sandstone of Ordovician age have been identified in eastern Kansas. The Eminence and Bonneterre dolomites and the

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Lamotte sandstone of Cambrian age have been identified. The rocks between the St. Peter sandstone and the Lamotte sandstone are commonly called Arbuckle or may be referred to as "siliceous lime." Lee (1943, pp. 19-20), however, has pointed out that the Bonneterre dolomite does not properly belong in the Arbuckle assemblage. It is recognized that the Arbuckle rocks, with or without the inclusion of the Bonneterre dolomite, constitute a convenient grouping of formations of Late Cambrian and Early Ordovician age. Late Devonian or Early Mississippian rocks rest directly on Arbuckle rocks in the Chautauqua arch area. Oil has been discovered in Arbuckle rocks in eastern Kansas in Elk, Wilson, Chautauqua, Montgomery, Labette, Cowley, and Marion Counties.

Lee (1943) has made known many data concerning the stratigraphy and structure of older Paleozoic rocks in the Forest City basin. Keroher (in Jewett, 1941, pp. 107, 110) interpreted drillers logs of several wells in Riley and Geary Counties, but he did not make separations within the Arbuckle rocks. Keroher also studied cuttings of pre-Mississippian rocks from a well in Linn County in the northern part of the Chautauqua arch area (Jewett, 1940a, pp. 12-14) and subdivided these rocks. Abernathy (1943) studied samples from the Jayhawk Ordnance Works deep water well in northeastern Cherokee County, and identified the Cotter dolomite, the Jefferson City dolomite, the Roubidoux formation, and the Gasconade dolomite. This well, which is near the crest of the Chautauqua arch, reached 20 feet into the Gasconde dolomite. Early Mississippian (Kinderhookian) beds lie on Cotter dolomite in this area.

The Maquoketa shale occurs east and west of the Nemaha anticline in northeastern Kansas (McClellan, 1930; Ockerman, 1935, fig. 2; Lee, 1943, fig. 12, pp. 40-42). It was originally deposited throughout northeastern Kansas and probably across the Chautauqua arch (Lee, 1943, p. 42). Pre-Devonian erosion removed it and some older and younger rocks from large areas in southeastern Kansas and Missouri. Near the end of Mississippian time, the Maquoketa was eroded generally from the northern part of the Nemaha anticline. According to Lee (1943, p. 41), the formation is separable roughly into an upper and a lower part. Generally the upper zone is silty impure dolomite, and the lower zone is dolomitic silty dark shale. In general, the Maquoketa shale is gray and greenish gray, and ranges from a featheredge to about 80 feet in thickness.

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The Kimmswick limestone has been eroded from the northern part of the Nemaha anticline and from the Chautauqua arch. The formation is largely dolomite in northeastern Kansas but it changes to limestone toward the south in Johnson, Douglas, and adjacent counties (Lee, 1943, p. 36). Chert is characteristic of the middle part of the formation. The thickness ranges from a featheredge to about 180 feet. Lee has identified the Decorah shale and the Plattin limestone in cuttings from several northeastern Kansas wells. The Decorah shale is characterized by sandy dolomite interstratified with dark and gray-green shale (Lee, 1943, p. 32). Later, Leatherock (1945) correlated the "Plattin" limestone with the Platteville limestone. The Decorah shale is believed to be more generally present than is the Platteville limestone. The thickness of the formations east of the Nemaha anticline ranges from a few feet to about 85 feet. About 300 feet of Viola limestone occurs in Clay and other counties in the northwestern part of eastern Kansas. The Kimmswick limestone, the Decorah shale, and the Platteville limestone are often correlated with the Viola limestone of Oklahoma. However, Lee believes that only the Decorah shale and the Kimmswick limestone correspond in age to the Viola limestone, and according to Leatherock (1945) the Platteville (Plattin of Lee) limestone and the St. Peter sandstone are of Simpson age.

The St. Peter sandstone occurs generally between the Viola and Arbuckle rocks, but it is separated from younger and older rocks by important disconformities. In northeastern Kansas it oversteps all older Ordovician and Cambrian rocks and in the northwestern part of eastern Kansas it lies on Pre-Cambrian granite (Lee, 1943, pp. 29-30, fig. 5, pl. 1). Lee has found that in most northeastern Kansas wells that have been drilled into these rocks, the Decorah shale lies upon the St. Peter sandstone, but in the deeper part of the North Kansas basin limestone tentatively identified as Plattin overlies the St. Peter sandstone.

The St. Peter sandstone and younger pre-Chattanooga rocks were eroded from the Chautauqua arch in southeast Kansas before deposition of the Chattanooga shale. Immediately before the beginning of Chattanooga deposition the St. Peter sandstone was exposed in a narrow belt extending from a point near the northeast corner of Johnson County southwestward to Sumner County. This line is used commonly to mark the boundary of the Chautauqua arch. Arbuckle rocks were exposed south and east of the St. Peter ex-

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posure; younger Ordovician, Silurian, and Devonian formations were exposed west and north of the St. Peter outcrop. South and east of this line the Chattanooga shale, or locally Mississippian limestones, now lie upon Arbuckle rocks. The St. Peter sandstone and other rocks were removed from the northern part of the Nemaha anticline before Pennsylvanian deposition. The St. Peter formation is chiefly white sandstone composed of well-rounded grains but it includes a minor amount of green shale. The thickness of the St. Peter in eastern Kansas ranges from a featheredge to more than 400 feet; the common thickness is between 50 and 85 feet. St. Peter sandstone is sometimes called "Wilcox sand."

In eastern Kansas the St. Peter sandstone oversteps older Ordovician and Cambrian rocks from the east (Lee, 1943, fig. 5). That is, the Cotter-Jefferson City dolomites and older rocks were beveled before burial under the St. Peter sandstone. Undifferentiated Cotter and Jefferson City dolomites are absent in the Forrester et al. No. 1 Hummer well in Shawnee County, but they are 106 feet thick in the Duffens et al. No. 1 Stanley well in Douglas County. Keroher (Jewett, 1940a, pl. 2B) identified 168 feet of tan and gray oölitic chert dolomite as undifferentiated Cotter-Jefferson City in the Holeman and Edwards No. 9 Pollman well in Linn County. Abernathy (1943, fig. 2) identified 105 feet of Cotter dolomite, including a few feet of Swan Creek sandstone in the basal part, and 300 feet of Jefferson City dolomite in the Jayhawk Ordnance Works water well in Cherokee County. An inconspicuous unconformity is believed to occur between the Cotter and Jefferson City formations in eastern Kansas.

The Roubidoux formation is present throughout a wide area in eastern Kansas (Keroher, in Jewett, 1940a, pl. 2B; Abernathy, 1943, p. 85, fig. 2B; Lee, 1943, pp. 25-26, fig. 5). It comprises sandy gray dolomite and sandstone. Recorded thicknesses are 175 feet in Shawnee County, 167 feet in Douglas County, 145 feet in Linn County, and 155 feet in Cherokee County.

Undifferentiated Gasconade-Van Buren formations are believed to occur throughout eastern Kansas except in the northern part of the Nemaha anticline area. Lee (1943, fig. 5) reported 90 feet in the Hummer well in Shawnee County and 206 feet in the Stanley well in Douglas County. Both figures include a few feet of Gunter sandstone in the basal part. Keroher (in Jewett, 1940a, pl. 2A) reported that these formations, including a few feet of Gunter sandstone, are

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135 feet thick in the Pollman well in Linn County. The Jayhawk Ordnance Works well in Cherokee County was drilled 20 feet into the upper part of the Gasconade dolomite (Abernathy, 1943, fig. 2B). The undifferentiated Gasconade-Van Buren formations are chiefly cherty dolomite.

The Eminence dolomite underlies the Gunter sandstone in most parts of eastern Kansas, but it is not present in the northwestern part of the Forest City basin (Lee, 1943, p. 23, fig. 5). Recorded thicknesses are 90 feet in Shawnee County, 175 feet in Douglas County, and 150 feet in Linn County. The formations consist chiefly of light crystalline dolomite. Lee has pointed out that the Potosi dolomite may be present in easternmost Kansas as a thin wedge between the Eminence and Bonneterre dolomites. The Bonneterre dolomite is commonly present in eastern Kansas unconformably below the Eminence dolomite and unconformably above the Lamotte sandstone. The thickness ranges from a featheredge to about 200 feet in Crawford County (Keroher and Kirby, 1948, p. 31). In the northeastern, extreme eastern, and southeastern parts of eastern Kansas several feet of sandstone lies next above the Pre-Cambrian floor. This sandstone is probably equivalent to the Lamotte sandstone of Missouri and it commonly is called Lamotte. The Reagan sandstone which is exposed in the Arbuckle Mountains in southern Oklahoma, occupies a stratigraphic position similar to that of the Lamotte sandstone. The Lamotte in eastern Kansas is coarse-grained and arkosic sandstone ranging in thickness from a featheredge to more than 100 feet. The known maximum is in Crawford County (Keroher and Kirby, 1948, p. 20).

Keroher and Kirby (1948) have shown results of studies of Upper Cambrian and Lower Ordovician rocks in Kansas. Descriptions and photographs of acid-insoluble residues included in their report are useful in identifying units in the Arbuckle and lower rock section. Formations studied include in descending order: (1) undifferentiated Cotter and Jefferson City dolomites, (2) Roubidoux dolomite, (3) undifferentiated Gasconade and Van Buren formations of Early Ordovician age, (4) the Eminence dolomite, (5) the Bonneterre dolomite, and (6) Lamotte sandstone.

Pre-Cambrian rocks.—Many wells in eastern Kansas have been drilled completely through the Paleozoic rocks into the more crystalline basement rocks. Some early wells were continued into granite or metamorphic rocks because it was not recognized that

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these rocks are Pre-Cambrian in age and are generally believed not to contain oil or gas. Pre-Cambrian rocks in Kansas are everywhere buried by sediments; hence they are known only from well cuttings or cores. They consist chiefly of granite, gneiss, and schist; quartzite, other metamorphic rocks, and igneous rocks of various kinds are also included.

According to Landes (1927), most of the "granite wells" east of the Nemaha anticline encountered granite or gneiss, but schist is not uncommon. Gneiss is a metamorphic rock in which the various minerals occur in more or less distinct bands. Some gneisses cannot be distinguished readily from granite in well cuttings. Schist is rather easily mistaken for shale. Wells that have been drilled through the sedimentary rocks in the area of the Nemaha anticline have chiefly revealed granite or gneiss in contact with the overlying Paleozoic rocks. It is reasonable to believe that in eastern Kansas beyond the flanks of the Nemaha anticline great thicknesses of metamorphic rocks lie between rocks of Paleozoic age and deeply buried granite or other igneous rocks. In fact, a well in Marshall County penetrated nearly 2,000 feet of schist and other Pre-Cambrian rock, and a well in Greenwood County was drilled into 650 feet of schist that was logged as shale (Landes, 1927, p. 822). The log of a well drilled at Iola, Allen County, indicates that 1,280 feet of metamorphic rocks was penetrated.

The upper surface of the eastern Kansas Pre-Cambrian rocks is an ancient irregular surface which was subjected to erosion for a long time before it was buried under younger rocks. The approximate configuration of the Pre-Cambrian rock surface in Kansas is shown in Figure 9. Sedimentary rocks ranging in age from Pennsylvanian to Cambrian directly overlie Pre-Cambrian rocks in Kansas. Pre-Cambrian rocks in Kansas are nearest the surface in Nemaha County on the crest of the Nemaha anticline where the cover of Pennsylvanian rocks is about 600 feet thick. The crest of the crystalline rock ridge in the core of the Nemaha anticline slopes southward. It is about 2,700 feet below the land surface near El Dorado, in Butler County, and it is deeper southwest of El Dorado. The Pre-Cambrian floor is generally more than 2,000 feet lower just east of the Nemaha anticline than it is on the crest of the granite core. Thence the surface of contact between crystalline and sedimentary rocks rises to the east.

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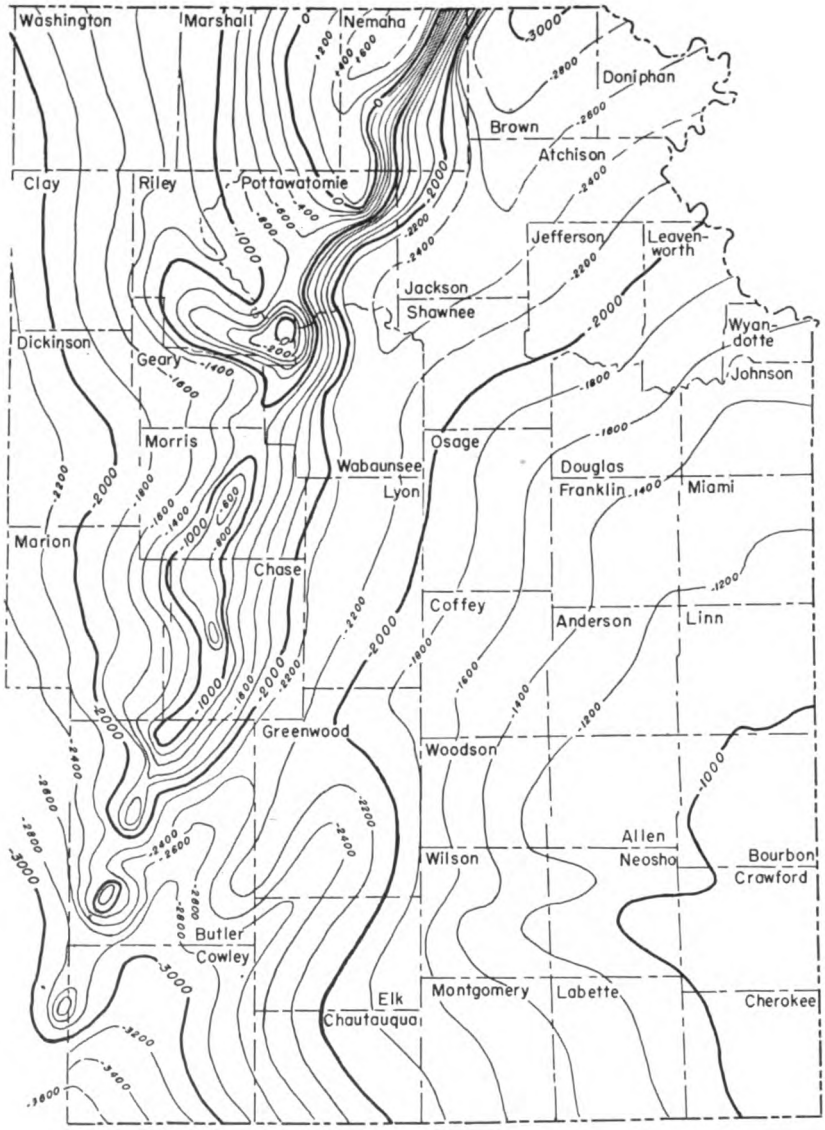

FIG. 9.—Map of eastern Kansas showing the approximate configuration of the upper surface of Pre-Cambrian rocks. Contour lines are drawn on sea level datum. Map drawn by John S. Porter.

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It is commonly believed that the Pre-Cambrian floor marks the lower limit of oil and gas occurrence. However, both oil and gas have been found in Pre-Cambrian rocks in Rice and Russell Counties, Kansas. The oil and gas there occur in stratigraphic traps in metamorphic rocks lying immediately below sediments of Pennsylvanian age.

Structural Geology and Structural Provinces

In the foregoing discussion of eastern Kansas stratigraphy, rocks are grouped in divisions that may be regarded as both stratigraphic and structural. For example the Pennsylvanian and Permian rocks constitute an independent structural unit, set off from higher and lower rocks by angular disconformities. They have been affected by more earth movements than have younger rocks and by less than the overlying strata. The same is true of Mississippian and other time-rock divisions. For convenience, however, and for better understanding of conditions under which oil and gas accumulated, it is desirable to consider geographic structural units (or structural provinces) and they too must be thought of in relationship to time. This is because some areas of ancient uplifts later became basins and *vice versa*. For example in middle Pennsylvanian time there was a shallow basin, the Cherokee, in southeast Kansas; but earlier the Chautauqua arch occupied the same place. In late Pennsylvanian time the Nemaha anticline, or uplift, was formed across an area that previously had been the North Kansas basin.

In general, basins, as the term is used in this kind of discussion, are areas in which sections of rock of some particular age span are thicker than in surrounding areas, and uplifts are areas in which certain rocks, although present in neighboring areas, are relatively thin or absent.

Pre-St. Peter structural provinces

Eastern Kansas seemingly was undergoing erosion for a long interval of time assigned to the early and middle parts of the Cambrian Period. This assumption is made because no Paleozoic rocks older than those of Late Cambrian age are known there. Any sediments that may have accumulated in that time were removed before the Lamotte sandstone, the lowermost recognized Cambrian unit, was deposited. In Late Cambrian time the shallow basin in which

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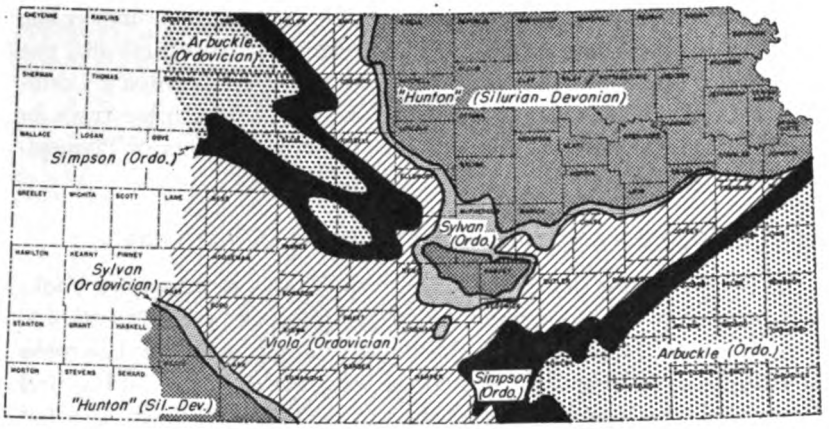

FIG. 10.—Sketch map of Kansas showing inferred post-Devonian pre-Mississippian areal geology.

the sands of the Lamotte formation were deposited spread westward; as it became deeper and wider the facies of sediments changed and the Bonneterre dolomite accumulated over probably all of Kansas, taking its place on the Pre-Cambrian floor beyond the site of Lamotte sandstone deposition or above the clastic deposits in smaller and earlier basinal areas. Then, in general, eastern Kansas continued to subside although an erosional unconformity is believed to separate the Bonneterre from the overlying Eminence dolomite. The Gunter sandstone, which is regarded as lowermost Ordovician of the region, rests on an erosional surface, and there probably is a disconformity at the top of the Gasconade formation. These disconformities mark times of uplift and removal of some rock material, but in general the earth movements were downward in Late Cambrian and Early Ordovician time. In part contemporaneous with this general subsidence, which produced what is known as the Ozark basin (Lee, Leatherock, and Botinelly, 1948, p. 122), relative uplift in southeastern Nebraska and in northeastern Kansas produced the Southeast Nebraska arch (Lee, 1943, p. 102).

Figure 9 shows the approximate configuration of the upper surface of Pre-Cambrian rocks in eastern Kansas. This surface is believed to have been nearly level at the time of deposition of Late Cambrian rocks. Its present shape is the result of the many earth movements that have taken place since the time of the earliest Lamotte sandstone deposition. The knowledge of ancient

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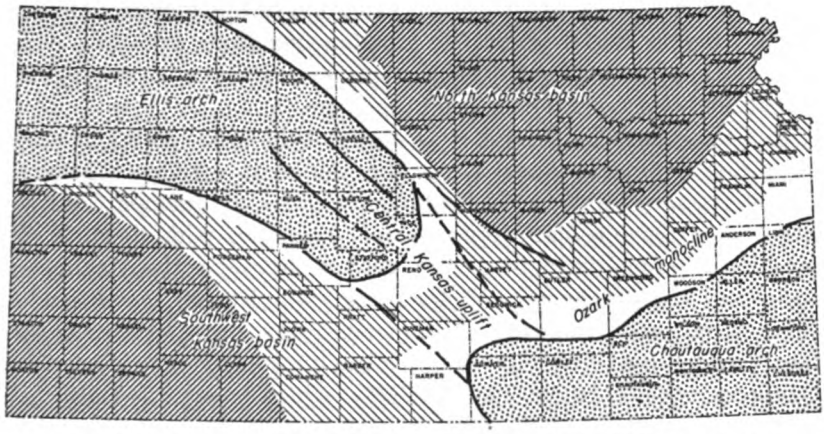

FIG. 11.—Sketch map showing main structural elements in Kansas during Mississippian time.

structural elements is gained chiefly through the study of thicknesses of stratigraphic units and their attitudes in reference to overlying rocks.

POST-ST. PETER PRE-CHATTANOOGA STRUCTURAL PROVINCES

The unconformity lying next below the Chattanooga shale (uppermost Devonian or lowermost Mississippian) is an important and convenient datum horizon in subsurface studies in eastern Kansas. Pre-Mississippian structures can be separated readily from those of later origin. Devonian and Silurian rocks occur next below the pre-Chattanooga unconformity in a large area in northeastern Kansas. Elsewhere different formations of Ordovician age lie next below the Chattanooga shale or, in places where the Chattanooga is absent, next below Mississippian limestone. Several southeastern Kansas counties lack Devonian, Silurian, and Upper and Middle Ordovician rocks, and there the strata next below the pre-Mississippian unconformity are classified as belonging to the Arbuckle group of Early Ordovician or Late Cambrian age. The major pre-Mississippian structural features in eastern Kansas are the Chautauqua arch and the North Kansas basin (Fig. 11).

Chautauqua arch.—In southeastern Kansas there is a broad area in which Arbuckle rocks, flanked on the northwest by bands of successively younger Ordovician formations, lie next below the pre-Chattanooga unconformity (Fig. 10). This situation is due to early

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uplift and erosion of the westward extension of the ancestral Ozark uplift. Before burial under the Chattanooga shale, the area was partly peneplaned; hence the Chattanooga sediments overstep various formations along the flanks of the dome.

In Kansas the Chautauqua arch occupies the area south and east of a line extending from about the southeast corner of Miami County to a point near the northwest corner of Sumner County (Fig. 10). Such a line approximately coincides with the line of pre-Mississippian outcrop of the contact between the Arbuckle rocks and the overlying St. Peter formation. The St. Peter sandstone, along with other pre-Chattanooga rocks, dips outward from the Chautauqua arch, forming a structural element called the Ozark monocline (Rich, 1933, p. 796), which is regarded also as the northwest flank of the Chautauqua arch or the south flank of the North Kansas basin.

Before leaving the discussion of the Chautauqua arch it is well to note that the structure actually is, with the Ellis arch, part of a large element called the Central Kansas arch (Rich, 1933, p. 796, fig. 2). The name is not to be confused with Central Kansas uplift (which is synonymous with the Barton arch) of central Kansas and which in part occupies the site of the earlier Ellis arch. The Central Kansas arch may be said to be the real backbone of Kansas structure and is the most prominent feature that establishes the ancient grain of the State, which is nearly southeast—northwest. Some if not all the higher parts of the younger Nemaha anticline lie along lines of pre-Mississippian folding. Disposition of oil pools in Elk, Montgomery, and Labette Counties suggests the southeastward extension of the pre-Mississippian Wilson-Burns structure (Koester, 1935; Jewett, 1951, p. 104; 1951a, p. 166), which extends from the Burns dome in Butler County to eastern Russell County, through the Elbing, Peabody (Marion County), and the Ritz-Canton and McPherson fields farther west. The Burns dome is a high part of the Nemaha anticline and the oil pools farther northwest are on structures that also lie along lines of post-Mississippian folding parallel to the Nemaha anticline.

The Ellis arch, mentioned above, is partly in the same area as the post-Mississippian Barton arch, but the strike of anticlinal folds in rocks below Pennsylvanian strata there are aligned with folds in the Chautauqua arch and seem best interpreted as older in origin

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than other structural features of the Barton arch (Moore and Jewett, 1942, p. 485, fig. 7).

North Kansas basin.—This is a pre-Chattanooga basin that lies north of the Chautauqua arch and east of the Ellis arch (Fig. 10). Northward from the Chautauqua arch and across the Ozark monocline, the Chattanooga shale and Mississippian limestone overstep successive Ordovician rocks including St. Peter (Simpson) sandstone, Viola dolomite, Maquoketa shale, and Silurian and Devonian rocks known as "Hunton." Hence in northeastern Kansas a more complete Paleozoic section is encountered, but it is one of many disconformities and overlaps. Porosity in the "Hunton" limestone in northeastern Kansas largely is due to pre-Chattanooga weathering, and the "Hunton" oil pools in Brown and Nemaha Counties, like those in the Viola and Arbuckle in various parts of eastern Kansas, may in part be regarded as being in stratigraphic traps, inasmuch as the pre-Chattanooga and pre-Maquoketa surfaces are beveled; if one could see the ancient weathered terrains, without doubt he would see that weathering was differential in accordance with the lithology of the rock layers.

Mississippian and Later Structural Provinces

Lee (1943, p. 115) has shown that movements of minor importance took place along the axis of the present Nemaha anticline during Mississippian time. However, deformations that occurred during early Pennsylvanian time produced the present main subsurface structural elements in eastern Kansas (Fig. 12). These structures include the Nemaha anticline and small parallel folds such as the Voshell anticline, the Cherokee and Forest City basins, and the low Bourbon arch between the two basins. Farther west and extending into western Kansas are the Salina and Sedgwick basins.

Nemaha anticline.—The Nemaha anticline, whose buried crystalline core is often referred to as the Nemaha mountains or granite ridge, trends south-southwest across Kansas from Nemaha County to Sumner County. Mississippian and older rocks are tilted and eroded on the flanks of this uplift, which is much steeper in most places along its length on the east than on the west (Jewett and Abernathy, 1945, pp. 1-3). Pennsylvanian sediments on the anticline overstep and overlap rocks ranging in age from Pre-Cambrian to Mississippian. Pennsylvanian strata lie upon Pre-Cambrian rocks

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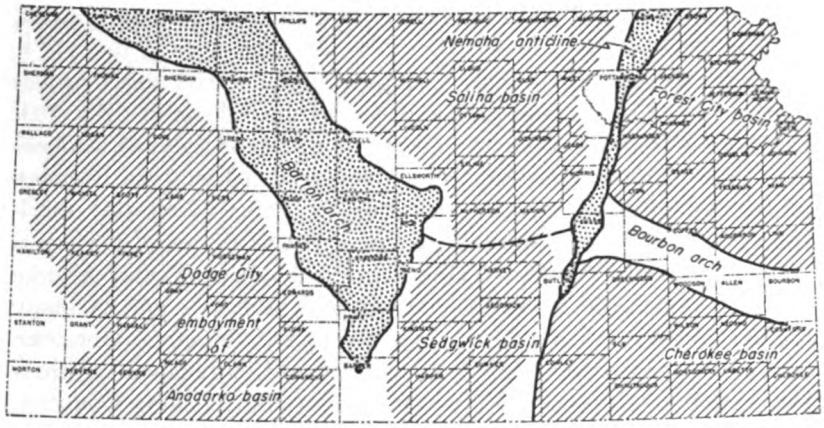

FIG. 12.—Sketch map showing early Pennsylvanian structural provinces in Kansas.

in a belt extending in a northeastward trending direction from a point in T. 11 S., R. 10 E., and in some areas farther south. The extreme northern part of the ridge of Pre-Cambrian granite in the Nemaha anticline was not covered by enduring Pennsylvanian sediments until Virgilian time. Older Pennsylvanian beds overlap and overstep Pre-Cambrian and Paleozoic rocks along the southern part of the axis of the ridge. In general Pre-Cambrian rocks lie about 2,000 feet lower a short distance east of the uplift than on its axis.

The famous El Dorado and Augusta oil fields (Butler County) lie in and on the flanks of the Nemaha anticline. In those fields the chief producing zone is along the beveled pre-Pennsylvanian surface cut in Ordovician rocks. Several other pools, mostly on the flanks of the uplift in its southern part, have yielded great quantities of oil from Ordovician, Mississippian, and Pennsylvanian strata.

In Nemaha County less than 600 feet of Pennsylvanian sediments lie on Pre-Cambrian rocks on the axis of the anticline, but southward the sedimentary cover increases in thickness. Along the axis in Butler County, except on the highest part of the granite core, a thin section of Arbuckle rocks lies between the crystalline rocks and about 2,250 feet of Pennsylvanian and Permian beds. The sedimentary section, of course, is much thicker on the flanks.

Forest City basin, Bourbon arch, and Cherokee basin.—Thinning of Cherokee sediments in a narrow area extending northwestward from Bourbon County to Lyon County indicates that briefly eastern

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Kansas was separated into two depositional basins, the Forest City basin in the north and the Cherokee basin in the south. The low separating structure expressed in pre-Pennsylvanian rocks is known as the Bourbon arch (Moore and Jewett, 1942, fig. 8). The thickness of Mississippian limestone increases from 300 feet or less on the arch to more than 450 feet in Miami County on the north and to more than 350 feet in northern Allen and Bourbon Counties on the south. The Forest City basin extends into northwestern Missouri, southeastern Nebraska, and southwestern Iowa. Pennsylvanian sedimentation seemingly began earlier in the Forest City basin than in the Cherokee basin. The Cherokee basin, however, is the northern or Kansas part of a sedimentation area that extended across eastern Oklahoma, and Pennsylvanian rocks older than any known in the Forest City basin occur in northeastern Oklahoma.

The Nemaha anticline marks the west boundary of the two basins. Although the separating Bourbon arch may have been an area of meeting of sediments from southerly and northerly directions at several times in middle and late Pennsylvanian time, in general the Forest City and Cherokee basins may be regarded as one continuous structural province of great lateral extent, containing in northeastern Oklahoma and probably in Iowa, Pennsylvanian sediments older than any known in eastern Kansas.

The synclinal area in the western part of the combined structure is of special interest. In the north this is called the Brownville syncline (Condra, 1927, p. 17), and although the name Walnut syncline (Fath, 1921, p. 66) has been given to the part of the same structure in Butler County, the name Brownville may well be applied throughout the entire length (Jewett, 1951, pp. 122-123). The Davis Ranch oil pool, in Wabaunsee County, is in an anticline that is believed to be a higher part of a longer fold that is parallel to the Nemaha structure and contains also the pools that have been found farther north in the county. Pre-Mississippian pools, the Bushong to the south in Lyon County and Nemaha County pools far to the north, are on the same trend and in light of present knowledge, are judged to be in a series of *en echelon* folds parallel to the Nemaha structure and in the Brownville syncline.

Farther south, as in Cowley County and east of the anticline, there are several *en echelon* folds detectable in outcropping rocks and more pronounced in buried formations (Bass, 1929). These exemplify some trends that may be designated Slick-Carson, Graham,

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Rainbow Bend, and Otto-Dexter. Seemingly the latter is a part of the long Beaumont anticline (Bass, 1936) which extends far to the north and east. Many miles farther east are the Longton (Elk County) and Fredonia (Wilson County) anticlines. These structures are cited as examples of anticlinal folds in southern Kansas, in the Cherokee basin, and in general parallel to the Nemaha anticline; all contain prolific oil pools.

In the Forest City basin a maximum of slightly less than 4,000 feet of sedimentary beds overlie crystalline Pre-Cambrian rocks. This thickness, however, is encountered only in the western part of the basin, in the Brownville syncline. More nearly average thickness is 2,500 feet. On the Bourbon arch, near the Kansas-Missouri line, Pre-Cambrian rocks are reached at about 1,500 feet. In the southeastern corner of Kansas about 1,500 feet of Mississippian, Ordovician, and Cambrian beds lie above the crystalline floor, but in the deeper part of the Cherokee basin, in Cowley County, 5,500 or more feet of sediments (Permian, Pennsylvanian, Mississippian, Ordovician, and Cambrian) cover the basement rocks.

Salina basin.—The Salina basin (Fig. 12) lies between the Nemaha anticline and the Central Kansas uplift. The greatest thickness of Mississippian rocks there is in the western part adjacent to the Central Kansas uplift. Pennsylvanian sediments were laid down in the Salina basin after Mississippian strata had been peneplaned. Washington, Clay, and Dickinson Counties and part of Marshall, Pottawatomie, Riley, Geary, Morris, and Marion Counties in eastern Kansas are in the Salina basin. Detailed studies of stratigraphic and structural conditions in the Salina basin have been made by Lee, Leatherock, and Botinelly (1948).

Sedgwick basin.—A basinal area southeast of the Central Kansas uplift and west of the Nemaha anticline is called the Sedgwick basin (Moore and Jewett, 1942, p. 7). It is differentiated from other structural provinces partly because it is more or less separated geographically from northward and westward continuations of other basinal areas and partly because of the general nature of geologic structure and oil and gas occurrence in the region. Large amounts of oil and gas are produced in the Sedgwick basin area, mainly from anticlinal folds on trends generally parallel to those of the Nemaha anticline. Parts of Marion and Butler Counties in eastern Kansas are in the Sedgwick basin.

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Thinning of Mississippian rocks in Marion and McPherson Counties (Lee, Leatherock, and Botinelly, 1948, pl. 8) indicates post-Mississippian separation of the Sedgwick and Salina basins.

Prairie Plains monocline.—In eastern Kansas and part of neighboring states, outcropping Permian and Pennsylvanian rocks dip gently in a general westward direction. This regional dip, which generally is about 20 feet per mile, is modified locally, especially in the area of the Nemaha anticline. Because of this regional dip, the area is called the Prairie Plains monocline. Outcropping Pennsylvanian rocks dip gently outward from the Ozark dome, and Permian beds, whose strike is more nearly directly north-south, dip westward into a Mesozoic basin. Hence the so-called monocline is a large, more or less indefinitely limited tectonic element. It is chiefly post-Permian in age. Overstep of Cretaceous rocks on beveled Permian beds in eastern Kansas and on beveled Pennsylvanian rocks in southeastern Nebraska and southwestern Iowa indicates pre-Cretaceous age for the Prairie Plains structure.

MINOR STRUCTURAL FEATURES

The regional westward dip of Pennsylvanian and Permian rocks in eastern Kansas is modified by small more or less local anticlines, synclines, domes, and basins, some of which have been mentioned in the discussions of the larger structures. There are many places in which dips to the east, north, or south amount to several feet per mile. Structural maps compiled from altitudes measured on limestones or other key beds and covering an area of a few square miles almost invariably show these structures. Many of them are known to contain oil or gas or both. However, a great amount of oil production in eastern Kansas is from lenticular sand bodies that in most cases are called shoestring sands. In other words this oil accumulation in Pennsylvanian rocks in eastern Kansas was localized by changes in porosity of the strata. A combination of porosity changes and anticlinal structures is responsible for the oil and gas accumulations. It is well to note also that in eastern Kansas and elsewhere rock layers do not lie in parallel planes. Because of lateral changes in thickness of units, especially thicker shales, dips measured on a certain rock bed are not the same as those of lower or higher beds. Observations of outcrops in eastern Kansas show that thicknesses of some shale units, for example the Labette shale (Jewett, 1945, p. 27), vary several feet within a mile. Locally

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oil and gas have accumulated in curved parts of shoestring sands that lie in a relatively high position due to regional dip of the beds (Rich, 1926, p. 579). Rich found that accumulation in the Bush City shoestring and the Colony-Welda gas field in Anderson County was probably due to this relationship. Rich wrote:

> In the case of the Colony-Welda gas pool, the sand, which southwest of Colony carries water, extends diagonally up the regional dip out of the water; turns north along the strike for several miles, filled with gas all the way; and finally turns northwestward down the regional dip and again runs into water.

Some Representative Oil Fields in Eastern Kansas

It has been shown that eastern Kansas has been affected by several major deformations of the earth's crust and that it can be divided geographically into structural provinces at different times. Movements that placed strata in its present position dipping away from the Ozark uplift were the last that determined to an important degree the inclination of beds. This major deformation that produced the Prairie Plains monocline took place at about the end of Paleozoic time. However in the millions of years that followed, eastern Kansas has been elevated and depressed several and perhaps many times. Possibly Cretaceous seas covered all the area as without doubt they did the western part. When the present Rocky Mountains were formed, near the end of the Cretaceous Period, eastern Kansas probably was elevated, and certainly it was elevated considerably when the mountains were again uplifted and began to be recarved late in Tertiary time. Uplifts in the Ozark area prior to the development of the present Ozark peneplain and plateau, and possibly contemporaneous with uplifts in the western mountains, likewise affected eastern Kansas.

Stream-laid deposits in eastern Kansas, some nearly 200 feet above present drainage, indicate drainage rejuvenating movements in late Tertiary and during Pleistocene time. The crust of the earth has never been at rest for a very long time.

Oil pools described here are assigned to geographic structural provinces; however, it should be remembered that it is not definite that any oil pool owes its existence to one set of geologic events. There is little doubt that comparatively recent earth movements and changes in pressures because of changes in overburden thicknesses have been important factors in oil and gas accumulations.

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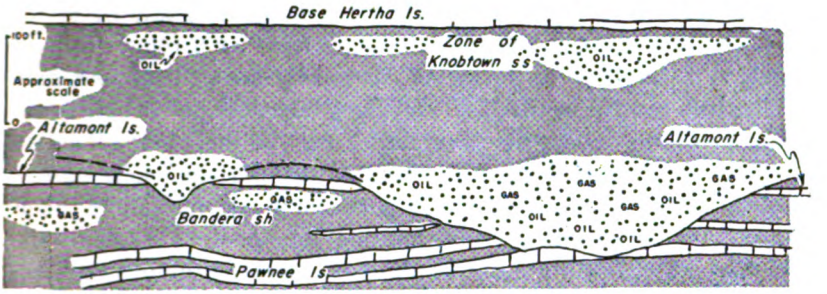

FIG. 13.—Diagram of geologic conditions in a part of the "Big Lake" oil field, Miami County.

"Big Lake" field, Miami County.—It has been reported that the "Big Lake" discovery was made when the only land section in Miami County without an oil well, a gas well, or a dry hole was selected for a location. The highly productive "Big Lake sand" was found in sec. 20, T. 16 S., R. 24 E., in the autumn of 1926. Pay zones in the sandstone, locally in excess of 55 feet of oil-bearing rock, lie at depths ranging from 325 to 400 feet. Initial oil production ranged from about 20 to 250 barrels per day. Many wells paid drilling expenses in a few days time. The field occupies the central part of T. 16 S., R. 24 E. It has produced continuously since the time of discovery. For many years after pumping and natural flow, air was injected. Water-flooding was initiated a few years ago and is being extended. In 1952 the field yielded 68,324 barrels of oil.

Figure 13 shows diagrammatically geologic conditions in a part of the field. The main sand body may be in part Bandera Quarry sandstone (in the Bandera shale) as well as the Hepler sandstone that lies at the base of the Pleasanton group of rocks. Seemingly everywhere in the area the disconformity at the base of the Pleasanton lies lower than the horizon of the Lenapah limestone, and in large areas below the Altamont limestone. Sand filling in "channels" that are cut below the Altamont and into the Bandera shale may be in contact with sandstone in the Bandera shale. In the latter case the "Big Lake sand" is part Hepler and part Bandera Quarry. Locally oil occurs in the Knobtown sandstone (in the upper part of the Pleasanton section) in the same area; and locally where the Altamont limestone can be identified, some oil and gas is known to occur in both the Hepler and Bandera Quarry sandstones.

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The "Big Lake" field is a part of the large area known as the Paola-Rantoul field, in which oil and gas have been found in many zones in Pennsylvanian rocks. Pools mostly are in lenticular sand bodies and mostly in the "Squirrel" and "Bartlesville" zones, in the Cherokee shale. Like the "Big Lake" most of the other sandstone pools in the area may be designated as "shoestrings," long narrow sand bodies encased in relatively impervious and nonporous shale. Hence they are regarded as stratigraphic type pools.

Bush City field, Anderson County.—Accidentally discovered while drilling for gas in a deeper objective, the Bush City pool may be cited as another representative Pennsylvanian "shoestring" oil pool in the southern part of the Forest City basin. The "shoestrings" in that part of eastern Kansas seemingly are channel fillings rather than near-shore marine deposits as those in Greenwood County are believed to be. The Bush City pool was discussed comprehensively by Charles (1941).

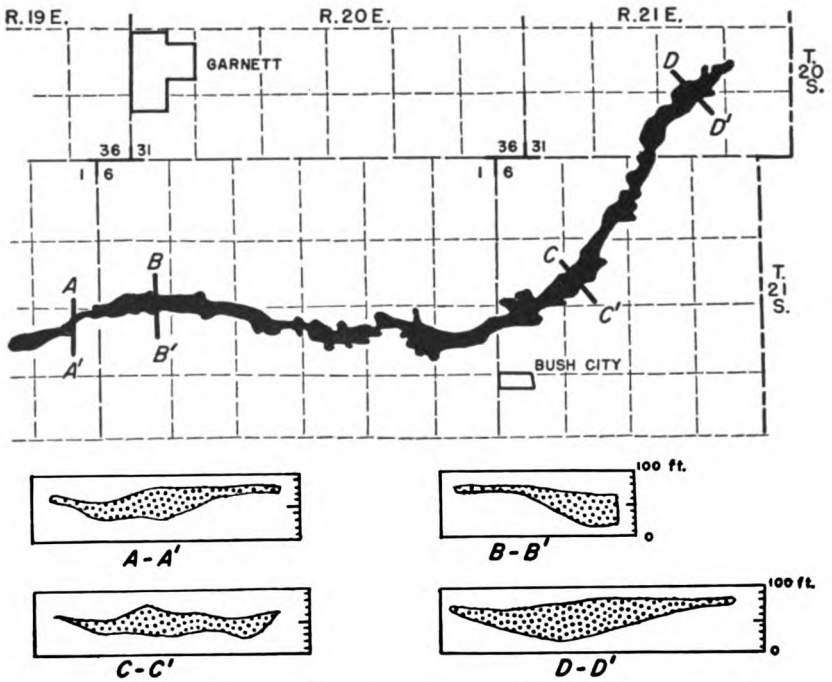

FIG. 14.—Map of a part of Anderson County showing location and shape of the Bush City oil field and diagrammatic cross sections showing geologic conditions in the field. Modified from Charles (1927).

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The Bush City oil field extends from the southern part of T. 20 S., R. 21 E., southwestward to the eastern part of T. 21 S., R. 21 E. (Fig. 18). The productive rock is an elongated sandstone body as much as 55 feet thick and ranging in width from about 1,000 to 2,000 feet. Its length is about 14 miles. The pay zone occupies the lower part of the sandstone body and ranges in thickness from about 15 to 20 feet. This sandstone lies in the upper part of the Cherokee shale about 35 feet below the Fort Scott limestone. The producing rock is known as the "Bush City sand," the "800-foot sand," or the "Squirrel sand." It lies at about 800 feet below the land surface.

The discovery well, the A. H. Keys No. 1 Ware in the SE cor. NE¼ sec. 15, T. 21 S., R. 20 E., was drilled in 1923. Within a few years the field, which extended the length of the reservoir body, contained about 800 producing wells and 100 dry holes. Initial daily production ranged from about 5 to 800 barrels of oil. It is reported that about 10 percent of the wells yielded 10 barrels or less and 10 percent of the wells produced 150 barrels or more. Among the early wells only one (producing 800 barrels in the first 24 hours) exceeded 300 barrels daily production. A few of the wells flowed naturally for a few days. At the end of 17 years it was estimated that the field had produced 4 million barrels of oil from 1,900 productive acres (Charles, 1941, p. 54).

Repressuring by air and gas was initiated in the Bush City field many years ago. At present three water-flood projects are operating in the field. During 1952, the field produced 338,296 barrels of oil.

Figure 14 shows the extent of the Bush City oil pool and shape of the sand body.

Coffeyville pool, Montgomery County.—The Coffeyville pool is cited as an example of the occurrence of oil on the Chautauqua arch in the upper weathered part of Arbuckle rocks and immediately below the Chattanooga shale. Oil occurs at about 1,216 feet. The top of Mississippian limestone lies at about 850 feet below the surface. Pennsylvanian rocks of the Marmaton group are at the surface in the area. The field sometimes is called the "Alloway."

Mapped in surface rocks the Coffeyville anticline or dome has closure of about 40 feet and is slightly more than a mile in diameter. For several years previous to oil discovery there, gas was produced from shallow Pennsylvanian sandstone. Geologic work upon which the discovery well was located consisted principally of making a

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structural map from data obtained from gas well logs. In 1923 the Red Bank Oil Company drilled the discovery well in sec. 17, T. 35 S., R. 17 E. Initial daily production was reported to have been 150 barrels of oil. Many closely spaced wells were drilled soon after the field was found.

Dips in the Coffeyville structure increase with depth and the apex of the dome in the Arbuckle rocks is about half a mile west and slightly south of the surface apex. According to Foster (1929, p. 49) a well drilled on the top of the surface structure would not have produced from the Arbuckle.

The pay zone in the Coffeyville Arbuckle pool is porous limestone immediately below the Chattanooga shale which probably is the source bed. Porosity is due to weathering before Arbuckle rocks were buried. The thickness of the pay is about 5 feet.

The field has produced, perhaps with some temporary abandonments, since the pool was discovered. In 1952 it yielded 1,018 barrels of oil.

Davis Ranch pool, Wabaunsee County.—The Davis Ranch pool was described comprehensively by Smith and Anders (1951) and will be reviewed briefly here as an example of an Ordovician pool in the synclinal area east of the Nemaha anticline in the Forest City basin. Oil occurs along a disconformity below the Maquoketa shale.

The Davis Ranch pool is in weathered Viola limestone (next below the Maquoketa shale) on the crest of an anticline that is believed to be continuous with structures that contain Viola pools farther north. The discovery well in the SW¼ SE¼ SW¼ sec. 33, T. 13 S., R. 10 E. was drilled on the anticline as mapped in outcropping rocks. The anticline at the surface has more than 20 feet of closure, is about 1½ miles long, and about half a mile wide. Production was encountered at 3,201 feet. Subsequent drilling revealed that the Davis Ranch anticline has closure of approximately 80 feet on the Viola limestone, and is at least three-fourths mile wide and 2 miles long. Expression of the structure in Mississippian rocks is about the same as in the Viola. The structure is faulted in the subsurface on its east side. A small oil pool, the Davis Ranch East, was found in Viola limestone east of the fault and on its downthrown side.

According to Smith and Anders (1951, p. 23) the average absolute completion potential for the first seven wells drilled was 6,810 barrels of oil per day. During 1952 the pool yielded 236,531 barrels of oil. Cumulative production at the end of the year was 895,220 barrels.

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After the Davis Ranch discovery was made other similar pools were found. The Davis Ranch East, now abandoned, is a Viola pool on the downthrown side of the fault. The Mill Creek and Newbury pools, about 6 and 12 miles, respectively, north and slightly east of the Davis Ranch are Viola pools on the same trend and probably on the same anticline with the Davis Ranch. The Bushong pool in Lyon County is a "Hunton" pool about 15 miles south of the Davis Ranch pool and about 18 miles east of the Nemaha uplift.

Elbing field, Butler and Marion Counties.—In the weathered zone at the top of the Viola limestone and below the pre-Mississippian disconformity in an anticlinal structure that chiefly is post-Mississippian and pre-middle Pennsylvanian, the Elbing oil pool is cited as an example of a structural-stratigraphic pool near the west flank of the Nemaha anticline.

The Elbing and similar near-by pools have been discussed by Thomas (1929) who believed that the minor surface structures of the area overlie "buried hills" of pre-Pennsylvanian rock and are due in part to differential settling and in part to original or depositional dips over buried hills. He concluded that accumulation of oil in the Elbing pool has been due to lateral migration and that the source rock is the Cherokee or Chattanooga shale.

The Elbing pool was discovered in 1918, when a well was drilled in the NW¼ sec. 18, T. 23 S., R. 4 E. The field was extended into Marion County in 1920, the same year that similar pools farther north were found. They are the Peabody, Covert-Sellers, and Florence-Urschel.

Figure 15 is a diagrammatic representation of geologic conditions in the Elbing field.

Hittle field, Cowley County.—The Hittle may be cited as one of many prolific oil fields where structure contours of surface rocks using a 10-foot contour interval show only a nose and no closure,

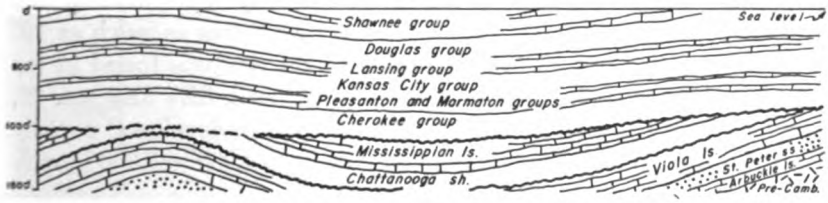

FIG. 15.—Diagram of geologic conditions in the Elbing oil field, Butler and Marion Counties, on the west flank of the Nemaha anticline. Lateral distance represented is about 9 miles. Data in part from Thomas (1929).

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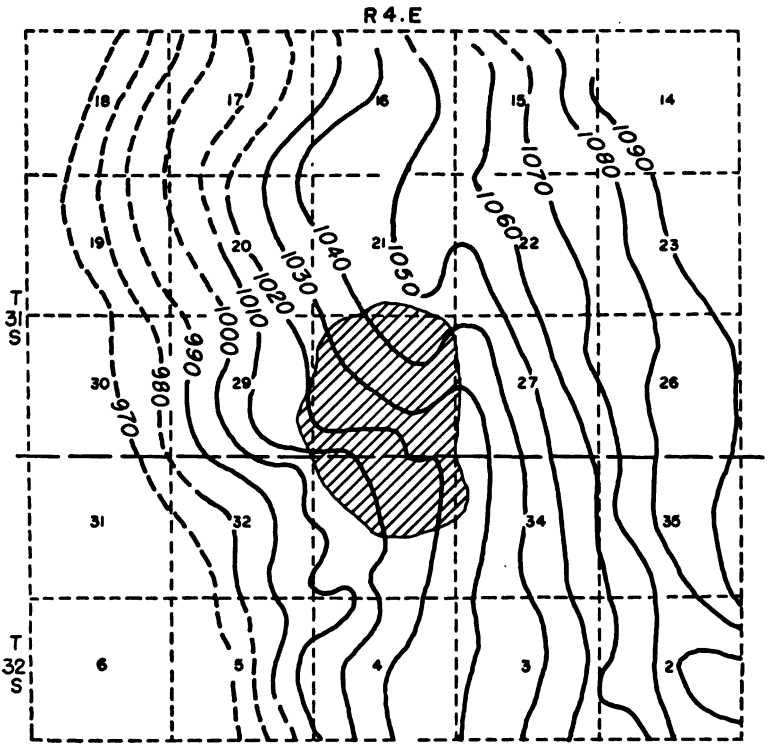

FIG. 16.—Map of the Hittle oil field, Cowley County, showing structure of the surface rocks. Elevations of contour lines are shown in feet above sea level. Structural data from Bass (1926, fig. 21).

and in which prolific Arbuckle production was found below a small Pennsylvanian pool. The first discovery well was drilled in 1926 in the NE¼ sec. 28, T. 31 S., R 4 E. Oil was found in sandstone and sandy limestone in the upper part of the Kansas City group at about 2,400 feet. Two producers extended the field into sec. 21 the following year and a few other Kansas City wells were drilled in 1928. Initial production from the early wells was as much as 125 barrels of oil daily. In 1928 Arbuckle production was found in the field, when the Arthur Brewer No. 1 Lewis well, SE¼ SE¼ sec. 28, found oil and gas at 3,346 feet. The field was developed rapidly in 1939; several wells had daily potentials from 4,000 to 8,000 barrels of oil, and one was rated at 8,501 barrels.

In 1952, the field yielded 212,886 barrels of oil; cumulative production at the end of the year stood at 9,005,861 barrels.

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The Hittle pools are in a more or less minor structure in the Cherokee basin about 8 miles east of the Nemaha anticline. Many other pools in southeast Kansas are in similar geologic setting.

Figure 16 is a map of the Hittle field, showing structure of the surface rocks.

Virgil field, Greenwood County.—The Virgil oil pools are cited as examples of oil in a well-formed domal structure, and especially of a Mississippian pool in weathered limestone below a shale cover in an anticlinal trap. The Virgil field was described comprehensively by Beekley (1929).

The Mississippian Virgil pool was one of the first Mississippian oil pools found in Kansas. It was discovered in October 1916 by a well in the SE cor. sec. 14, T. 24 S., R. 12 E. The discovery well's initial daily production was 15 barrels of oil and the average daily production of 34 early wells in the field was 28½ barrels. The field should be said to contain three pools because a few wells in secs.

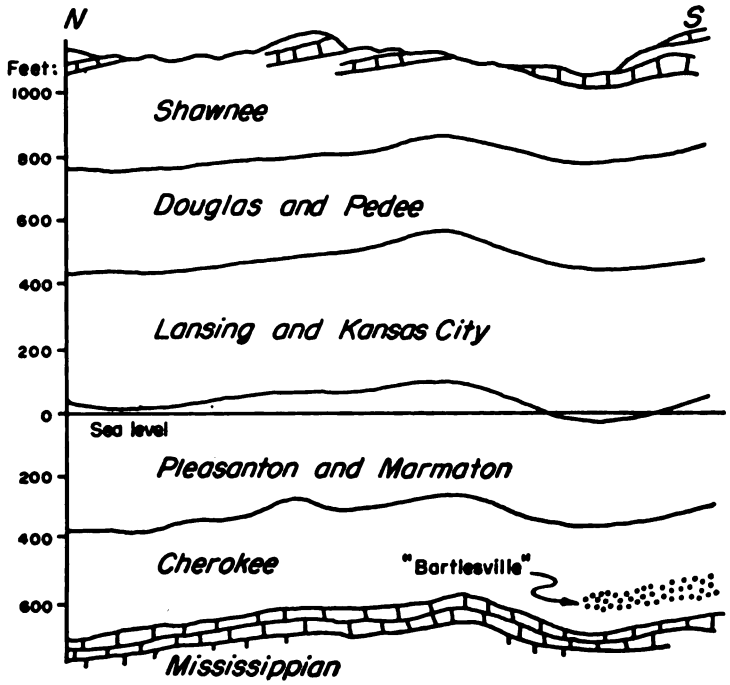

FIG. 17.—Diagram of geologic conditions in the Virgil oil field, Greenwood County. Data in part from Beekley (1929).

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6 and 7 and a few in sec. 36 have produced oil from the "Bartlesville sand." These "Bartlesville" wells are in the northwest and southeast extremities of the Virgil structure. The "Bartlesville" zone consists of sandy shale, commonly with oil stains, in most of the township; hence oil production from it is limited by its porosity.

Beekley (1929, p. 145) has shown that the Virgil pools are located in a structure that has more than 60 feet of closure in outcropping rocks. Structure that is determined on subsurface beds and the eroded surface of Mississippian limestone conforms closely to the structure expressed in surface rocks. The structure is cited by Beekley (1929, pp. 146, 149) as a "textbook example of a closed anticline which makes a perfect trap for oil accumulation . . ."

The Mississippian pay zone at about 1,700 feet is a porous zone in limestone, cherty in places, but not a true sand. Variable porosity is said to account for rich and lean producing areas in the field. Oil production has been continuous in the Virgil field since its discovery. In 1952 the field produced 150,888 barrels of oil. Cumulative figures are not available.

Figure 17 shows geologic conditions in the Virgil field, an example of a Mississippian oil field in the Cherokee basin.

INDEX OF OIL-FIELD NAMES FOR PRODUCING ROCKS

During the many years of oil and gas discoveries and developments in eastern Kansas a large number of names designating the producing formations have come into more or less general usage. Some of these names are recognized stratigraphic terms that appear commonly on geologic sections and in the texts of scientific publications. Others are names that were given to subsurface rocks before correlation with formations that have formal names had been established. In several cases two or more names have been applied to the same or equivalent formations. In other cases two or more formations are known in different places by the same name.

The names that are listed here are those that one hears in the oil fields and frequently some of them occur in reports of various kinds. Some are officially recognized scientific terms, but others are "local names." Because of their more or less common usage, however, they are well established as part of our language, although they

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are somewhat confusing except to those people who have become accustomed to local usage.

Although the original usages of some of these names and the correlations of some of the deposits to which they are applied are discussed here, these remarks primarily do not constitute an argument for or against the adoption or discarding of the terms by people who find them useful. An attempt has been made to explain the usage.

Names that are listed in United States Geological Survey Bulletin 896, Lexicon of Geologic Names of the United States (Wilmarth, 1938) are starred in this index.

Arbuckle*.—Arbuckle limestone or dolomite is the common designation for Lower Ordovician and Upper Cambrian rocks in eastern Kansas. The term "siliceous lime" is used locally for Arbuckle rocks and in some areas they are known as "Wilcox." "Wilcox," however, more commonly designates the Simpson or St. Peter sandstone which occurs stratigraphically above the Arbuckle.

The Arbuckle rocks in Kansas comprise the Cotter and Jefferson City dolomites, the Roubidoux formation, the Gasconade and Van Buren dolomites, and the Gunter sandstone of Ordovician age; and the Eminence dolomite of Cambrian age. The name "Arbuckle," however, is applied often to the sequence between the St. Peter sandstone (above) and the Lamotte sandstone (below), hence, including in its span in addition to the formations named above, the Bonneterre dolomite.

Bartlesville sand*.—The name "Bartlesville sand" is in common use for several sandstones in eastern Kansas and in northern Oklahoma, and according to Powers (1926, pp. 14-15) it has been applied to Ordovician rocks.

The name "Bartlesville sand" is in common use as a name for productive sandstone in all eastern Kansas counties that are important as oil producers. It is applied to sandstone in the middle and lower parts of the Cherokee shale section. In some areas sandstone about 100 feet below the top of the Cherokee rocks is called "Bartlesville." In places there are a "Lower" and an "Upper Bartlesville." In some places the "Bartlesville" is the lowermost sandstone of the local Pennsylvanian section. The name is applied to "shoestring sand" bodies and to more sheetlike deposits. The term "true Bartlesville" of authors seemingly has little significance.

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"Bartlesville" was used first as a subsurface stratigraphic term in the northern mid-continent area to designate a productive formation in the Bartlesville-Dewey oil field, Washington County, Oklahoma. The "Bartlesville sand" there lies 365 feet below the top of the "Oswego" (Fort Scott) limestone (Mills-Bullard, 1928, p. 50). It is probable that it is older than most of the beds that are called Bartlesville in Kansas.

As used now the name "Bartlesville" may mean any of several sandstone bodies that occur in the Kansas Cherokee section below the Ardmore limestone.

Big Lake sand.—The name "Big Lake sand" is used in Miami County to designate shallow sandstone that is productive in the Big Lake field, a part of the Paola-Rantoul area. In part the "Big Lake" seemingly comprises two sandstone bodies, the Hepler sandstone which is the basal deposit of the Pleasanton group, and the Bandera Quarry sandstone, in the Bandera shale. The two locally are in contact because of disconformable relationships. Probably most but not all the oil and gas production in the Big Lake area is from the Bandera Quarry sandstone, which elsewhere in Miami County often erroneously is called "Wayside." "Weiser sand," however, is the more commonly used name for subsurface sandstone bodies in the Bandera shale but Bandera Quarry sandstone is the formal name. "Wayside" according to its original and more common usage designates sandstone in the Nowata shale.

Big lime.—The term "Big lime" is used to designate the Pawnee limestone in the subsurface in eastern Kansas. The name "Pink lime" is used for the same rocks.

Big Salt sand.—The name "Big Salt sand" is used for sandstone in the Douglas group in southern Kansas. The "Big Salt sand" may be Ireland or Tonganoxie sandstone or both. Probably sandstone in the Pedee group also is called "Big Salt." The Tonganoxie sandstone is called also "Layton" and "Stalnaker."

Big shale.—The term "Big shale" is used extensively in eastern Kansas to designate the rock section below the Hertha limestone and the locally uppermost Marmaton limestone (commonly the Lenapah). Hence the term is applied essentially to the Pleasanton group but the section may include at its base the Memorial shale (uppermost formation of the Marmaton group) or in places where the Lenapah limestone is absent or inconspicuous the name may be applied to rocks as low as the basal part of the Nowata shale. The

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Knobtown sandstone occupies a position in the upper part of the "Big shale" and the Hepler sandstone (included in part in the "Big Lake sand") is the basal formation of the Pleasanton group. Locally the Hepler is in contact with the Lenapah limestone or lower Marmaton formations.

Brown lime.—The name "Brown lime" is used to designate the Higginsville limestone (upper member of the Fort Scott formation) in southern Kansas, especially in Montgomery County. "Oswego" and "First lime" are local names for the same rock. Some operators refer to the Pawnee limestone as "Brown lime."

Burbank sand*.—The name "Burbank" is used somewhat commonly for sandstones in the Cherokee shale in eastern Kansas that lie below the Ardmore limestone and above deposits in the same areas that are called "Bartlesville." Seemingly deposits that are called "Burbank" in some places are called "Bartlesville" or "Upper Bartlesville" elsewhere.

The term "Burbank" was first used as a subsurface stratigraphic name for a producing sandstone in the Burbank oil field, Ts. 26 and 27 N., Rs. 5 and 6 E., Osage and Kay Counties, Oklahoma. The "Burbank sand" there lies about 275 to 290 feet below the "Oswego" (Fort Scott) limestone (Mills-Bullard, 1928, p. 28). According to Beckwith (1928, p. 44), the "Burbank" and "Bartlesville sands" of Osage County, Oklahoma, and the "Rainbow Bend" and "Fox Bush" sands in Kansas are seemingly about stratigraphically equal; and the "Bartlesville" is a blanket formation but the other three are more lenticular. According to Mills-Bullard (1928, p. 180) who seemingly made distinction between lenticular and blanketlike deposits, the "Burbank is not Bartlesville but is found at that horizon."

Burgess sand*.—The name "Burgess" is used rather widely to designate sandstone in the Cherokee shale in eastern Kansas that lies next above or almost in contact with Mississippian limestone (Jewett, 1940a; Jewett and Abernathy, 1945). Similar usage for basal Pennsylvanian sandstone in Oklahoma is common (White and others, 1922, p. 184, pls. 3, 28, 31; Oakes, 1952, p. 110). However Mills-Bullard (1928, p. 180) lists the "Burgess" in Oklahoma as Mississippian in age.

It is probable that in most places in eastern Kansas the deposit that is called "Burgess" is younger than rocks to which the name commonly has been applied in northern Oklahoma. "Basal Pennsylvanian sandstone" is perhaps better usage in eastern Kansas. In

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some parts of eastern Kansas "Burgess" and "Tucker" are used interchangeably, but as shown in this index "Tucker" seems to have been applied only to Ordovician rocks. However, "Tucker" in Oklahoma is used commonly for a Pennsylvanian sandstone below the "Bartlesville" and above the "Burgess" (White and others, 1922, p. 184.)

Bush-Denton sand.—The name "Bush-Denton sand" is used for the highest of three productive sandstones that occur in the Lane-Vilas shale (Lansing group) in Elk and Montgomery Counties. It is known also as the "Ferguson sand."

Cattleman sand*.—The name "Cattleman sand" is used for a productive sandstone in Greenwood County, as in the Wiggins field. It is from 50 to 75 feet above the rock that is there called "Bartlesville sand" and lies about 110 feet below the top of the Cherokee shale.

Chat.—The term "chat" is used widely in eastern Kansas for deposits of fragmentary chert and other debris overlying Mississippian limestone. It is common to speak of the "Mississippian chat," but most of the so-called deposits probably are only slightly older than the overlying Pennsylvanian sediment and probably all or most all of them are of Pennsylvanian age. The chert generally is much weathered and deeply stained by iron oxide and the fragments are intermingled with deeply oxidized ferruginous clayey material. The chert is residual or transported from chert-bearing Mississippian limestones. The "chat" is an oil-bearing deposit in several eastern Kansas fields.

Cleveland sand*.—The name "Cleveland sand" is used in some eastern Kansas areas for sandstone bodies in the Coffeyville formation. The names "Layton" and "Cleveland" are used more or less interchangeably, but in the Cleveland oil field, Pawnee County, Oklahoma, the "Layton" is 400 feet above the "Cleveland" (Mills-Bullard, 1928, p. 35), and in Kansas the name "Layton" is used more commonly for sandstone in the upper part of the Kansas City group.

Colony sand*.—The name "Colony sand" has been used for a gas-producing sandstone in several Anderson County fields (Charles, 1927; Jewett and Abernathy, 1945, pp. 57-58). The name originated in the Colony gas field. The sandstone called "Colony" occurs in the upper middle part of the Cherokee shale and more commonly is called "Bartlesville."

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Dennis sand.—The name "Dennis sand," not to be confused with the Dennis formation in the lower part of the Kansas City group, is applied to a gas-bearing sandstone in the Bandera shale in Labette County (Jewett and Abernathy, 1945, p. 153). The term "Weiser" is used more commonly for subsurface sandstone bodies in the Bandera shale but Bandera Quarry sandstone is the more acceptable term.

Dutcher sand°.—Sandstone at or near the base of the Cherokee shale in some oil fields in southeastern Kansas sometimes is called "Dutcher." According to Wilmarth (1938, p. 646), the "Dutcher sand series" in Oklahoma lies in the Cherokee shale lower than the "Bartlesville" and "Burgess" sands. The sandstone in northeastern Oklahoma, to which the name Dutcher was first applied, seemingly is not present in eastern Kansas. Oakes (1952, p. 110) states that in Tulsa County, Oklahoma, the "Dutcher sand" is 50 to 100 feet above Mississippian limestone and rests unconformably on limestone in the Morrow group and that it is probably of Atokan age.

Eight Hundred-Foot sand.—The name "800-foot sand" has been used for sandstone deposits in the Cherokee group in Anderson County about 200 feet below the top of the Cherokee section (Charles, 1927, pl. 1).

Encill sand.—The name "Encill sand" is used for the lowest of three sandstones that occur in the Lane-Vilas shale (Lansing group) in Elk and Montgomery Counties. It occurs at a depth of about 1,300 feet in the central part of the county.

Eudora gas sand.—The name "Eudora gas sand," not to be confused with Eudora shale in the Stanton formation, is used by some drillers to designate sandstone in the upper part of the Pleasanton shale. It is the sandy zone that generally is called Knobtown.

Ferguson sand.—The name "Ferguson sand" is used for the highest of three productive sandstones that occur in the Lane-Vilas shale (Lansing group) in Elk and Montgomery Counties. It is known also as the "Bush-Denton sand."

First break.—The term "first break" is used often for a porous zone in the upper part of the Mississippian limestone. It may be applied to a part of any one of several formations.

First lime.—The term "first lime" is used to designate the Higginsville limestone (upper member of the Fort Scott formation) in southern Kansas, especially in Montgomery County. "Oswego" and "Brown lime" are local names for the same rock.

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Forty-foot lime.—The name "40-foot lime" is used to designate the Pawnee limestone in southern Kansas, especially in Montgomery County. "Pink lime" and "Big lime" are used as names for the same rock.

Garnett sand.—The name "Garnett sand" is used in Anderson County for sandstone in the upper part of the Cherokee section. It is known also as the "800-foot sand."

Hancock shale.—The name "Hancock shale" is used to designate the Little Osage shale member of the Fort Scott formation in the subsurface in Chautauqua County, Kansas, where it bears gas.

Heck sand.—The name "Heck sand" is applied to the middle one of three sandstones that occur in the Lane-Vilas shale in northwestern Montgomery County, Kansas. It is known also as the "Longton" and as the "Webb sand."

Hoover sand.—The name "Hoover sand" is used in southeastern Kansas for sandstone believed to be equivalent or nearly equivalent to the Elgin sandstone of the Kanwaka formation or the name is applied to sandstone in the Douglas group. However, according to Mills-Bullard (1928, p. 180), the "Hoover series" lies between the Grayhorse limestone and the Elgin sandstone. In the Burbank oil field, Osage and Kay Counties, Oklahoma, the "Hoover" lies at a depth of 990 feet.

Hunton limestone*.—"Hunton" is used to designate undifferentiated Silurian and Devonian limestones and dolomites in the subsurface in northeastern Kansas. The term Siluro-Devonian has been used by some geologists for these same rocks that lie between the Chattanooga shale and the Sylvan shale of Ordovician age. In northeastern Kansas Silurian and Devonian rocks are separated by an angular disconformity and comprise undifferentiated limestone and dolomite of late Devonian age, the Cooper limestone of middle Devonian age, and the Brassfield and Edgewood limestones of Silurian age which are correlatives of the Chimneyhill limestone of Oklahoma (Lee, 1943, pp. 43-59).

The name Hunton was introduced as a stratigraphic term by Taff (1902). The name is from a former townsite in Coal County, Oklahoma. According to Reeds (1911) the Hunton as defined by Taff includes in descending order, the Bois d'Arc limestone (Oriskany age), the Haragan shale (New Scotland age), and the Henryhouse limestone (Niagaran age), all of Devonian age and the Chimneyhill limestone (Alexandrian age) of Silurian age.

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Kansas City*-Lansing*.—In areas where the shale formations in the Lansing and Kansas City groups (Missourian Series) are thin and the section is chiefly limestone, the rocks of the two groups often are designated as "Kansas City-Lansing."

Knobtown sandstone*.—Sandstone that seemingly is of non-marine origin near the top of the Pleasanton group in eastern Kansas and western Missouri is called "Knobtown" (Greene, 1933, p. 13). The type exposure is in sec. 22, T. 48 N., R. 3 W., Jackson County, Missouri, where Wallace Howe of the Missouri Geological Survey has shown that a thin sandstone of the "Knobtown" type in Kansas is underlain by shale and marine deposits consisting of sandy limestone. In eastern Kansas, at outcrops the Knobtown locally is in contact with the Hertha limestone which overlies it. Gas has been produced from the formation in Johnson County, Kansas (Jewett and Abernathy, 1945, p. 148).

Lansing limestone (Lansing group*).—In areas where the rocks of the Lansing group (Missourian Series, Pennsylvanian) are largely limestone, the term "Lansing limestone" or "Lansing lime" is used to designate the combined Plattsburg and Stanton limestones and the interlying Vilas shale (if present).

Layton sand*.—The name "Layton" designates sandstones in the Kansas City group in southern Kansas, as in the Slick-Carson, Countryman, and Graham fields, Cowley County.

The name had its origin from the Layton farm in the Cleveland field, sec. 2, T. 20 N., R. 8 E., Pawnee County, Oklahoma. The sandstone that is called Layton in the Cleveland field has been assigned to the upper part of the Coffeyville formation (Wilmarth, 1938, p. 1159).

It is probable that the sandstone that is most commonly called "Layton" in southern Kansas is in the Chanute formation and is correlative with the Cottage Grove sandstone.

Longton sand.—The name "Longton" is used for the middle of three productive sandstones that occur in the Lane-Vilas shale (Lansing and Kansas City groups) in Elk and Montgomery Counties. It is known also as the "Webb sand" and the "Heck sand."

McLouth sand.—McLouth sand is the name of an oil-producing rock in the McLouth field, Jefferson County. It lies near the base of the Cherokee shale section in the McLouth area. Exact correlation with outcropping rocks has not been established.

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Misener sand*.—The term Misener is used to designate sandstone deposits at the base of the Chattanooga shale immediately above the pre-Chattanooga disconformity in southeastern Kansas. The name was used first as a stratigraphic name in Okmulgee County, Oklahoma, where a sandstone said to lie in the upper part of the Viola limestone was named for Fred D. Misener of Tulsa (Bass, in Wilmarth, 1938, pp. 1384-1385). The rock to which the term commonly is applied seemingly is the Sylamore sandstone.

Mississippi lime.—The name "Mississippi lime" is applied to limestone of Mississippian age. In the Kansas subsurface the Mississippian limestones comprise several formations.

New Albany sand.—The name "New Albany sand" is used for sandstone in the Nowata shale in some parts of eastern Kansas. It was first applied in the New Albany oil field in northeastern Elk County. "Wayside" is the more common term for sandstones in the Nowata shale which collectively are known as Walter Johnson sandstone.

Nine Hundred-Foot sand.—The term "900-foot sand" has been applied to sandstone deposits in the Cherokee group in Anderson County about 300 feet below the top of the Cherokee section (Charles, 1927, pl. 1).

Old Red sand.—The name "Old Red sand" is used for oil-producing sandstone that occurs in the Nowata shale in southern Kansas, as in Chautauqua County. In several parts of eastern Kansas sandstone in the same stratigraphic position is called "Wayside." The term "Red" is used by some operators for the same beds. Lenticular sandstone deposits in the Nowata shale collectively have the name Walter Johnson sandstone.

Oswego lime (Oswego limestone*).—"Oswego lime" is a common designation of the Fort Scott limestone in eastern Kansas. Some operators restrict the term to the Higginsville limestone, the upper member of the Fort Scott formation. Others apply it to the lower member of the formation which is the Blackjack Creek limestone or they may apply it to the Breezy Hill limestone which is a lenticular limestone in the upper part of the Cherokee group a few feet below the Fort Scott limestone.

Peacock sand*.—The name "Peacock sand" is used to designate the principal producing formation in the Peacock oil field, Cowley County, Kansas. According to Bass (1929, p. 135) the "Peacock

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sand" is a zone in the lower part of the Shawnee group about 150 feet above the Oread limestone.

Peru sand*.—"Peru sand" is the common name for subsurface sandstone bodies in the Labette shale, which occur below the Altamont limestone and above the Pawnee limestone. The name is used widely but in some areas it is misapplied to higher and lower beds. The name originated in the Peru oil-producing area (Peru-Sedan field), Montgomery County. Englevale sandstone is the term applied in State Geological Survey reports to sandstone bodies in the Labette shale.

Pink lime.—The term "Pink lime" is used for the Pawnee limestone in the subsurface in eastern Kansas. The name "Big lime" is used in the same sense, and some operators call the Pawnee limestone "Brown lime."

Potwin chat.—The term "Potwin chat" is used for detrital chert deposits at the top of the Mississippian limestone in the Potwin field, Butler County, Kansas.

Prue sand*.—The name "Prue" designates sandstone in the upper part of the Cherokee group in southern Kansas and northern Oklahoma. The name originated in the Prue field, T. 21 N., R. 10 E., Osage County, Oklahoma, where it is about 150 feet below the top of the "Oswego" (Fort Scott) limestone (Mills-Bullard, 1928, p. 128). According to Mills-Bullard (1928, p. 180) the "Prue" is correlative with the "Squirrel," "Bixler," and "Perryman sands."

Rainbow Bend sand*.—Oil-producing sandstone in the lower part of the Cherokee shale in the Rainbow Bend oil field, Cowley County, was called "Rainbow Bend sand" by Snow and Dean (1925, p. 980), who correlated it with the Burbank sand of the Burbank field in Oklahoma.

The term "Burgess" is used also for the producing sandstone in the Rainbow Bend oil field.

Red sand.—"Red sand" is used to designate sandstone in the Nowata shale in some eastern Kansas areas. The name "Old Red sand" is used somewhat more widely, but "Wayside sand" is the more common term used by drillers and operators for sandstones in the Nowata shale, which collectively are known as the Walter Johnson sandstone.

Redd sand*.—The name "Redd sand" is used in southern Kansas for one or more sandstones that occur above the "Wayside sand." Probably it is most often applied to sandstone in the upper part of

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the Coffeyville formation, and is used as the name of the same deposit that is called "Cleveland."

Red Fork sand*.—The term "Red Fork" is used for sandstone in the upper part of the Cherokee group in some places in eastern Kansas but commonly for deposits that are lower than what locally is called "Squirrel sand." According to Mills-Bullard (1928, p. 180) the "Skinner" and "Red Fork sands" are equivalent. The name originated in the Red Fork oil field, Tulsa County, Oklahoma, where the "Red Fork" lies about 675 feet below the top of the "Oswego" (Fort Scott) limestone and about 45 feet above the "Bartlesville."

Second break.—The term "second break" has been used, as cited by Charles (1927, p. 28), for the Chattanooga shale and some higher rocks in Anderson County.

Second lime.—The name "second lime" is used to designate the second limestone from the top of the Fort Scott formation in southern Kansas. Generally the term is applied to the Blackjack Creek limestone but it may be applied to the lower part of the Higginville limestone where separated from the upper part by a shale bed.

Siliceous lime.—The "siliceous lime" is applied to limestones and dolomites of the Arbuckle group. Hence, it may be used for any one of several formations.

Properly the Arbuckle rocks in Kansas comprise the Cotter and Jefferson City dolomites, the Roubidoux formation, the Gasconade and Van Buren dolomites, and the Gunter sandstone of Ordovician age, and the Eminence dolomite of Cambrian age.

Simpson*.—Rocks of Simpson age (Lower and Middle Ordovician) in northeastern Kansas comprise the Platteville limestone and the St. Peter sandstone. Frequently the St. Peter alone is called "Simpson sand."

Six Hundred-Foot sand.—The name "600-foot sand" has been applied to sandstone in the Bandera shale in Anderson County, Kansas (Charles, 1927, p. 25). This sandstone, however, more commonly is called "Weiser" and is the Bandera Quarry sandstone.

Skinner sand*.—The name "Skinner sand" is used in some places for sandstone in the upper part of the Cherokee shale but commonly for deposits that are lower than what locally is called "Squirrel sand."

Squirrel sand*.—The name "Squirrel sand" is widely used in eastern Kansas for sandstone bodies in the upper part of the Cherokee group. Seemingly the term is acceptable to many oil-field operators

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and drillers for any sandstone body that occurs in the Cherokee group above the Ardmore limestone, or in the upper approximate 100 feet of the Cherokee section. According to Mills-Bullard (1928, p. 180) the "Squirrel" is equivalent to the "Prue," "Perryman," and "Bixler sands" but is higher than the "Skinner" or "Red Fork."

Stalnaker sand*.—Seemingly the name "Stalnaker" is used for sandstone that occurs both above and below the disconformity that separates Virgilian and Missourian rocks; however, it may be more commonly applied to sandstone in the Lansing group. The term "Tonkawa" is also used to designate lower Virgilian sandstone in southern Kansas.

Stapleton zone*.—"Stapleton zone" is the name that was applied to highly productive rocks found next below Pennsylvanian sediments in the El Dorado field. It is a porous zone of beveled Ordovician rocks that lies immediately below Pennsylvanian beds. The zone includes weathered pre-Pennsylvanian outcrops of the Viola limestone, St. Peter sandstone, and Arbuckle rocks. The term "Varner" is used in essentially the same sense.

Stokes sand*.—The name "Stokes sand" is not to be confused with the Stokes sandstone, the name that was used by Cragin (1895, pp. 361, 367) for some lower Cretaceous beds in southern Kansas.

The name "Stokes sand" has been used for a subsurface sandstone in the upper part of the Kansas City group, in the El Dorado area, Butler County. Seemingly it is the same rock that widely has been called "Layton sand."

Stone Bluff sand.—The name "Stone Bluff sand" has been used by some operators for a producing sandstone in eastern Kansas, and said to be the same as the "Dutcher sand." The latter name is applied to sand deposits in the basal part of the Cherokee shale. Seemingly the names "Burgess" and "Tucker" are used interchangeably with "Stone Bluff" and "Dutcher."

Suitcase sand*.—The name "Suitcase sand" is used by some operators in southern Kansas. According to Wilmarth (1938, p. 2082) this sandstone lies in the Ochelata formation and is lower than the "Tonkawa" and higher than the "Layton sand." According to Mills-Bullard (1928, p. 28) the "Suitcase sand" is about 390 feet above the "Layton" in the Burbank field, Osage County, Oklahoma.

Third lime.—In southern Kansas, especially in Montgomery County, where the Fort Scott limestone seemingly comprises three or four limestones, the terms "first, second, and third limes" are

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used. Probably the Breezy Hill limestone is called "third lime" or in other cases the "third lime" may be the Blackjack Creek limestone.

Tonkawa sand*.—The name "Tonkawa sand" is used for the Tonganoxie sandstone, and seemingly also for sandstone in the upper part of Missourian rocks. The name "Stalnaker" is used in the same ways. "Tonkawa" as a subsurface stratigraphic name originated in the Tonkawa field, Kay and Noble Counties, Oklahoma (Mills-Bullard, 1928, p. 160) where it is about 30 feet thick and lies about 520 feet above the "Layton sand."

Tucker sand*.—The name "Tucker sand" is used in a few eastern Kansas districts for sandstone that occurs in the lower part of the Cherokee shale immediately or a few feet above its base and in contact with or almost in contact with Mississippian limestone. The names "Burgess" and "Tucker" are used interchangeably in some areas. Elsewhere the name "Dutcher" is used for sandstone in the same stratigraphic position. Seemingly this usage of "Tucker" deviates greatly from the original application of the term. According to Wilmarth (1938, p. 2190) the "Tucker sand" in Oklahoma is lower than the "Bartlesville" and higher than the "Burgess" and is of early Pennsylvanian age; references are not cited. However, according to Powers (1926, pp. 14-15) the "Tucker" sand was found in the Cleveland field in 1912 and is entirely of Ordovician age, in part representing the "Wilcox sand" and in part the "siliceous lime." Seemingly at the time of original use of the term the rocks called Tucker were believed to be in the basal part of the Pennsylvanian section of the region, but it was found later that the name had been applied to a zone of beveled Ordovician rocks. In some reports the "Tucker" is shown as the higher of two sandstones in the basal part of the northern Oklahoma Cherokee section; the lower is called "Burgess" (White and others, 1922, p. 184, pls. 3, 28, 31). According to Mills-Bullard (1928, p. 180) the "Tucker" is of Pennsylvanian age and is the first producing formation below the "Bartlesville."

Varner sand.—The name "Varner sand" seems to have very local application. An example is its use as the name of a producing formation in the Douglass field, Butler County (Berg and Page, 1948, table 1B). In the Douglass field the "Varner" lies at a depth of about 2,835 feet.

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According to Berry and Harper (1948, p. 215, footnote) the term "Varner sand" was used in the Augusta field, Butler County, for Simpson sandstone and Arbuckle dolomitic limestone, either singly or collectively. The usage is essentially the same as that of "Stapleton zone."

Viola limestone*.—The term Viola is often used to include the Kimmswick limestone, Decorah shale, and Platteville limestone in eastern Kansas. However, it is probable that only the Decorah shale and Kimmswick limestone in eastern Kansas correspond in age to the Viola limestone (Middle Ordovician) in Oklahoma. The Kimmswick limestone in eastern Kansas is a partial equivalent of the Viola limestone of Oklahoma.

Wayside sand*.—The name "Wayside" is used commonly for sandstone in the Nowata formation. The name originated in the Wayside oil field (now Wayside-Havana) in Montgomery and Chautauqua Counties, where sandstone in the Nowata formation is one of the principal reservoir rocks. Hence this sandstone lies below the Lenapah limestone and above the Altamont limestone. In some reports (McQueen and Greene, 1938; Clair, 1943) the term "Wayside" is used to designate sandstone that seemingly lies in the basal part of the Pleasanton group. The "Wayside sand," as the name is used commonly, is correlated with the Walter Johnson sandstone. Sandstone in the basal part of the Pleasanton group is the Hepler sandstone. In some places the "Wayside sand" is called "New Albany."

Webb sand.—"Webb sand" is the name used for the middle of three productive sandstones that occur in the Lane-Vilas shale (Lansing group) in Elk and Montgomery Counties. It is known also as the "Longton sand" and as the "Heck sand."

Weiser cap or Weiser lime.—The names "Weiser cap" and "Weiser lime" are used to designate the Altamont limestone in southern Kansas.

Weiser sand*.—The term "Weiser sand" is used to designate sandstone in southeastern Kansas that occurs in the Bandera shale. This sandstone occurs below the Altamont limestone and above the Pawnee limestone. An example of usage is its application to sandstone in the Wayside-Havana oil-producing area, Montgomery County, Kansas, where it is about 120 feet below the "Wayside sand" and lies at a depth of about 700 feet. In the Elk City gas field the

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"Weiser" lies from 70 to 90 feet below the "Wayside" (Boughton, 1920, p. 14).

Sandstone that occurs in the Bandera shale is known as the Bandera Quarry sandstone.

Wilmarth (1938, p. 2296) lists "Weiser sand" as a synonym of "Wiser," named from the Wiser Hill oil field, Osage County, Oklahoma. Boughton (1920, p. 15), however, stated that the "Weiser sand" was named for a Mr. Weiser who first encountered it in Montgomery County, Kansas.

Wilcox sand*.—"Wilcox" is used for two oil-producing zones in eastern Kansas. In some areas as in the McCullough field, Butler County, the term is used for the St. Peter sandstone in the upper part of the Simpson group of Late Ordovician age (White, 1926). Elsewhere, as in the Coleman field, Montgomery County, the name is used to designate uppermost Arbuckle rocks. "Wilcox" was first applied to a subsurface formation in the northern mid-continent region in 1914. The name then was used for the Simpson sandstone to which it still is generally applied. First usage was in the Bixby field, Tulsa County, Oklahoma, when a well was completed by H. F. Wilcox in sec. 3, T. 16 N., R. 13 E. The Bixby field had been opened a few months earlier in 1916, however, and the sand had been found to be productive in sec. 29, T. 17 N., R. 12 E. as early as 1908 (Powers, 1926, pp. 14-15). For many years the "Wilcox" had been called "Sapulpa" or "Mounds sand."

Wiser sand*.—The term "Wiser sand" is used to designate oil-bearing sandstone in the upper part of the Cherokee section in southeast Kansas, as in the Wiggam oil field in Chautauqua County. The "Wiser sand" there is at a depth of about 1,600 feet. Sandstone in that part of the stratigraphic section more commonly is called "Squirrel." The name as used in Kansas probably is of local derivation and was not a correlation with the "Wiser sand" of northern Oklahoma.

According to Wilmarth (1938, p. 2357) the "Wiser sand" in north-central Oklahoma is correlated with a part of the Oologah formation. The Oologah limestone is, at least in part, equivalent to the Pawnee limestone in Kansas.

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ALLEN COUNTY

The geology and oil and gas resources of Allen County have been discussed by Moore and Elledge (1920). The early report is comprehensive of early development and should be of interest to operators of water-flood and other projects.

During 1952 Allen County produced 609,577 barrels of oil, an increase of nearly 70 per cent over that of 1951. Production figures for preceding years are shown in Tables 2 and 3.

Locations of the Allen County oil and gas fields and areas of 1952 oil production are shown in Figure 18.

Geology

SURFACE ROCKS

The surface rocks in Allen County consist of alternating beds of limestone, shale, and some sandstone. The consolidated rocks exposed in the county belong to the Lansing, Kansas City, and Pleasanton groups (Moore and Landes, 1937) of Pennsylvanian age. Lansing rocks in the county are about 90 feet thick and are exposed in the western part. Of these the Stanton limestone is exposed in the northwestern part and the Plattsburg limestone caps uplands in a broad belt east of the Stanton outcrops. All the rocks of the Kansas City group (including the Bronson group of some reports, now regarded as a subgroup) are exposed in the eastern part of Allen County. Rocks of the Bronson subgroup are the surface rocks in most of the southeastern part of the county, but the upper part of the Pleasanton group is exposed in the northern part of T. 26 S., R. 31 E. Several feet of chert gravel deposits of probable Tertiary age mantle the bedrock in several places in the western part of the county and constitute terraces along Neosho River. Thick alluvial deposits in the valley of the river and its larger tributaries are composed principally of sand and gravel and bear considerable water.

SUBSURFACE ROCKS

Pennsylvanian rocks.—In Allen County the Pleasanton group is about 100 feet thick and consists principally of shale. It is the "big shale" of drillers and is easily recognized in drill holes as the first thick shale section after the Hertha and higher limestones have been drilled. Rocks of the Marmaton group are about 165 feet

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thick in the county. They consist of alternating beds of limestone and shale, some sandstone, and a few thin beds of coal. The Cherokee group in Allen County is about 340 feet thick. These rocks are chiefly light and dark shale, sandy shale, sandstone, and a few thin limestone and coal beds. Lenticular sandstones in the Cherokee section yield oil and gas. The "Bartlesville sand" is the most important of these.

Mississippian rocks.—The Mississippian rocks in Allen County consist of limestone (some cherty or dolomitic) and shale. The "Warsaw," Burlington, Sedalia, and Chouteau limestones and the Chattanooga shale (probably of Mississippian age) (Lee, 1940, pl. 3) are present in the county. The total thickness of Mississippian limestones in the county averages about 300 feet (Lee, 1939, pl. 1). The Chattanooga shale is less than 50 feet thick. Oil is produced from a porous zone in the upper part of the Mississippian limestone (Cowley formation) in what is known as the "first break" in the northwestern part of Allen County in the extension of the Neosho Falls field.

Ordovician and Cambrian rocks.—The Arbuckle limestone of Ordovician and Cambrian age lies immediately below the Chattanooga shale in Allen County. In a well drilled at Iola about 750 feet of rock was encountered between the Chattanooga shale and rocks of Pre-Cambrian age. Studies by Keroher and Kirby (1948) indicate that the Cotter-Jefferson City sequence in Allen County has an average thickness of about 350 feet, it being somewhat less than 300 feet in the northeastern part and more than 400 feet in the southwestern part; the Roubidoux dolomite ranges in thickness from slightly less than 100 feet in the northwestern part to about 150 feet in the southeastern part; the Van Buren-Gasconade sequence ranges from about 100 feet in the northwestern part of the county to about 150 feet in the southwestern part; the Eminence dolomite has an average thickness of about 50 feet, increasing eastward; the Bonneterre dolomite is somewhat more than 100 feet in thickness; the Lamotte sandstone is believed to be absent in the northwestern approximate half of the county.

Pre-Cambrian rocks.—The record of a well drilled at Iola indicates that Pre-Cambrian metamorphic rock was reached at 2,160 feet. The well was drilled to a total depth of 3,440 feet. Seemingly granite was not found in this well. Depths to some stratigraphic horizons in the "Iola deep well" are listed in Table 5.

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TABLE 5.—*Depths to some stratigraphic horizons in the "Iola deep well," sec. 26, T. 24 S., R. 18 E., Allen County*

Horizon	Depth, feet
Base Hertha limestone (base Kansas City group)	296
Top Pawnee limestone	562
Base Fort Scott limestone (top Cherokee shale)	674
Top Mississippian limestone	1,040
Top Chattanooga shale	1,318
Top Misener sandstone	1,340
Top Arbuckle rocks	1,348
Top Pre-Cambrian rocks (schist)	2,160
Total depth	3,440

OIL AND GAS DEVELOPMENTS

Gas was discovered at Iola in 1873 and within a short time several wells were drilled in the vicinity and a gas field large enough to supply the city was developed. For many years the Iola gas field was one of the leading ones in Kansas. Several industrial plants made use of the abundant cheap fuel. Oil and gas were found near Humboldt in 1894 and 1895 but the area was not well developed until about 1903.

In later years oil and gas were found in many parts of Allen County and now areas as indicated in Figure 18 are defined as oil and gas fields. However, small amounts of oil and gas have been found in areas not shown as fields on the map and comparatively small areas now produce oil.

The **Bayard** oil and gas field is no longer active. Few logs of wells are available. Oil and gas were produced probably from the "Bartlesville sand." The **Bronson-Xenia** oil and gas field extends from eastern Allen County into Bourbon County. Oil is produced from the "Bartlesvile sand" at a depth of about 700 feet. Most of the oil is produced by water-flooding methods.

The **Colony West** oil and gas field extends into northwestern Allen County from Anderson County. The 1952 production was primary production. Most of the production in the Allen County part of the **Davis-Bronson** field, however, was by water flooding.

The **Elsmore Shoestring** field lies above a shoestring sand about 2 miles east of Elsmore. It is about half a mile wide and more than 5 miles long. The "Bartlesville sand" is about 55 feet thick

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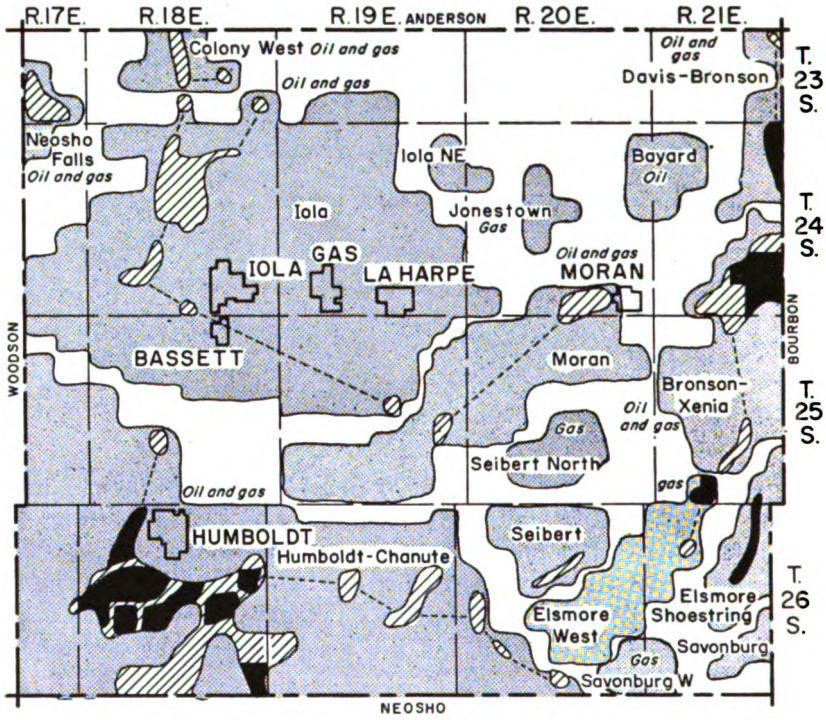

FIG. 18.—Map of Allen County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

in this field. It lies at a depth of about 550 feet and is about 160 feet below the Fort Scott limestone. Present production from the field, which extends eastward into Bourbon County, is from the Allen County part. The **Elsmore West** oil and gas field produces from the "Bartlesville sand" at a depth of about 775 feet.

The southwestern part of Allen County is included in the large **Humboldt-Chanute** oil and gas field, which covers adjacent parts of Neosho, Wilson, and Woodson Counties. The chief producing formation is the "Bartlesville sand."

The **Iola** oil and gas field covers most of T. 24 S., Rs. 18 and 19 E. and smaller parts of adjacent townships. Oil was produced in six areas in 1952. A few years ago only one small area was productive (Jewett, 1949, p. 80) and attention was called to the possibilities of water flooding there. In the early part of the century there

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were important gas fields in this area in the vicinity of Iola, Gas, and La Harpe. Oil occurs in the "Bartlesville sand" at an average depth of about 850 feet. In the **Iola Northeast** field the "Bartlesville sand" is at a depth of about 1,000 feet. The field was developed several years ago but is not now active.

The **Jonestown** gas field, in the central part of T. 24 S., R. 20 E., produced gas from a depth of about 500 feet. The **Moran** oil and gas field extends west of Moran to La Harpe, east to the county line, and about 10 miles north and south. Oil and gas occur in this area in the "Bartlesville sand," which is about 25 feet thick and lies at a depth of about 680 feet. In the Moran area the "Bartlesville" is about 235 feet below the Fort Scott limestone. Oil and gas were discovered in this area in 1903. Water flooding to increase oil production was begun in this area in 1937 (Landes, 1937, p. 5); the subsequent history of the secondary recovery project has not been recorded.

The **Neosho Falls** oil and gas field extends from Woodson County into the northwestern part of Allen County. The field was extended as far as sec. 36, T. 23 S., R. 17 E. late in 1947. Production is from the "first break" in the Mississippian limestone (Cowley formation) at a depth of about 1,200 feet.

The **Savonburg** oil and gas field, which lies east of Savonburg, extends eastward into Bourbon County. Oil production, from the "Bartlesville sand," was confined to Bourbon County during 1952. The **Savonburg West** gas field produced from the "Bartlesville sand" at a depth of about 750 feet.

The **Seibert** oil and gas field produces oil from a depth of about 625 feet. Gas was found in the field in the "Squirrel sand" at a depth of about 400 feet. The **Seibert North** gas field produced from the "Bartlesville sand," at a depth of about 760 feet. Several years ago the No. 1 Anderson well, SW¼ SW¼ sec. 23, T. 25 S., R. 20 E., tested pre-Pennsylvanian formations in this field to a depth of 1,553 feet.

Recent production and developments.—Oil production in Allen County has increased very remarkably during the past few years. In 1949 the reported production was 278,363 barrels; in 1952 it was 609,577 barrels, which was an increase of approximately 70 percent over that of 1951. Approximately 280,872 barrels of the 1952 oil production is estimated to be from water-flood operations. Fourteen projects are operating in the county; three of them extend

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across county boundaries (Table 4). It is noteworthy that oil production in Allen County presently is approaching the all-time high figures; the 1952 production was exceeded only in 1917, 1918, 1920, and 1921. The peak was in 1920 when the county produced approximately 730,000 barrels of oil. Oil production in the various Allen County fields for 1949 through 1952 is listed in Table 73. Gas production in the county has remained rather constant for the last few years, but is rather insignificant when compared with the gas yield of many years ago.

ANDERSON COUNTY

Anderson County has been a producer of oil and gas since the first years of the present century. Gas was discovered near Garnett in 1904 and oil was found in the same part of the county a few years later. Secondary recovery by water drive is now an important phase of production.

The geology and oil and gas resources of Anderson County were described by Charles (1927). Carefully made observations were recorded by Charles and his conclusions should be considered by anyone interested in developing untested areas and in increasing production by secondary recovery methods.

During 1952 Anderson County produced 576,882 barrels of oil. Production figures for the preceding years are shown in Tables 2 and 3. Table 73 shows the production in the various oil fields in the county from 1949 through 1952. Locations of the Anderson County oil and gas fields and the areas of 1952 production are shown in Figure 19. Most of the oil is being produced by water flooding. There are 10 reported projects operating in the county.

Geology

SURFACE ROCKS

With the exception of unconsolidated surficial beds of sand and gravel which range in age from Pleistocene to Tertiary, the outcropping rocks of Anderson County belong to the Shawnee, Douglas, Pedee, Lansing, and Kansas City groups of the Pennsylvanian System (Moore and Landes, 1937). The oldest rocks crop out in the southeastern part of the county and the youngest Pennsylvanian rocks are exposed in the northwestern part. The youngest exposed Pennsylvanian rock is the Plattsmouth limestone member of the

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Oread formation and the oldest exposed rock is the Bethany Falls limestone member of the Swope formation.

The Oread limestone, which caps hills in the northwestern part of the county, is the only formation of the Shawnee group present in Anderson County. All recognized units of the Douglas group, with the possible exception of the Robbins shale, are believed to be exposed in the county. The Williamsburg coal and the Ireland sandstone are rather persistent units of the Lawrence shale. There is some sandstone included in the Vinland shale. The thickness of the Douglas group in the county is about 300 feet. The Westphalia limestone occurs about 60 feet from the base, and the Haskell limestone 60 or 75 feet higher. It is difficult to separate the Stranger formation from the underlying Weston shale at some exposures and on soil-covered slopes, and it is nearly impossible to separate them in the subsurface by means of drillers logs.

The Pedee group is the uppermost group in the Missourian Series. It is limited at the top by a regional disconformity which separates it from the overlying Virgilian rocks. The Iatan limestone is not known to occur in Anderson County. Probably it and the upper part of the Weston shale were removed by erosion before deposition of the overlying rocks of Virgilian age. Based on surface and subsurface observations, the Weston shale in Anderson County ranges in thickness from a featheredge to about 30 feet.

The total thickness of the Lansing group (Fig. 5) in Anderson County is about 110 feet. The units vary in thickness. The thickness of the Stanton limestone is generally about 50 feet. At outcrops the Vilas shale ranges from less than 2 to about 30 feet. The Plattsburg limestone in the shallow subsurface is about 50 feet thick, but where exposed its thickness is generally somewhat less. Thin shales are included in the Stanton and Plattsburg formations. The most prominent escarpments in the county are capped by the Stanton and Plattsburg limestones. Cliffs of Plattsburg limestone are especially noticeable. The rock is well exposed in a quarry a short distance north of Garnett. The lines of outcrop extend in a general north-south direction across the east-central part of the county. The Stanton limestone, covered only by thin residual soil or by deposits of gravel, underlies the surface in a wide area west of its outcrop.

Rocks of the Kansas City group (Fig. 5) are exposed in the eastern part of Anderson County. The Wyandotte limestone is rep-

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resented only by calcareous sandy shale and very thin limestone beds. The Westerville limestone is believed to be absent in the county. Hence, the rocks of the upper part of the Kansas City group, whose total thickness is about 250 feet, crop out in an area characterized by the prominent Iola limestone escarpment and the thick Wea-Fontana and Lane-Bonner Springs shale sections.

The Bronson subgroup of limestone and shale (Fig. 5) is approximately 100 feet thick in Anderson County. No single exposures showing the whole group are known in the county. The upper part of the Winterset limestone (upper member of Dennis formation) is generally eroded from the top of the Bronson escarpment, and rocks below the Bethany Falls limestone (upper member of the Swope formation) are not exposed. These rocks in Anderson County are characterized by flinty and oölitic limestones in the Winterset and Bethany Falls limestones and by black platy shale in the Stark shale member of the Dennis formation. These rocks crop out only in the southeastern part of the county.

SUBSURFACE ROCKS

Hundreds of wells, most of which did not reach Mississippian rocks, have been drilled in Anderson County. Several wells have penetrated Mississippian or deeper strata, however. The following discussion of rocks older than Mississippian is based largely on data obtained from the record of the Lambert et al. No. 1 Wiggins well, in the SE¼ NE¼ sec. 12, T. 23 S., R. 17 E., which was drilled to a total depth of 2,303 feet.

Pennsylvanian rocks.—The Pleasanton shale has an average thickness of about 175 feet in Anderson County. Lenticular sandstones occur in its upper part. Marmaton rocks are about 175 feet thick in

TABLE 6.—*Depths to some stratigraphic horizons in the Lambert et al. No. 1 Wiggin well, Cen. NE¼ sec. 13, T. 23 S., R. 17 E., Anderson County*

Horizon	Depth, feet
Base Kansas City group (base Hertha limestone)	480
Top Pawnee limestone	690
Top Mississippian limestone	1,180
Top Chattanooga shale	1,520
Top Arbuckle rocks	1,570
Top Pre-Cambrian (?) rocks	2,285
Total depth	2,303

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the county. They include shale, limestone, and sandstone. All formations and most members known from surface exposures of the Marmaton can be recognized in most drillers logs. Care must be taken in using the base and top of the Marmaton rocks as subsurface markers. Locally the Fort Scott limestone is underlain by a lenticular limestone in the upper part of the Cherokee shale, and locally the upper limestone formation of this group, the Lenapah, is absent. Sandstone in the Bandera shale formation commonly called "Wayside sand," has yielded some oil in the county. This is the Bandera Quarry sandstone; it is called "Weiser" in several parts of eastern Kansas. The sandstone that is more commonly called "Wayside" occurs in the Nowata shale.

The average thickness of the Cherokee rocks in Anderson County is about 400 feet. The Cherokee is composed principally of dark shale containing sandstone lenses and thin limestone and coal beds. The Ardmore limestone is a persistent marker in the upper part of the Cherokee rocks. Lenticular sandstones near the top of the Cherokee shale are called "Squirrel sand" by drillers. The "Bartlesville sand" or "Colony sand" lies in the upper middle part of the Cherokee, and thicker lenticular sandstones occur in the basal part. The Cherokee shale lies on the eroded Mississippian limestone surface and is conformably overlain by the Fort Scott limestone.

Mississippian rocks.—Mississippian limestones lie next below the Cherokee shale. Their total thickness is about 300 feet. Drillers commonly report shaly zones in the lower part and sandstone in the middle part. However, the "sandstone" probably everywhere is flinty or cherty limestone or dolomite. Cherty limestone is characteristic of the "Mississippi lime" in eastern Kansas. Lee (1939, 1940) has studied carefully the subsurface Mississippian rocks in Kansas and has shown several disconformities within them. Lee (in Jewett, 1940a, fig. 2B) has shown that rocks of Meramecian, Osagian, and Kinderhookian ages are present in Linn County, and it is probable that sample studies would show the presence of the same subdivisions in Anderson County.

Shale assigned to the Chattanooga formation, about 45 feet thick and seemingly conformable with the overlying Mississippian limestone, is believed to underlie all Anderson County.

Ordovician rocks.—The Chattanooga shale lies upon Ordovician rocks in a large triangular area in southeastern Kansas and extends into Missouri and Oklahoma (McClellan, 1930; Ockerman, 1935,

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fig. 2; Lee, 1940, fig. 1); therefore, rocks representing a long interval of Silurian and Devonian time are absent there. McClellan (1930) has shown that the Simpson (St. Peter) sandstone dipping under younger Ordovician rocks to the northwest is present in the northwestern corner of Anderson County. This indicates that the overlying Chattanooga shale oversteps various Ordovician strata. This condition resulted from erosion on the Chautauqua arch before the Chattanooga shale was deposited. The Chattanooga shale lies on slightly upturned and intensely eroded Ordovician strata that in Anderson County dip to the northwest away from the ancient Chautauqua arch. Because of this condition there is a possibility of stratigraphic oil traps in Ordovician rocks.

Cambro-Ordovician rocks.—The Arbuckle rocks include about 700 feet of strata, mostly dolomite but containing some shale in the lower part and perhaps some sandstone. Keroher (in Jewett, 1940a, pp. 12-14, pl. 2A) was able to differentiate Cambrian and Ordovician strata and to subdivide rocks of each system in the Holeman and Edwards No. 9 Pollman well, in the SE¼ sec. 35, T. 19 S., R. 24 E., Linn County. It is probable that a study of well cuttings from Anderson County would reveal a sequence of Arbuckle rocks similar to that in Linn County. Available data indicate a rather uniform total thickness for the Arbuckle rocks in the two counties.

Cambrian rocks.—About 30 feet of sandstone in Anderson County lying on granite is correlated with the Lamotte sandstone of Missouri.

Depths to some stratigraphic horizons in a well in the southwest part of Anderson County are listed in Table 6.

Oil and Gas Developments

The first well in Anderson County of which we have record was drilled in about 1885 in the SW¼ sec. 6, T. 20 S., R. 20 E. A good show of oil was reported, but because gas was being sought the well was not completed as an oil well. Another early well was drilled in the SE¼ sec. 19, T. 20 S., R. 20 E. A small flow of gas was encountered, but the well was abandoned at about 500 feet. During the next several years only a few scattered wells were drilled. Gas was discovered a mile southeast of Garnett in 1904. An important field which supplied gas to the City of Garnett was soon developed. As drilling continued to the northeast, both oil

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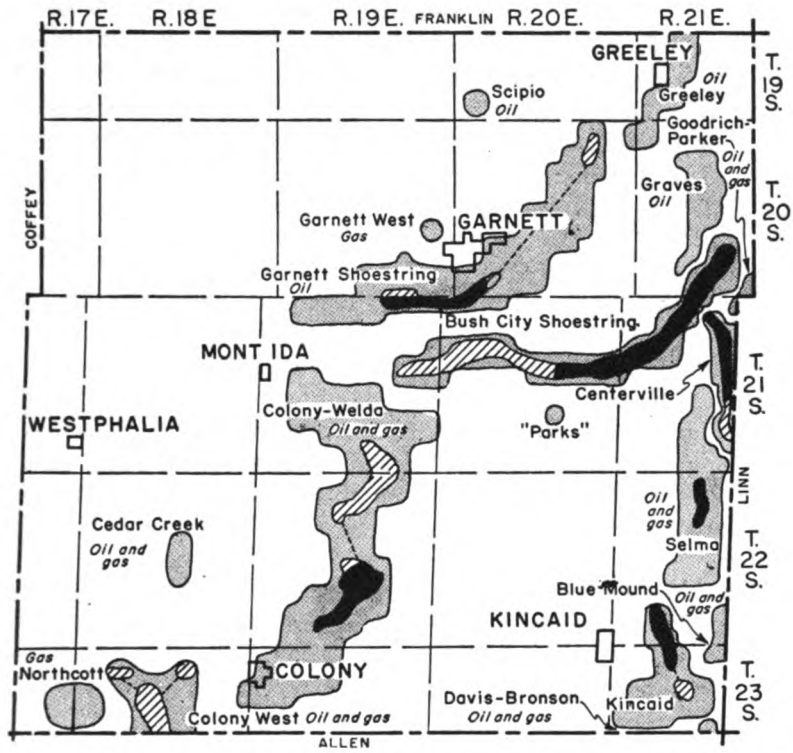

FIG. 19.—Map of Anderson County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

and gas were discovered in a narrow discontinuous belt between Garnett and Greeley. Gas was discovered near Colony in the summer of 1921. Rapid development followed and in less than 2 years an unbroken strip of oil and gas producing territory 12 miles long was opened between Colony and Mount Ida (Charles, 1927, p. 14). Oil was discovered about a mile southeast of Garnett in September 1921, opening the **Garnett Shoestring** which extends westward into sec. 2, T. 21 S., R. 19 E. and south and west to sec. 14, T. 21 S., R. 19 E.

Although several deep tests have been drilled in Anderson County, all oil and gas production has been from Pennsylvanian rocks. Production is from sandstone in the Bandera shale and from sandstones in the Cherokee rocks. The shoestring type of sandstone body is the common form.

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The oil and gas fields in Anderson County as designated by the Kansas Oil Field Nomenclature Committee are indicated in Figure 19 and are discussed briefly in the following paragraphs.

The **Blue Mound** oil and gas field, which lies chiefly in southeastern Linn County, extends into Anderson County in Ts. 22 and 23 S., R. 21 E. Oil and gas were produced from several Pennsylvanian sandstones and several years ago a small amount of oil was produced in the Linn County part of the field from a deeply weathered zone at the top of the Mississippian limestone.

The **Bush City Shoestring** oil field is narrow, being 13 miles long and averaging about a quarter of a mile in width. It seemingly is a continuation of the **Goodrich Shoestring** in Linn County. Production is from an elongated sand body called "Squirrel" that lies 20 to 40 feet below the top of the Cherokee shale. This sand body is at approximately the same horizon as is the sand body underlying Pottawatomie Valley from southwest of Garnett to Greeley. Charles (1927, p. 44) believed these sand bodies to be channel fillings.

The **Cedar Creek** gas field is no longer active. Gas was formerly produced from the Bandera Quarry sandstone at a depth of about 750 feet.

The Anderson County part of the **Centerville** oil and gas field is the northern part of an area in which oil and gas occur in a "Bartlesville shoestring sand." The area has been known as the **Schimmerhorn-Selma-Kincaid** oil and gas producing area that extends as far south as sec. 9, T. 23 S., R. 21 E. Oil occurs in the north and south ends of the shoestring and gas and oil in the middle part.

Because of the presence of continuous oil and gas producing territory from the vicinity of Mount Ida southward to Colony, the area has been designated the **Colony-Welda** oil and gas field. Oil is now produced in areas shown in Figure 19. Individual smaller "fields" merit separate consideration. The **Colony** gas pool, at the southern end of the **Colony-Mount Ida trend,** is centered in the town of Colony. This field was drilled out rapidly and great quantities of gas were wasted. Closely spaced drilling on town-lot locations resulted in many wells being exhausted after a few weeks. The first wells were drilled in 1921. Production was from the "Colony sand," which is the same formation that is known locally as "Bartlesville." The field is now used for natural gas storage. In the **Polkinghorn** oil and gas producing area, now part of the larger

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Colony-Welda field, gas has been produced from three zones: a sandstone in the Bandera formation, a sandstone near the top of the Cherokee shale, and the "Bartlesville" or "Colony sand." Most of the gas has been produced from the "Colony sand," which has a maximum thickness of more than 100 feet. The largest gas well is reported to have had an initial flow of 32 million cubic feet. The maximum open flow of the field is estimated to have been 250 million cubic feet. The original rock pressure was 280 pounds per square inch (Charles, 1927, p. 61). Oil was found in small disconnected areas in the "Squirrel sand." Initial daily productions of the wells ranged from 25 to 125 barrels.

The **Colony West** oil and gas field extends into Allen County. Oil production is from a sandstone in the upper part of the Cherokee shale at a depth of about 825 feet.

The **Davis-Bronson** oil and gas field, chiefly in Allen and Bourbon Counties, extends into the southeast corner of Anderson County. No oil was reported from the Anderson County part of the field in 1952.

The chief producing sand in the **Garnett Shoestring** oil field is a part of the same shoestring which produces in the **Greeley** field. The primary development in the **Garnett Shoestring** took place between 1921 and 1923. Water-flooding operations were started in the field in December 1936 by the Brundred Oil Corporation. The **Garnett West** gas field was developed several years ago. Gas was produced from a Marmaton sandstone at a depth of about 650 feet. The field is now abandoned.

The **Graves** oil and gas field may be regarded as the northward extension of the **Bush City** field. Gas was found in this area in December 1929 in the Monitor No. 1 Graves well, sec. 20, T. 20 S., R. 21 E. in a sandstone in the Cherokee shale at a depth of about 760 feet. Production records are not available, but oil is reported to have been produced in sec. 32 from the "Squirrel sand" at a depth of about 600 feet.

The **Greeley** oil pool, in secs. 29 and 31, T. 19 S., R. 21 E., is in the northeast extension of the **"Pottawatomie Valley field"** of Charles' report (1927, p. 49). Oil was produced from sandstone near the top of the Cherokee shale. This sandstone is a shoestring that extends the entire length of the "Pottawatomie Valley field" and beyond. It is locally known as "the 800-foot sand." Water

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flooding was initiated recently in the field (Powell and Eakin, 1953, p. 34).

The **Kincaid** oil field produces oil from a "Bartlesville shoestring sand" which extends as far northward as the Anderson County part of the **Centerville** field.

The **Northcott** gas field was developed several years ago. Production records are not available but gas was reported in drillers logs as occurring in several sandstones ranging in depth from about 470 feet (Knobtown sandstone) to about 1,000 feet ("Bartlesville"). A deep test well in the SE¼ NE¼ sec. 12, T. 23 S., R. 17 E. is reported to have reached granite at 2,100 feet.

The **Scipio** oil field is no longer active. Production data are not available, but oil probably was produced from the "Bartlesville sand" which lies at a depth of about 750 feet.

The **Selma** oil and gas field produces oil from the "Bartlesville sand." The sand body seemingly is a part of a shoestringlike body extending northward from the vicinity of Kincaid on the south to the northern part of T. 21 S., R. 21 E.

Oil production in Anderson County fields for 1949 through 1952 is listed in Table 73.

Recent production and developments.—Nearly all oil now produced in Anderson County is produced by water flooding. There are 10 projects operating in the county. Data on the operations are listed in Table 4.

ATCHISON COUNTY

Oil and gas in commercial quantities have not been found in Atchison County. Testing, especially of deeper formations, has not been sufficient to disprove the area as potential oil and gas territory. Atchison County is in the Forest City basin and on the eastern margin of the North Kansas basin. The outcropping bedrock is of Pennsylvanian age, and glacial drift occurs in thick deposits.

Geology

SURFACE ROCKS

Outcropping Pennsylvanian rocks in Atchison County include those from near the top of the Pennsylvanian System (Pony Creek shale) to the upper part of the Douglas group (Fig. 4).

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SUBSURFACE ROCKS

Depths to some key stratigraphic horizons in the Earl F. Wakefield et al. No. 1 National Life Insurance Company well, Cen. NW¼ NE¼ sec. 17, T. 6 S., R. 20 E., are listed in Table 7.

Pennsylvanian rocks.—Pennsylvanian rocks are about 2,500 feet thick in the northwestern part of Atchison County where nearly the whole section is present.

Mississippian rocks.—According to Lee (1939, pl. 1), the total thickness of Mississippian limestone formations in Atchison County ranges from less than 200 feet in the northwestern part to slightly more than 400 feet in the southeastern part. The Ste. Genevieve limestone is the uppermost Mississippian formation that has been identified in the county. It lies next below Pennsylvanian rocks in the eastern and northeastern parts of the county (Lee and Payne, 1944, fig. 17). West of the area of the Ste. Genevieve limestone, Pennsylvanian sediments overstep the St. Louis and Spergen limestones and in the western part of the county they lie on the "Warsaw" limestone. The "Warsaw," Burlington-Keokuk, and Gilmore City limestones are believed to be present throughout the county.

The thickness of the Chattanooga shale in Atchison County ranges from slightly more than 50 feet in the southeastern part to nearly 200 feet in the northwestern part (Lee, 1943, fig. 14).

TABLE 7.—*Depths to some key horizons in the Earl F. Wakefield et al. No. 1 National Life Insurance Company well, Cen. NW¼ NE¼ sec. 17, T. 6 S., R. 20 E., Atchison County*

Horizon	Depth, feet
Base Oread limestone (top Douglas group)	350
Top Stanton limestone	555
Base Hertha limestone (top Pleasanton group)	875
Base Fort Scott limestone (top Cherokee shale)	1,085
Top Mississippian (Ste. Genevieve) limestone	1,665
Top Chattanooga shale	2,060
Top Devonian limestone	2,150
Top Maquoketa shale	2,425
Top Viola limestone	2,502
Top Decorah shale	2,657
Top St. Peter sandstone	2,675
Top Arbuckle limestone	2,750
Total depth	2,789

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Pre-Chattanooga rocks.—According to Lee (1943, fig. 12), the thickness of rocks between the base of the Chattanooga shale and the top of the Maquoketa shale ranges from about 200 feet in the southeastern corner of Atchison County to 400 feet in the northwestern corner. In the Wakefield et al. No. 1 National Life well, in sec. 17, T. 6 S., R. 20 E., 275 feet of Devonian limestone was found between the Chattanooga shale and the Maquoketa shale (Lee, 1943, fig. 7). The thickness of rocks between the top of the St. Peter sandstone and the Pre-Cambrian floor ranges from about 400 feet in the northwestern part of the county to about 700 feet in the northeastern part (Lee, 1943, fig. 9).

Oil and Gas Exploration

Several years ago when there was increased interest in oil possibilities in the Forest City basin area, much geologic work was done in Atchison and other northeastern Kansas counties, but few test wells have been drilled in Atchison County and no drilling has been reported for several years. Data on eight wells of which the Geological Survey has records are given in Table 8. Locations of the eight wells are shown on Figure 20.

Table 8.—*Data on wells drilled for oil and gas in Atchison County*

No. on map	Name of well	Location	Total depth, feet	Remarks
1	Scroggins No. 1 Duff	SE NE 5-5-17E	1,800?	No log available
2	Carter Oil Co. No. 3 Stratigraphic test	NE NW SW 10-6-19E	2,941	Top Arbuckle, 2,894 ft.
3	Bailor Mfg. Co. No. 1 Argol Plant	NE SE NW 1-6-20E	643	Stopped in Pleasanton sh.
4	Bailor Mfg. Co. No. 2 Argol Plant	SE NE NW 1-6-20E	1,405	Stopped in Cherokee rks.
5	Wakefield et al. No. 1 National Life	NW NE 17-6-20E	2,789	Depths to some horizons given in Table 7
6	Atchison No. 1 Martin	SW SW SE 33-6-20E	1,280	Stopped in upper Cherokee rks.
7	Citizens of Atchison No. 1 Atchison	SW SW NE 18-6-21E	1,352	Diamond drill hole; top Mississippian, 1,300 ft.
8	Indian Mound Oil Co. No. 1 Oak Mills	NE NE NE 13-7-21E	3,085?	Pre-Cambrian, 2,900 ft.

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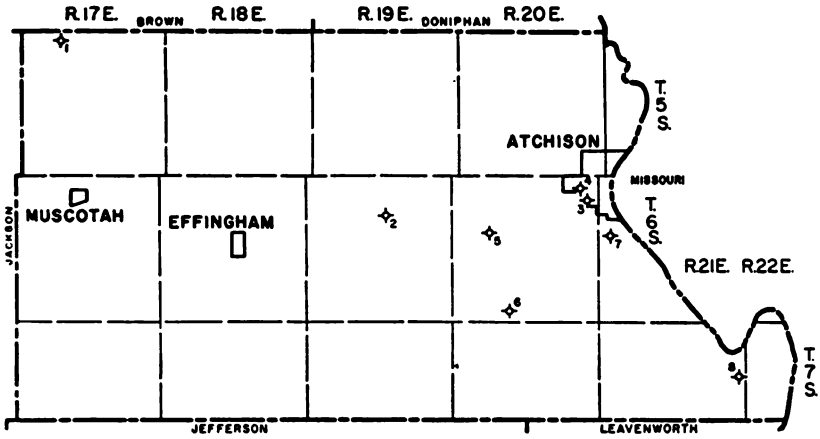

FIG. 20.—Map of Atchison County showing location of wells listed in Table 8.

BOURBON COUNTY

As early as 1906 there were eight oil wells and six gas wells in Bourbon County, and it is reported that some gas was produced in the vicinity of Fort Scott many years earlier. The Hepler pool in the southwestern part of the county was discovered in 1917. Gas was discovered near Mapleton in 1918. Oil was found near Bronson in 1919. Production of oil and gas in Bourbon County is almost entirely from sandstones in the Cherokee shale, and no oil has been found in lower rocks.

During 1952 Bourbon County produced 56,984 barrels of oil. Production figures for preceding years starting with 1917 are shown in Tables 2 and 3. Table 73 shows the production in the various oil fields in the county for 1949 through 1952.

Locations of the Bourbon County oil and gas fields and the areas of production in 1952 are shown in Figure 21.

GEOLOGY

SURFACE ROCKS

The surface rocks of Bourbon County consist of alternating beds of shale, limestone, and sandstone. All outcropping consolidated rocks are of Pennsylvanian age.

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The youngest outcropping Pennsylvanian formation is the Chanute shale in the Kansas City group (Fig. 5) which crops out in the northwestern part of the county. Rocks of the Bronson subgroup crop out in a narrow band along the Bourbon-Allen County line and on the uplands between Marmaton and Little Osage Rivers in the northwestern part of Bourbon County. They consist of alternating beds of limestone and shale and some thin beds of sandstone. The three limestone formations of the Bronson subgroup crop out along a steep winding escarpment. The Dennis limestone is present below an extensive dip slope west of the escarpment. The Bronson rocks have a total thickness of about 110 feet in the county. The Pleasanton group consists of beds of shale and sandstone and a few thin beds of limestone; the Hepler sandstone is a thin but persistent sand deposit at the base. The total thickness of the Pleasanton is about 150 feet in Bourbon County. It is separated from the underlying Marmaton rocks by a disconformity. The Marmaton rocks consist of alternating beds of limestone and shale and some beds of sandstone and thin coal. The thickness of the Marmaton rocks in Bourbon County is about 180 feet. The Marmaton formations are well exposed along Marmaton River between Fort Scott and Uniontown, and along smaller streams in the eastern part of the county.

The Cherokee shale (Fig. 6) is the oldest outcropping rock in Bourbon County. It is exposed in the eastern part of the county in the valleys of Little Osage and Marmaton Rivers and in the southeastern part of the county. The Cherokee consists of beds of shale and sandstone, a few thin beds of limestone, and several beds of coal. Some of the shale is sandy, and part of the sandstone contains shale. The total thickness of the Cherokee shale in Bourbon County is about 350 feet. Only the upper part is exposed.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons in the Oklahoma Natural Gas Corporation No. 1 Stephenson well, in sec. 16, T. 26 S., R. 24 E., Bourbon County, are given in Table 9.

Pennsylvanian rocks.—Pennsylvanian rocks in Bourbon County have an average thickness of about 500 feet. The Cherokee shale, of which only the upper part crops out, is about 350 feet thick. The "Squirrel sand," about 20 feet thick, lies a few feet below the top of the Cherokee shale. The "Bartlesville sand" is about 180 feet below the top of the Cherokee and ranges from a few feet to 40

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TABLE 9.—*Depths to some stratigraphic horizons in the Oklahoma Natural Gas Corporation No. 1 Stephenson well in the SW¼ NE¼ sec. 16, T. 26 S., R. 24 E., Bourbon County*

Horizon	Depth, feet
Top Labette shale	35
Top Cherokee shale	130
Top "Warsaw" limestone	490
Top Burlington-Keokuk limestone	600
Top St. Joe limestone	790
Top Sedalia (?) limestone	803
Top Northview shale	818
Top Compton limestone	845
Top Chattanooga shale	900
Top Sylamore sandstone	913
Top Cotter-Jefferson City dolomite	915
Top Roubidoux formation	1,200
Top Gasconade-Van Buren formation	1,280
Top Gunter sandstone	1,451
Top Proctor dolomite	1,476
Top Eminence dolomite	1,533
Top Bonneterre dolomite	1,658
Top Lamotte sandstone	1,760
Top Pre-Cambrian rocks	1,810
Total depth	2,403

feet in thickness. The "Burgess sand" occurs in the basal part of the Cherokee and is about 10 feet thick.

Mississippian rocks.—The total thickness of Mississippian rocks in Bourbon County ranges from about 300 to 350 feet (Lee, 1939, pl. 1). Mississippian formations present in the county include the "Warsaw," Keokuk, Burlington, Reeds Spring, and St. Joe limestones, the Northview shale, and the Compton limestone. The Chattanooga shale is less than 50 feet thick (Lee, 1940, pl. 3). It overlies beveled Ordovician rocks and is seemingly conformable with the overlying Compton limestone.

Ordovician rocks.—Studies of a deep well drilled in sec. 16, T. 26 S., R. 24 E. show the thickness of the Ordovician rocks to be 660 feet. The units identified are the Cotter-Jefferson City dolomite, the Roubidoux formation, the Gasconade and Van Buren dolomites, and the Gunter sandstone.

Cambrian rocks.—The thickness of Cambrian rocks in Bourbon County is about 300 feet. The Eminence-Potosi dolomite, the

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Bonneterre dolomite, and the Lamotte sandstone have been identified. They are separated from Ordovician rocks by an unconformity and rest on Pre-Cambrian rocks.

Oil and Gas Developments

Oil and gas have been found chiefly in the western part of Bourbon County. Several fields lie along the western border and extend into Allen County. A large number of wells, mostly shallow, have been drilled in the county.

The Kansas Oil Field Nomenclature Committee has designated oil and gas fields in Bourbon County as shown in Figure 21. The fields are described briefly below.

The **Bronson Southeast** oil field is no longer active. Production data are not available, but some oil was produced from the "Bartlesville sand" which is reported to be about 18 feet thick in the area, and which occurs at a depth of about 718 feet.

The **Bronson-Xenia** oil and gas field covers most of the western part of T. 24 S., R. 22 E. and extends southwestward across T. 24 S., R. 21 E. into Allen County. Oil production is from the "Bartlesville sand" which has an average thickness of about 20 feet and lies at a depth of about 665 feet.

The **Davis-Bronson** oil and gas field extends into Allen and Anderson Counties. Oil production is from the "Bartlesville sand." Several gas wells in sec. 35, T. 23 S., R. 21 E. are recorded as having produced gas from the "Bartlesville sand" at a depth of about 560 feet.

Few data on the **Devon** gas field are available. Gas was produced from a depth of about 455 feet. One well, in the SW cor. sec. 31, T. 24 S., R. 24 E., was reported as having had an initial daily production of 1 million cubic feet of gas.

The **Elsmore Shoestring** oil and gas field extends into Bourbon County from Allen County. Oil production is from a "Bartlesville shoestring sand" about 50 feet thick and at a depth of about 550 feet. No production has been reported from the Bourbon County part of the field for several years.

The **Fulton** gas pool was opened in 1943. Production was from the "Bartlesville sand" which there has an average thickness of about 20 feet and lies at a depth of about 450 feet. Wells were reported to have had an initial open flow of 150,000 cubic feet of gas and rock pressure of 225 pounds.

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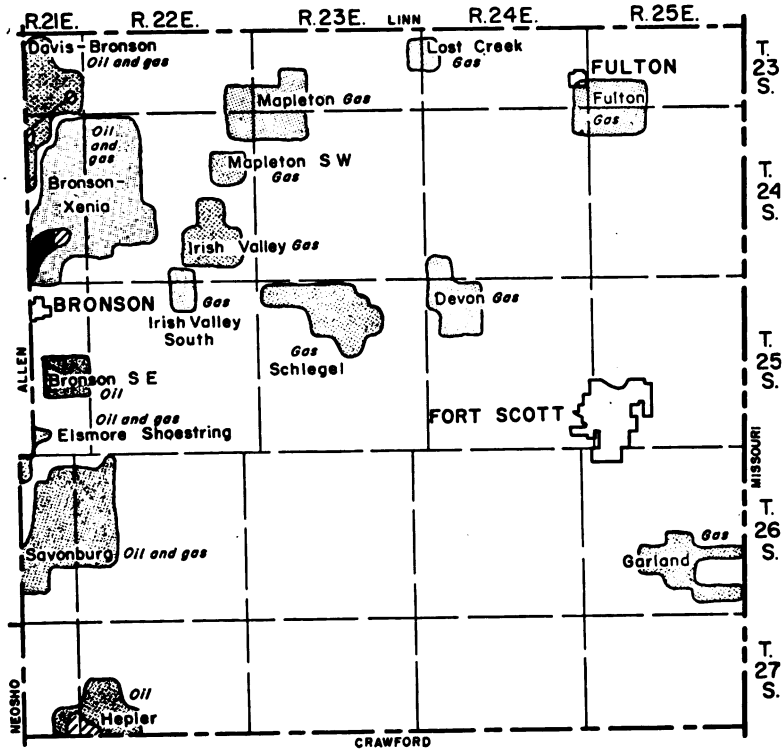

FIG. 21.—Map of Bourbon County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

Almost no data on the **Garland** gas field are available. Gas was produced there from shallow wells. The **Hepler** oil field was reactivated a few years ago after temporary abandonment. Production is from the "Bartlesville sand." The field extends into Crawford County; most of the 1952 production was from the Bourbon County part.

Few data on the **Irish Valley, Irish Valley South, Lost Creek, Mapleton,** and **Mapleton Southwest** gas fields are available. In the **Irish Valley South** area gas has been produced at depths between 700 and 800 feet. It is probable that the "Bartlesville sand" is the principal reservoir rock in the fields. Oil production has not been reported in the **Savonburg** field since 1950, when only 25 barrels was reported.

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The Schlegel gas field was developed many years ago. Principal gas production was from the "Bartlesville sand" at a depth of about 600 feet, but gas was encountered at several shallower horizons.

Recent production and developments.—Oil production in Bourbon County in 1952 amounted to 56,984 barrels, more than 5 times as much as that of 1948 when only 11,188 barrels was recorded.

Production in the various Bourbon County oil fields for the years 1949 through 1952 is listed in Table 73.

BROWN COUNTY

Much information on the stratigraphy and structural geology of Brown and other northeastern Kansas counties has been made available by Lee (1943). Brown County is in the northwestern part of the Forest City basin and on the eastern margin of the North Kansas basin. The deepest part of the Forest City basin is in this county (Lee, 1943, fig. 1). Devonian rocks truncate northwestward-dipping Silurian rocks in this area. There are numerous potential producing zones, especially below disconformities.

Late in 1944 oil was discovered in the Gall No. 1 Livengood well in the NE¼ NW¼ SW¼ sec. 3, T. 1 S., R. 15 E. The oil pool is in "Hunton" (Devonian) rocks, just below the Chattanooga shale.

Brown County produced 5,001 barrels of oil in 1952. Production figures for the years 1944 to 1952 inclusive are given in Table 73. The Livengood is still the only oil field in the county.

Geology

SURFACE ROCKS

The exposed consolidated rocks in Brown County are Permian and Pennsylvanian in age. Thick deposits of glacial drift cause difficulty in outcrop studies.

Permian rocks.—Permian rocks of the Council Grove and Admire groups (Fig. 3) crop out in the western half of Brown County. There are few exposures because of the presence of glacial drift.

Pennsylvanian rocks.—Pennsylvanian rocks extending from the uppermost part of the system to the upper part of the Severy shale (Fig. 4) are exposed in Brown County. These rocks crop out in the approximate eastern half of the county. Like the Permian rocks, the Pennsylvanian beds are exposed in relatively few places. From

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outcrop studies and data from shallow drilling, it is evident that both Permian and Pennsylvanian rocks in Brown County are similar to equivalent formations farther south where they are more completely exposed.

SUBSURFACE ROCKS

Depths at which some key stratigraphic horizons were reached in six wells in Brown County are given in Table 10.

Pennsylvanian rocks.—In western Brown County, where the entire Pennsylvanian section is present under Permian beds, the Pennsylvanian strata have a total thickness of about 2,000 feet.

Mississippian rocks.—The total thickness of Mississippian limestone formations in Brown County ranges from about 50 feet in the northwestern corner to about 225 feet in the southeastern corner (Lee, 1939, pl. 1). According to Lee and Payne (1944, fig. 4), the St. Louis limestone is the uppermost Mississippian limestone formation. It lies next below Pennsylvanian deposits in southeastern Brown County. Successively the Spergen limestone and the "Warsaw" limestone are overstepped to the west, and in the western part of the county undivided Burlington and Keokuk limestone lie next below Pennsylvanian rocks.

TABLE 10.—*Depths in feet to some key horizons in six wells in Brown County*

Horison	Gall No. 1 Livengood, NE NW SW 3-1-15E	Woods Oil & Gas Co. No. 1 Turner, SW NW SW 7-1-15E	Davron Oil Co. No. 1 Yost, SE SW NE 33-1-16E	Natl. Assoc. Petro. Co. No. 1 Titus, SE SE NE 20-2-15E	Natl. Assoc. Petro. Co. No. 1 Georgeson, SW SW SW 11-3-16E	Woods Oil & Gas Co. No. 2 Speiker, NE NW NW 6-4-15E
Top Howard limestone	590	663	.....	.....	.....	.....
Top Topeka limestone	650	.....	.....	883	.....	.....
Top Lansing group	1,018	1,180	1,027	.....	1,044	1,229
Top Mississippian rocks	2,215	2,377	2,334	2,647	2,344	2,572
Top Kinderhookian rocks	.....	2,478	2,517	2,796	2,586	.....
Top "Hunton" limestone	2,579	2,731	2,748	3,045	.....	2,991
Top Maquoketa shale	.....	3,377	.....	3,696	3,314	3,503
Top Viola limestone	.....	3,449	3,372	3,735	3,405	3,597
Top Simpson	3,676	.....	.....	.....	.....	.....
Top Arbuckle	3,826	.....	.....	.....	.....	.....
Total depth	2,590	3,874	3,425	3,775	3,433	3,708

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The Chattanooga shale ranges in thickness from about 150 feet in the northeastern part of the county to slightly more than 250 feet in the western part (Lee, 1943, fig. 14). Lee identified 231 feet of Chattanooga shale in the Carter No. 4 Stratigraphic test well in sec. 24, T. 4 S., R. 16 E. (Lee, 1943, fig. 7). In the Gall No. 1 Livengood well, in sec. 3, T. 1 S., R. 15 E., rocks in the upper part of the 264-foot interval (Table 10) between the base of Mississippian limestones and the top of the "Hunton" limestone may be post-Chattanooga in age.

Devonian and Silurian rocks.—Lee (1943, fig. 7) identified 163 feet of Devonian limestone and 263 feet of Silurian limestone in the Carter No. 4 Stratigraphic test well. In the Wakefield et al. No. 1 National Life well in sec. 17, T. 6 S., R. 20 E., Atchison County, no Silurian rocks were found and Devonian rocks lie on a reduced thickness of Maquoketa shale.

Ordovician rocks.—In the Carter No. 4 Stratigraphic test well, Lee (1943, fig. 7) identified 135 feet of Maquoketa shale, 130 feet of Kimmswick limestone, and 95 feet of undivided Decorah-Plattin limestone. The St. Peter sandstone, 25 feet thick, lies on Arbuckle rocks. The maximum thickness of rocks between the top of the St. Peter sandstone and the Pre-Cambrian floor in Brown County is about 400 feet (Lee, 1943, fig. 9).

Oil and Gas Developments

The first test for oil and gas in Brown County of which we have record is a diamond drill hole that was put down at Horton many years ago in sec. 33, T. 4 S., R. 17 E. to a depth of 1,105 feet. This well did not reach Mississippian rocks. More recently several wells were drilled in the county (Table 11).

Oil was discovered late in 1944 in the Gall No. 1 Livengood well in the NE¼ NW¼ SW¼ sec. 3, T. 1 S., R. 15 E. Production is from the upper part of the "Hunton" limestone at a depth of 2,579 feet. The initial production was approximately 85 barrels of oil per day. Five oil wells have been drilled in the Livengood field, which is the only oil field in Brown County.

The second producing well in the field is the R. S. Tomer No. 1 "B" Livengood, NE¼ SW¼ SW¼ sec. 3, T. 1 S., R. 15 E. This well was drilled to a depth of 2,635 feet. The top of the "Hunton" was reached at 2,617 feet. The initial production of the well, which was completed April 28, 1945, was reported as 80 barrels of oil per

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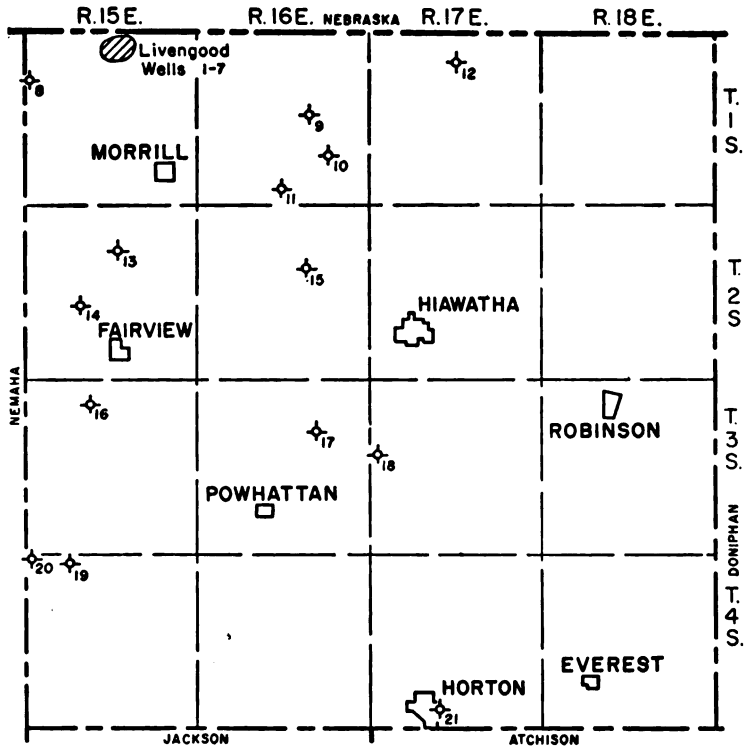

FIG. 22.—Map of Brown County showing the Livengood oil field and locations of wells listed in Table 11.

day. The third oil well, the Stout and Hahn No. 1 Livengood, was completed January 25, 1948, in the SW¼ NE¼ SW¼ sec. 3. The initial daily production was estimated as 40 barrels per day. The total depth of the well is 2,612½ feet; the "Hunton" was reached at 2,605 feet; and saturation from 2,607½ feet to 2,612½ feet was reported.

Recent developments. — No drilling was reported in Brown County during 1949, but four dry holes including three wildcat wells were put down in 1950; one of the dry holes is in the Livengood field. In 1951 one oil well was drilled in the field and two dry holes were abandoned elsewhere in the county. Another oil well was added to the Livengood field in October 1952. A dry wildcat well was abandoned in sec. 10, T. 1 S., R. 17 E. in the same month.

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TABLE 11.—*Data on wells drilled for oil and gas in Brown County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Clifton Gall No. 1 Livengood	SE NW SW 3-1-15E	1944	2,590	85 bbl. oil well; see Table 10
2	Stout & Hahn No. 1 Livengood	SW NE SW 3-1-15E	1948	2,612	Top Kansas City, 1,028; Mississippian, 2,224; base Mississippian, 2,401; top "Hunton," 2,605 ft.; 40 bbl. oil well
3	R. S. Tomer No. 1 "B" Livengood	NE SW SW 3-1-15E	1945	2,635	Top "Hunton," 2,617 ft.; 80 bbl. oil well
4	Stout & Hahn No. 1 Husted	S½ S½ NW 3-1-15E	1950	2,613	Dry hole; top Kansas City, 1,010; Mississippian, 2,185; "Hunton," 2,168 ft.
5	Ray Smith No. 2 Livengood	SW NW SW 3-1-15E	1952	2,658	Oil well; 12 bbls. per day
6	Smith & Houston No. 1 Livengood	NW NE SE 4-1-15E	1951	....	Oil well; 15 bbls. per day
7	R. S. Tomer No. 1 Warner	NE SE NE 4-1-15E	1945	2,701	Top Mississippian, 2,275; "Hunton," 2,650 ft.
8	Woods Oil & Gas Co. No. 1 Turner	SW NW SW 7-1-15E	1951	3,874	Stratigraphic data in Table 10
9	Ohio Oil Co. No. 1 Peck	SE SE SE 15-1-16E	1944	2,880	Top "Hunton," 2,780 ft.
10	Gall & Towle No. 1 Allerton	SW NE 26-1-16E	1943	2,785	Top Kansas City, 923; Mississippian, 2,272; base Mississippian, 2,472; top "Hunton," 2,684 ft.
11	Davon Oil Co. No. 1 Yost	SE SW NE 33-1-16E	1950	3,425	Stratigraphic data in Table 10
12	Palensky & Sons No. 1 Babcock	NW NW NW 10-1-17E	1952	2,600	Dry hole
13	Stanolind Oil & Gas Co. No. 1 Wikle	NW NW SW 10-2-15E	1946	3,433	Top Mississippian, 2,592; Kinderhookian, 2,755; "Hunton," 3,036 ft.
14	National Assoc. Petro. Co. No. 1 Titus	SE SE NE 20-2-15E	1950	3,775	Stratigraphic data in Table 10
15	Nichols-Neff-Stearns No. 1 Yaussi	CNL NE NE 15-2-16E	1941	2,766	Top "Hunton," 2,658 ft.
16	McAlpine et al. No. 1 Tyler	NE SW SW 4-3-15E	1941	1,250	
17	National Assoc. Petro. Co. No. 1 Georgeson	SW SW SW 11-3-16E	1950	3,433	Stratigraphic data in Table 10
18	Gall & Towle No. 1 Amann	SW SW 18-3-17E	1943	2,732	
19	Towle & Gall No. 1 Dillaplain	SW NE 5-4-15E	1943	3,066	Top Kansas City, 1,237; Mississippian, 2,561; base Mississippian, 2,695; top "Hunton," 2,995 ft.
20	Woods Oil and Gas Co. No. 2 Speiker	NE NW NW 6-4-15E	1951	3,708	Stratigraphic data in Table 10
21	Diamond Drill Hole at Horton	33-4-17E		1,105.9	Stopped in lower Kansas City rks.

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The locations of the **Livengood** oil field and of dry holes drilled in other parts of Brown County are shown in Figure 22. Data on tests drilled in the county are listed in Table 11.

BUTLER COUNTY

Shallow commercial gas wells were drilled in the vicinity of Augusta as early as 1906 (Fath, 1931, p. 17). In June 1914 oil was discovered near Augusta and the El Dorado oil field was opened the following year. The discovery of oil in Ordovician rocks in the El Dorado and Augusta fields was one of the most outstanding events in the history of the mid-continent oil industry. Butler County's peak year in production of oil was 1918 when 28,807,680 barrels of oil was produced in the El Dorado field and a total of 36,069,670 barrels was produced in the county.

Comprehensive reports on the El Dorado field were written by Fath (1921) and by Reeves (1929). Bass (1936) discussed the origin of the shoestring sands of Butler and Greenwood Counties, and the Augusta oil field has been described by Berry and Harper (1948).

Butler County is by far the most important oil-producing county in eastern Kansas, producing 8,164,208 barrels of oil during 1952. The El Dorado field has yielded more than twice as much oil as any other Kansas field; cumulative production of the field at the end of 1952 stood at 211,333,902 barrels. Oil production figures for the years 1915 to 1952 inclusive are shown in Tables 2 and 3. Table 73 shows production in the various fields in Butler County for 1949 through 1952 and cumulative production at the end of 1952 where available. Water flooding is being practiced in the county in 19 projects (Table 4).

New fields are being opened in Butler County each year. One oil field was opened in 1945, four oil fields in 1946, four oil fields and one gas field in 1947, three oil fields in 1948, seven oil fields in 1949, three oil fields in 1950, six oil fields in 1951, and three oil fields in 1952. During 1952, 62 fields were active.

Locations of Butler County's oil and gas fields and areas of oil production during 1952 are shown in Figure 23.

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Geology

SURFACE ROCKS

The consolidated rocks exposed in Butler County belong to the Sumner, Chase, and Council Grove groups of the Permian System (Fig. 3). The youngest rocks crop out along the western boundary of the county; the oldest rocks are exposed in the extreme eastern part.

Only the lower part of the Wellington shale is present in Butler County. It is underlain by the Herington limestone member of the Nolans formation. The maximum thickness of the rocks of the Sumner group in the county in about 65 feet. The Chase group has a maximum thickness of about 340 feet in Butler County. The Fort Riley and Florence limestone members of the Barneston formation are the surface rocks throughout most of the central and eastern parts of the county. Their combined thickness ranges from about 80 to 90 feet. The upper part of the Council Grove group is exposed in extreme eastern Butler County. Strata slightly older than the Neva limestone member of the Grenola limestone are the oldest rocks exposed. The total thickness of rocks of the Council Grove group is about 310 feet.

SUBSURFACE ROCKS

Subsurface rocks in Butler County are modified by two major structural features, the Nemaha anticline and the older Chautauqua arch. The northwestern flank of the Chautauqua arch underlies the southern part of the county (Fig. 11). In this area the Chattanooga shale rests upon rocks ranging in age from Devonian (Kimmswick limestone) to Ordovician (Cotter dolomite). Along the Nemaha anticline (Fig. 12), which crosses the county from the north to the southwest, Pennsylvanian rocks rest upon the upturned edges of formations ranging in age from Mississippian to Ordovician.

Permian rocks.—The Admire group has an average thickness of about 190 feet in Butler County. It consists of shale and thin limestones. The Permian rocks are slightly arched over the granite ridge and there are several smaller domes and basins on the flanks of the Nemaha anticline which are expressed in outcropping rocks.

Pennsylvanian rocks.—Pennsylvanian rocks in the county consist of about 2,100 feet of limestone, sandstone, and shale. The Wabaunsee group consists largely of shale and contains a few thin

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beds of coal, minor amounts of sandstone, and some thin beds of limestone. It is about 495 feet thick. The Shawnee group consists of about 375 feet of interbedded limestones and shales and contains four sandstones that produce gas (Fath, 1921, p. 43). The Douglas group is about 250 feet thick. It is chiefly shale and contains a few thin limestone and sandstone beds. A disconformity separates the Douglas and Pedee groups, but it is difficult to differentiate them in drillers logs.

The Lansing group is about 150 feet thick in Butler County. It is composed chiefly of limestone. The Kansas City group consists of shale, thick beds of limestone, and thin beds of sandstone. A sandstone called "Layton" which lies near the top of the group yields gas. The Kansas City group is about 340 feet thick. The Pleasanton shale is about 125 feet thick. The Marmaton group, which consists of beds of limestone and shale, is about 165 feet thick.

The Cherokee shale consists of light and dark shale, lenses of sandstone, a few thin beds of limestone, coal, and red shale. Shoestring sandstone lenses ("Bartlesville sand") in the lower part of the Cherokee yield oil. The average thickness of the Cherokee shale in this county is about 340 feet.

Mississippian rocks.—The Mississippian limestones are about 400 feet thick in Butler County; they are mostly cherty. The "Warsaw" probably is the uppermost Mississippian formation in most of the county. Porous zones in Mississippian limestones yield oil. The common thickness of the Chattanooga shale in the county is about 100 feet; locally the Chattanooga is absent.

Ordovician and Cambrian rocks.—The Chattanooga shale or Mississippian limestone lies unconformably on Ordovician rocks. Silurian and Devonian rocks are absent. The Viola limestone and the Simpson sandstone are believed to be present in most of Butler County (Jewett and Abernathy, 1945, pl. 3; Jewett, 1949, pl. 4). The combined thickness is about 100 feet. According to Keroher and Kirby (1948, figs. 6, 8, and 9) thicknesses of lower Ordovician and upper Cambrian formations in Butler County are: Jefferson City-Cotter, 300 feet in the north part of the county to 550 feet in the southwest corner; Roubidoux, 100 to 200 feet; Van Buren-Gasconade, present in the southern approximate half of the county, ranging from a featheredge in the central part to about 175 feet in the southwest corner. They (Keroher and Kirby, 1948, fig. 3) found the Roubidoux dolomite in contact with Pre-Cambrian rocks

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TABLE 12.—*Depths to some stratigraphic horizons in the Deforrest Drilling Company No. 1 Nibel well, SE cor. SE¼ sec. 22, T. 29 S., R. 3 E., Butler County*

Horizon	Depth, feet
Base Oread limestone	1,860
Top Lansing group	2,020
Base Kansas City group	2,785
Top Mississippian limestone	2,925
Base Mississippian limestone	3,078
Top Simpson group	3,166
Top Arbuckle rocks	3,175
Pre-Cambrian rocks	4,015
Total depth	4,030

in the northern part of Butler County and Van Buren-Gasconade dolomites first above the basement rocks in the southern part.

Depths to some stratigraphic horizons in the Deforrest Drilling Company No. 1 Nibel well, sec. 22, T. 29 S., R. 3 E., are listed in Table 12.

OIL AND GAS DEVELOPMENTS

The locations of oil and gas producing areas in Butler County are shown in Figure 23. A list of the oil and gas fields of the county and other data are given in Table 73.

The **Augusta** oil and gas field is in southwestern Butler County. The maximum width is about 4 miles. Gas was discovered in the area in 1906 or earlier, and oil was found in the Wichita Natural Gas Company No. 1 Varner well, NW¼ NE¼ NW¼ sec. 21, T. 28 S., R. 4 E. in 1914, in the "Varner sand" (Ordovician) at 2,466 feet. Initial production was about 150 barrels. The **Augusta North** pool was discovered by the McMann Oil and Gas Company No. 1 Kramer well, SE¼ sec. 28, T. 27 S., R. 4 E. This well had an initial production of 504 barrels of oil per day from the Simpson sandstone and Arbuckle limestone ("Varner zone"). Peak production in the **Augusta** area took place in 1917 when more than 1 million barrels per month was produced. The geology of the **Augusta** field has been described comprehensively by Berry and Harper (1948). According to Berry and Harper two anticlines are separated by a narrow northeast-southwest trough that passes through the City of Augusta. Closure, measured in surface rocks, amounts

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to about 40 feet in the north structure and about 60 feet in the south anticline. Lower rocks of Pennsylvanian age are folded more steeply. Ordovician rocks are still more steeply folded and probably are faulted along the east side of the main Nemaha fold, of which the Augusta domes are parts. Noninflammable gas, containing nitrogen and helium, was found in rocks of the Wabaunsee group at depths ranging from 450 to 550 feet in the **Augusta** field. Much of the gas that has been produced in the area has come from sandstone and overlying shale and limestone assigned to the Douglas group. This gas-producing zone is 100 feet thick and is reached at about 1,400 feet. Open flow from this zone was as much as 30 million cubic feet of gas per day (Berry and Harper, 1948, p. 220). Oil is produced from Lansing rocks in the southwest part of the **Augusta** field at depths ranging from 1,700 to 1,750 feet. One well in the NE¼ NW¼ SE¼ sec. 20, T. 28 S., R. 4 E. is reported to have had an initial production of 2,050 barrels of oil per day. Both fields have produced considerable oil from rocks in the upper part of the Kansas City group. Initial production ranged from a few to 500 barrels of oil per day. According to Berry and Harper (1948, p. 222) approximately 775 wells in the Augusta fields have produced oil from Ordovician rocks. Ordovician gushers were common during the early life of the field. One well, the Empire Oil and Gas Company No. 9 Scully, SW¼ NE¼ NW¼ sec. 28, T. 27 S., R. 4 E., flowed 525 barrels of oil per hour and 5,000-barrel wells were not uncommon. The average Ordovician well in the **Augusta** field was 200 barrels and in the **Augusta North** 350 barrels initially. Simpson production generally was less than Arbuckle production. Initial daily production of new wells in the **Augusta** and **Augusta North** fields is as much as 60 barrels of oil per day, but most of the recently drilled wells came in for about 25 or 30 barrels daily.

The **El Dorado** oil and gas field was discovered in 1915, and became the greatest field ever developed in Kansas. It was reported to be the leading field in the United States in 1918; the production in that year was 28,807,680 barrels. On September 29, 1915, the Wichita Natural Gas Company started drilling on the Stapleton farm in the SE¼ sec. 29, T. 25 S., R. 5 E. Commercial production, estimated at 50 to 200 barrels per day, was found in a sandstone in the Admire group of Permian rocks at a depth of 660 feet. This was the opening of the field. Late in 1915 deeper drilling found commercial production in the "Stapleton zone" at a depth of 2,465 feet.

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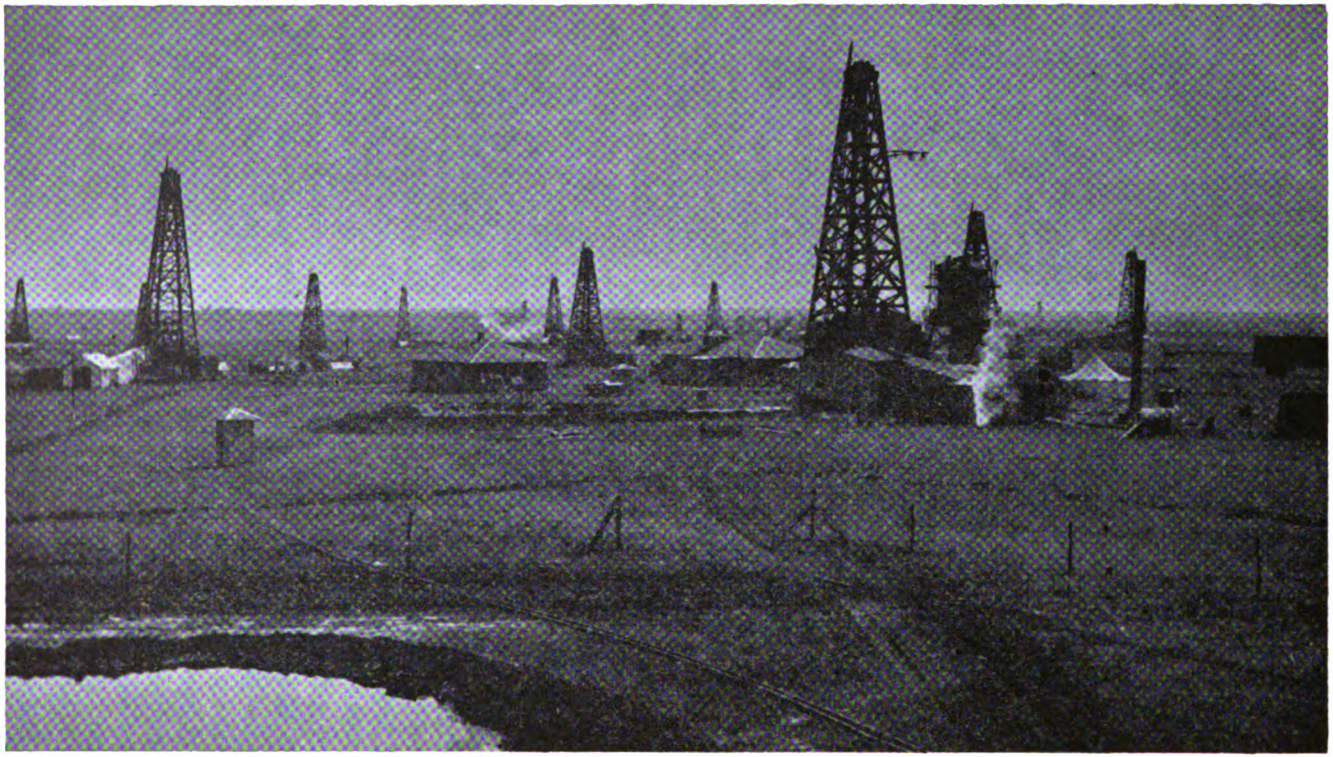

PLATE 1. View on the Trapshooter lease, El Dorado oil field, sec. 11, T. 26 S., R. 4 E., July 1917. (Photo by W. P. Haynes.)

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The discovery well was drilled 46 feet into the pay zone; the initial production of this well was 175 barrels per day. The field was extended to the east by drilling on the Wilson farm in the E½ sec. 27, T. 25 S., R. 5 E., 2¼ miles east of the discovery well. In this well the "Stapleton zone" was encountered nearly 200 feet lower than the same zone in the discovery well.

Other developments rapidly extended this field. By the end of 1916 there were 600 producing wells having a total daily production of about 12,000 barrels. In the early part of 1917 several 500-barrel wells were drilled to the "Stapleton zone." In June 1917, the first gusher was completed. Production of this well was estimated to be from 6,000 to 24,000 barrels per day. Many other gushers were soon drilled; production in all of these was from the "Stapleton zone."

The "Stapleton" is a porous zone of beveled Ordovician rocks which lies immediately below Pennsylvanian rocks. These Ordovician rocks include the Viola limestone, the St. Peter sandstone, and the Arbuckle dolomite. The accumulation of oil in them is the result of anticlinal concentration in a porous zone at the angular disconformity immediately below Pennsylvanian rocks. This anticline, which has a structural relief of about 1,400 feet, is typical of the Nemaha anticline of which it is a part. Most of the folding is confined to pre-Pennsylvanian rocks. However, the field was discovered on the basis of surface structural mapping.

The **El Dorado** field now has about 1,850 producing oil wells. Oil occurs in the Admire group at a depth of about 600 feet; in the lower part of the Douglas group at about 1,550; at the top of the Lansing group at about 1,700 feet; in the upper part of the Kansas City group at about 2,000 feet; and in the "Stapleton zone" which ranges in depth from 2,350 to 2,750 feet. Gas was produced from rocks of the Admire, Shawnee, and Douglas groups which range in depth from 900 to 1,500 feef. In 1952, there were 70 new oil wells drilled in the **El Dorado** field, initial daily production ranging from a few to 167 barrels of oil.

The **Allen North** pool was opened in 1947 with a well rated at 25 barrels of oil daily from "Mississippian chert." This pool is now part of the **Allen-Robison** field. In 1951, a 2,500 thousand cubic foot daily gas well in sec. 31, T. 27 S., R. 3 E., revived gas production in the **Andover South** field. The gas producing zone is in the "Stalnaker sand" at a depth of 2,006 feet. The **Bare,** a "Bartlesville

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sand" pool between 2,778 and 2,798 feet, was discovered in 1952 in T. 28 S., R. 5 E. Initial daily production of the discovery well was rated at 11 barrels of oil.

Oil is produced in the **Bausinger** field from the "Wilcox" (Simpson) sandstone at an average depth of about 3,000 feet. The pool was discovered in T. 27 S., R. 3 E. in 1929. Initial daily production of the discovery well was reported to be 100 barrels of oil. The **Benton,** a Mississippian "chat" oil pool, was found in 1929 in T. 26 S., R. 3 E. Oil was found at a depth of 2,760 feet and the well was rated as having an initial daily production of 400 barrels of oil. The **Blankenship** is a large "Bartlesville sand" oil field, with production from about 2,650 feet. Three secondary recovery projects are operating in the field, which covers a large part of T. 26 S., R. 8 E. and extends into Greenwood County. The **Brandt-Sensenbaugh** is a large Mississippian limestone oil field in T. 28 S., R. 7 E. The reservoir lies at a depth of about 2,700 feet. The field was opened in 1926.

In T. 27 S., R. 7 E., the discovery well of the **Brickley** field found production at 2,636 feet from the "Bartlesville sand"; it was rated at 35 barrels of oil per day. A well in T. 27 S., R. 7 E. in 1952 discovered the **Brickley Southwest,** also a "Bartlesville sand" pool. Daily production amounting to 20 barrels of oil was found between 2,699 and 2,732 feet. The discovery well of the **Butwick** pool, opened in 1949 in T. 26 S., R. 3 E., had initial daily production rated at 3,000 barrels of oil in Mississippian "chat" in a zone between 2,860 and 2,866 feet. Another 1949 well in T. 26 S., R. 3 E. which found oil in Mississippian limestone from 2,804 to 2,840 feet is the discovery well of the **Butwick Northeast** pool. Initial daily production of 50 barrels of oil was reported.

The **Combs** field, discovered in Cowley County in 1947, extends into Butler County. Production is from "Bartlesville sand" at 2,820 feet and Mississippian rocks at 2,850 feet. The **Combs Northeast** field was opened in 1948 by a well producing 50 barrels of oil per day from the "Bartlesville sand." Oil is produced in the **De Moss** field, T. 28 S., R. 7 E., from sandstones ("Bartlesville" and "Burgess") in the lower part of the Cherokee section. Their depths are about 2,700 and 2,735 feet respectively. The **Dixon** oil field, producing from "Mississippi lime," was opened in 1946. Oil and gas in the **Douglass** field in southwest Butler County occur in Lansing rocks at a depth of about 1,850 feet and in "Bartlesville sand" at about 2,875 feet.

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The **Dunn's Mill** oil field, now abandoned, was opened in 1932 by a well in T. 29 S., R. 4 E. whose initial production, from an Arbuckle limestone reservoir, was rated at 5,459 barrels of oil per day. The discovery well is the only oil well in the field of which a

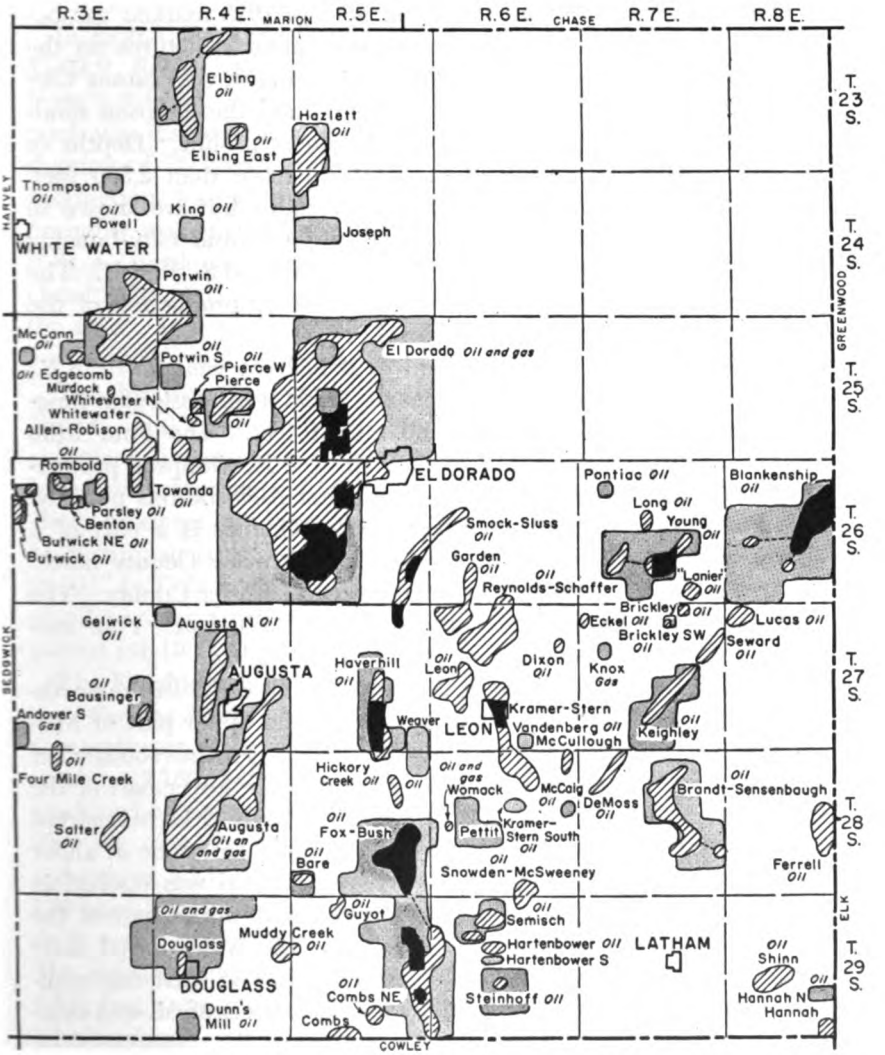

FIG. 23.—Map of Butler County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

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record is available. Oil is produced in the **Eckel** field from rocks in the middle part of the Kansas City group at a depth of about 2,185 feet. The field is in T. 27 S., R. 7 E. The **Edgecomb** field was opened in 1951 in T. 25 S., R. 3 E. Initial daily production from the Mississippian at 2,759 feet was rated at 25 barrels of oil.

The discovery of oil in the **Elbing** field in 1918 marked the beginning of production from more or less minor structures on the west flank of the Nemaha anticline. Oil occurs in the Kansas City group, the "Hunton" and Viola limestones, and the Simpson sandstone. Probably the Viola has been the most prolific. Depths to reservoir rocks range from about 2,000 to more than 2,500 feet. Cumulative production figures are not available but are known to be larger than recorded amounts indicate. A Kansas City-Lansing pool, the **Elbing East,** was opened in 1950 in T. 23 S., R. 4 E. The producing zone lies at 1,799 feet. Initial daily production of the discovery well was rated at 30 barrels of oil.

The **Ferrell** oil field was opened in 1939 by a well in T. 28 S., R. 8 E. rated at 50 barrels of oil per day from a Mississippian limestone reservoir between 2,681 and 2,689½ feet. The **Four Mile Creek** was discovered in 1951 in T. 28 S., R. 3 E. Simpson production, from 3,069 to 3,072 feet, was gauged at 2,068 barrels per day. The **Fox-Bush** oil field in southern Butler County is a part of a "Bartlesville sand" trend that extends from Cowley County northward as far as the **Smock-Sluss** field in central Butler County. The reservoir lies at an average depth of about 2,730 feet. Four secondary recovery projects are operating in the field.

The **Garden** oil field is in Ts. 26 and 27 S., R. 6 E. In the northern part of the field production is found in the upper part of Mississippian rocks at a depth of about 2,760 feet. Farther south chief oil production seemingly is from sandstone in the lower part of the Cherokee section. One well in sec. 6, T. 27 S., R. 6 E. is reported to have found oil in the upper part of the Viola limestone at about 3,100 feet. The now abandoned **Gelwick** oil field was opened in 1929 in T. 27 S., R. 4 E. Oil was found in the upper part of the Viola limestone at a depth of 2,924 feet. The well's initial daily production was reported as 700 barrels of oil. At least one additional well with a daily production of 1,000 barrels of oil was completed in the same pool.

The discovery well of the **Guyot** field, opened in 1948, had initial daily production of 30 barrels of oil daily from "Bartlesville sand."

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The field is in T. 29 S., R. 5 E. The **Hannah** oil field was drilled first in or about 1925. Oil occurs in sandstone which lies probably just below the rocks of the Kansas City group at a depth of about 2,130 feet. The **Hannah North** field was opened in 1945 in sec. 28, T. 29 S., R. 8 E.; production is from the "Mississippi lime." No production has been reported since 1947.

In 1950 a "Peru sand" pool, the **Hartenbower,** was discovered in T. 29 S., R. 6 E. Initial daily production of 30 barrels was reported from 2,404 feet. The **Hartenbower South,** a Lansing-Kansas City pool, was discovered in 1951 in T. 29 S., R. 6 E. Initial daily production of 25 barrels is from between 2,060 and 2,072 feet. No production was reported during 1952. The **Haverhill** oil field probably was opened in 1928 by a well in sec. 22, T. 27 S., R. 5 E. It is a "Bartlesville sand" field, the reservoir lying at a depth of about 2,736 feet. Two secondary recovery projects are operating in the field. It is part of a long trend of shoestring fields extending northward from Cowley County.

The discovery well of the **Hazlett North** pool, drilled in T. 23 S., R. 5 E., had initial daily production of 35 barrels of oil from Mississippian limestone from 2,462 to 2,472 feet. The pool was combined with **Hazlett** in 1951. The **Hickory Creek** field, opened in 1946, produces oil from the "Bartlesville sand" at 2,685 feet and Mississippian rocks at 2,700 feet. The **Joseph** oil pool, discovered in 1947 in T. 24 S., R. 5 E., had initial production of 15 to 20 barrels of oil per day from "chat" at 2,491 feet. No production was reported for 1952.

The **Keighley** oil field, T. 27 S., R. 7 E., is in the southern part of the **"Golden Lanes"** trend of shoestring oil fields extending far to the northeast. The reservoir rock is "Bartlesville sand" at a depth of about 2,760 feet. The **King** oil field, T. 24 S., R. 4 E., formerly produced oil from rocks in the basal part of the Kansas City group. The pay zone was reached in the discovery well, drilled in 1937, at a depth of 2,248 feet. Initial daily production was established at 176 barrels of oil. Later in the same year a second oil well, with daily production of 70 barrels at a depth of 2,235 feet, was drilled. The second well was deepened into Mississippian limestone (top at 2,534 feet) to a total depth of 2,612 feet without finding additional oil reservoirs.

In 1927 a 3¼ million cubic foot gas well was completed in sec. 17, T. 27 S., R. 7 E. Gas was found in sandstone in the upper part

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of the Cherokee shale section between 2,590 and 2,608 feet. The field was called the **Knox**. The **Kramer-Stern** field was opened in 1926 in T. 28 S., R. 6 E. Production is from Simpson and Arbuckle rocks. A secondary recovery project was begun in the field in 1952. The discovery well of the **Kramer-Stern South** oil field, in T. 28 S., R. 6 E., had an initial daily production of 35 barrels of oil from the Viola limestone. The pool was opened in 1947. No production has been reported since 1949. Logs of wells in the **"Lanier"** field, sec. 35, T. 26 S., R. 7 E. from which production currently is reported, are not available.

In the **Leon** field, T. 27 S., R. 6 E., production is from sandstone in the basal part of the Cherokee section at a depth of about 2,730 feet. Possibly some oil has been produced from Mississippian "chat" and from Ordovician rocks. The **Long** pool was opened in 1949 in T. 26 S., R. 7 E. Initial daily production from Mississippian limestone between 2,770 and 2,887 feet was reported as 25 barrels. Oil is produced in the **Lucas** field, sec. 6, T. 27 S., R. 8 E., from "Bartlesville sand" at a depth of about 2,600 feet.

The **McCaig** oil field is in T. 28 S., R. 6 E. The reservoir is in the "Bartlesville sand" at an average depth of about 2,700 feet. The field is now abandoned. The **McCann** oil pool, T. 25 S., R. 3 E., was discovered in 1933. The discovery well, which is the only oil well in the field of which records are available, had an initial daily production of 50 barrels of oil from Mississippian "chat" at a depth of 2,796 feet. The **McCullough,** a "Wilcox" (Simpson) sandstone pool, was discovered in 1937 in T. 28 S., R. 6 E. The reservoir lies at a depth of about 3,175 feet. In 1950 the **Muddy Creek,** a "Bartlesville sand" pool, was found in T. 29 S., R. 4 E. The producing zone lies at 2,811 feet. Initial daily production was rated at 40 barrels of oil.

The Mississippian limestone **Murdock** pool, between 2,709 and 2,719 feet, was found in 1952 in T. 25 S., R. 3 E. The well's daily production was rated at 10 barrels of oil. The **Parsley** field was opened in 1949 in T. 26 S., R. 3 E. The discovery well was rated as having an initial daily production of 45 barrels from Mississippian limestone at 2,710 feet. The **Pettit** oil field, now abandoned, was opened by a small well in T. 28 S., R. 6 E. The discovery well, drilled in 1926, found oil in the "Wilcox" (Simpson) sand at 3,132 feet. The **Pierce,** a Mississippian "chat" oil field, was opened in 1921 in T. 25 S., R. 4 E. The pay zone lies at a depth of about

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2,600 feet. A 1951 well in T. 25 S., R. 4 E., found oil in Mississippian rocks between 2,515 and 2,525 feet, opening the **Pierce West** field. Initial daily production of 25 barrels of oil was reported.

Few data concerning the abandoned **Pontiac** field, T. 26 S., R. 7 E., are available. Oil production probably was from Mississippian "chat" at a depth of about 2,780 feet. The **Potwin** field is reported to have been opened in 1921. Chief oil production is from the upper part of the Mississippian limestone at a depth of about 2,700 feet. Some production in the field has come from Kansas City rocks at about 2,550 feet. No production has been reported from the **Potwin South** oil field, T. 25 S., R. 4 E. for several years. Probably the field was opened by a very small well in 1925. Oil occurs at the top of Mississippian limestone at a depth of about 2,680 feet.

The **Powell** oil field, which has been abandoned for several years, was opened in T. 24 S., R. 3 E. in 1925. Initial daily production from Mississippian chat at a depth of 2,585 feet was about 480 barrels. At least two smaller oil wells were drilled on near-by locations the same year, and a 15-barrel oil well was drilled in the field in 1947. The **Reynolds-Schaffer** is regarded as a stratigraphic trap oil field. It lies mostly in T. 27 S., R. 6 E., along the flank of the Chautauqua arch. Production is chiefly from Simpson sandstone at a depth of about 3,160 feet. Some oil has been reported in the upper part of the Mississippian limestone and some in Kansas City rocks.

The **Rombold** pool was discovered in 1949 in T. 26 S., R. 3 E. Initial production rated at 30 barrels of oil daily was found between 2,764 and 2,771 feet in Mississippian limestone. The **Salter** field, T. 28 S., R. 3 E., which produces from Simpson rocks at a depth of 3,000 feet, was opened in 1946. The **Semisch** pool was opened in 1947 in T. 29 S., R. 6 E. The discovery well had initial daily production of 75 barrels of oil daily from the "Bartlesville sand." The **Seward** oil field, T. 27 S., R. 7 E., is part of a trend of shoestringlike fields. Oil occurs in the "Bartlesville sand" at a depth of about 2,650 feet. The **Shinn** oil field, T. 29 S., R. 8 E., discovered in 1946, produces from "Mississippi lime."

The **Smock-Sluss** oil field, Ts. 26 and 27 S., Rs. 5 and 6 E., has produced oil chiefly from "Bartlesville sand" at a depth of about 2,700 feet, but some Ordovician production from about 3,000 feet has been reported. Two secondary recovery projects are operating in the field, which is the northern part of a long trend of shoestring

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fields extending northward from Cowley County. The **Snowden-McSweeney** oil field produces from the upper part of the Mississippian limestone at average depths of about 2,840 feet. The field is in Ts. 28 and 29 S., R. 6 E. The **Steinhoff** oil field, in T. 29 S., R. 6 E., has produced principally from Mississippian limestone at an average depth of about 2,840 feet. Some oil has been reported from Kansas City rocks.

The **Thompson** oil field, now abandoned, was opened in T. 24 S., R. 3 E. in 1929. The discovery well, which is the only well in the field of which there is an available record, had an estimated daily potential of 250 barrels of oil from the upper part of the Mississippian limestone at a depth of about 2,540 feet. The **Towanda** field, T. 26 S., R. 4 E., discovered in 1948, was opened by a 40-barrel oil well producing from the Viola at 2,565 feet. The **Vandenberg** oil pool, T. 27 S., R. 6 E., is in Simpson sandstone at a depth of about 3,100 feet. The field is now abandoned.

The **Weaver** oil field, Ts. 27 and 28 S., R. 5 E., was discovered in 1929. Production came from "Bartlesville sand" at 2,690 feet. No production has been reported since 1948. The discovery well of the **Whitewater** pool, drilled in 1949 in T. 25 S., R. 4 E., had initial daily production of 50 barrels of oil from Viola limestone in a zone between 2,645 and 2,656 feet. The **Whitewater North** pool was discovered in 1951 in T. 25 S., R. 4 E. Initial daily production of 35 barrels of oil was reported from the Viola between 2,700 and 2,702 feet. The **Womack** gas field, in T. 28 S., R. 6 E., was opened in 1947. Initial daily production from the "Bartlesville sand" was 2 million cubic feet. Oil production from the field was reported for the first time in 1949.

Oil production in the **Young** field, T. 26 S., R. 7 E., is from rocks in the lower part of the Kansas City group at a depth of about 2,150 feet. Some oil production has been reported from Mississippian rocks at about 2,650 feet. A secondary recovery project is being operated in the field.

Recent developments.—Nineteen oil pools have been discovered in Butler County during the period 1949 through 1952. These are listed in Table 1. Of the seven opened in 1949, one produces from Viola limestone, one from "chat," and five from Mississippian limestone. Three Pennsylvanian pools were discovered in 1950. Six oil fields were opened in 1951; of these one produces from "Bartlesville," one from Lansing-Kansas City, two from Mississippian, one

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from Simpson, and one from Viola rocks. Of three fields opened during 1952, two produce from "Bartlesville sand" and one from Mississippian rocks.

Data on pool wells drilled in Butler County and oil production of the various fields are given in Table 73. Data on 74 dry wildcat wells drilled in the county are given in Table 13. Data on the 19 secondary recovery projects operating in the county are given in Table 4.

TABLE 13.—*Data on dry wildcat wells drilled in Butler County, 1949 through 1952*

Company and farm	Location	Depth to top of Kansas City, feet	Depth to top of Mississippian, feet	Total depth, feet
	1949 Wells			
E. H. Adair Oil Co. No. 1 Methodist Church	E½ NE NE 14-23-5E	1,870	absent	2,286
E. H. Adair Oil Co. et al. No. 1 Lilley	NE NE SW 15-23-5E	1,865	absent	2,424
Franco-Central & Wixson No. 1 Harder	NE SW SE 21-24-3E	?	2,786	2,870
A. D. Allison & Co. No. 1 Hawes	NW NE SW 7-25-3E	2,360	2,815	2,820
H. & M. Drlg. Co. No. 1 Bodecker	NE NE NE 17-25-3E	?	2,769	2,852
H. & M. Drlg. Co. No. 1 Truman	SW SE SE 21-25-3E	?	2,781	2,825
H. & M. Drlg. Co. No. 1 Bachelder	NE NW NE 28-25-3E	2,333	2,763	3,153
Rex & Morris Drlg. Co. No. 1 Ohlsen	SE SW SE 30-25-3E	2,080	2,805	2,861
Penguin Petro., Inc., et al. No. 1 Anderson	NW NW SW 28-26-3E	2,320	2,776	2,860
El Dorado Refg. Co. No. 1 Waite	SW SW NW 21-26-4E	2,100	2,594	2,612
D. R. Lauck Oil Co., Inc. No. 1 Rickard	NE SW SE 8-27-3E	2,368	2,842	3,162
Inland Oil Co. No. 1 Manlove	NW NW NE 9-27-3E	2,335	2,784	3,140
El Dorado Refg. Co. No. 1 Butts	SW SW SE 25-27-7E	2,090	2,826	2,875
Ramsey Petro. Corp. No. 1 Showalter	SW SW SW 4-28-3E	2,379	2,858	3,167
Ramsey Petro. Corp. No. 1 Delibuk	NW NW NE 9-28-3E	?	2,858	3,163
Thrifty Drlg. Co. No. 1 Hines	NW SW SE 7-29-3E	2,475	2,962	3,310

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TABLE 13.—*Data on dry wildcat wells drilled in Butler County, 1949 through 1952, continued*

Company and farm	Location	Depth to top of Kansas City, feet	Depth to top of Mississippian, feet	Total depth, feet
	1950 Wells			
Rex & Morris Drlg. Co. No. 1 Kaufman	SE SE SE 12-23-4E	.....	2,442	2,452
Rex & Morris Drlg. Co. No. 1 Winsor	NE NW NW 18-23-5E	.....	2,429	2,457
George Sheehan et al. No. 1 Heymann	SE SW SE 33-23-5E	1,815*	2,420	2,557
E. H. Adair Oil Co. & C. L. Carlock No. 1 Brenning	SW SW SE 7-23-6E	2,165	2,780	3,290
Birmingham-Bartlett Drlg. Co. No. 1 "B" Hinnen	SE NE SW 7-24-6E	2,032	2,563	2,912
R. J. Wixson Drlg. Co. et al. No. 1 J. C. Truman	NW NW SE 21-25-3E	2,310	2,762	2,827
J. C. Scanlon & W. R. Dillard No. 1 Koble	NW NE NW 33-25-6E	2,124	2,780	2,801
Nadel & Gussman No. 1 Elmore	SW SW NW 34-25-6E	.....	2,776	2,786
Artnell Co. No. 1 L. B. Jahren	NE NW NW 29-25-8E	1,930	2,657	2,755
W. L. Hartman No. 1 Lygrisse	S½ SW NE 24-26-3E	2,266	2,728	3,079
Crest Petro., Inc. No. 1 Priest	SE SE NW 20-26-4E	2,128	2,638	2,906
Rex & Morris Drlg. Co. No. 1 Mannion	SW SE SE 28-26-4E	2,055	2,636	2,900
Richard A. Mayer et al. No. 1 Church	NE SE SW 5-28-5E	2,208	2,765	2,780
The Texas Co. No. 1 C. E. Keller	NE NE NW 32-29-3E	2,430	2,942	3,345
	1951 Wells			
Donald T. Ingling No. 1 Zuercher	SW SW NE 30-23-3E	2,325	2,781	3,139
Rex & Morris Drlg. Co. No. 1 Penner	SE NE NE 18-23-5E	.....	2,406	2,661
Donald T. Ingling et al. No. 1 Barker	SW SW NE 7-24-3E	2,310	2,764	2,800
Donald T. Ingling et al. No. 1 Claassen	NE NE SW 19-24-3E	2,341	2,807	3,330
Rex & Morris Drlg. Co. No. 1 Hill	SW SW SE 30-24-3E	2,352	2,847	2,899
J. P. Gaty No. 1 Entz	NE SE SE 31-24-3E	2,346	2,777	2,800
Birmingham-Bartlett Drlg. Co. No. 1 Frerking	SW SW SE 4-24-4E	2,522	2,129	2,930

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J. P. Gaty No. 1 Harder	NE SW SE 19-25-3E	2,369	2,765	3,227
Natl. Assoc. Petro. Co. No. 1 Buckman	N½ NE NW 11-25-7E	2,026	2,721	3,216
Natl. Assoc. Petro. Co. No. 1 Liggett Estate	NW NE SE 17-25-7E	.....	2,745	2,793
H. M. Williams No. 1 Jahren	NE Cor. Lot 2 30-25-8E	1,960	2,752	2,789
Beardmore Drlg. Co. et al. No. 1 Wolf	NE SE NW 31-26-3E	2,375	2,839	3,285
Aladdin Petro. Corp. No. 1 Oliver	NE SW SW 19-26-4E	2,242	2,705	3,218
Natl. Assoc. Petro. Co. No. 1 Webb	NE NE NW 11-26-6E	2,081	2,740	3,298
Palmer Oil Corp. No. 1 Allan	SE SW NW 23-26-6E	2,130	2,779	3,203
E. V. Elwell No. 1 Elwell	NE NE SW 15-27-3E	2,334	2,850	3,217
Musgrove Petro. Corp. No. 1 Belford	SW SE NE 16-27-3E	2,310	2,825	3,133
H. M. Williams et al. No. 1 Lauck	SE SE NW 21-27-3E	2,317	2,768	3,170
H. Keener et al. No. 1 Stephens	SE SW NW 17-28-3E	2,384	2,879	3,240
Natl. Assoc. Petro. Co. No. 1 Brandt	NE SE SW 33-28-7E	2,092	2,806	2,815
Leftwich Co., Inc. No. 1 McKay	NW SE SW 27-29-3E	2,405	2,943	3,289½
	1952 Wells			
R. J. Wixson Drlg. Co. No. 1 Langley	NE NW SW 33-23-3E	2,220	2,680	2,946
Saturn Drlg., Inc. No. 1 Mamie Harsh	SE SW SE 32-23-8E	2,010	2,754	2,784
Rex & Morris Drlg. Co. No. 1 Poffinbarger	NE SE SE 14-24-4E	2,080	2,460	2,490
J. H. Wagner No. 1 C. R. Joseph	NE NE NE 22-24-4E	2,100	2,490	2,615
White & Ellis Drlg. Co. No. 1 Dornbos	SE SE NE 14-24-5E	2,050	.....	2,650
Saturn Drlg., Inc. No. 1 Stone	NW NW NE 23-24-7E	2,005	2,731	2,773
Rex & Morris Drlg. Co. No. 1 Daily	SW SW NW 30-24-7E	2,346	2,700	2,728
Time Petro. Co. No. 1 Schimpff	NE NE SW 4-24-8E	1,906	2,695	2,705
R. J. Wixson Drlg. Co. et al. No. 1 Reed	SW SW SE 29-25-3E	2,320	2,757	2,816
Murfin Drlg. Co. No. 1 Dickson	SW SE SE 36-25-6E	.....	2,747	2,758
Imperial Petro. Co., Inc. No. 1 Liggett	NE NE SW 34-25-7E	2,054	2,741	2,791
Imperial Petro. Co., Inc. et al. No. 1 Jahren Ranch	NE SE SE 30-25-8E	2,076	2,781	2,807

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TABLE 13.—*Data on dry wildcat wells drilled in Butler County, 1949 through 1952, concluded*

Company and farm	Location	Depth to top of Kansas City, feet	Depth to top of Mississippian, feet	Total depth, feet
Imperial Petro. Co., Inc. No. 1 Jahren	NE Lot 4 30-25-8E	2,060	2,754	2,773
Rex & Morris Drlg. Co. No. 1 Shaffer	SW SW NW 23-26-3E	2,354	2,775	2,795
J. P. Gaty No. 1 Stephens	NE SE NE 28-26-3E	2,341	2,800	2,863
Rex & Morris Drlg. Co. No. 1 Anderson	SE SE SW 29-26-3E	2,381	2,812	3,265
White & Ellis Drlg. Co. et al. No. 1 Frazier	NW NW NE 20-26-4E	2,143	2,620	2,922
J. P. Gaty No. 1 Scott	NE NW NW 17-27-3E	2,360	.....	2,569
Mallonee Drlg. Co. No. 1 Young	SE NE SE 3-28-3E	2,293	2,779	3,116
Eckland Drlg. Co. No. 1 Leaply	SE SW NE 31-28-3E	2,460	3,010	3,300
Mallard Drlg. Co. et al. No. 1 C. W. Clark	NE SW NE 19-28-5E	2,165	2,763	2,800
Ben Gralapp No. 1 Simmons	NW NE SE 3-29-3E	2,300	2,785	3,044
Rex & Morris Drlg. Co. No. 1 Carsten	SE NE SW 26-29-3E	2,550	.....	3,252

* Lansing.

CHASE COUNTY

Oil production in Chase County is confined to the southeastern part. Two of the three oil fields extend into neighboring counties. The known oil pools are in Pennsylvanian rocks. Several gas pools have been found in Pennsylvanian and Permian reservoirs.

The geology and mineral resources of Chase County are described comprehensively by Moore and others (1951a).

In 1952, 30,629 barrels of oil and 65,145 thousand cubic feet of gas were produced in Chase County. Locations of oil and gas fields are shown in Figure 24. Oil production in the various fields during the years 1949 through 1952 is tabulated in Table 73. Production in many previous years has not been separated from that of Greenwood and Lyon Counties (Tables 2 and 3).

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Geology

SURFACE ROCKS

The consolidated surface rocks of Chase County are of Permian age. They include the lower part of the Sumner group, the Chase and Council Grove groups, and the upper part of the Admire group.

The youngest Permian rocks in Chase County comprise several feet of shale and thin limestone beds belonging to the lower part of the Wellington shale, the lowermost formation of the Sumner group. Rocks of the Chase group (Fig. 3) in Chase County are about 350 feet thick. Strata of this group are well exposed in the county in Flint Hills slopes. Numerous limestones are useful key beds in structural mapping. This group is characterized by flinty massive limestones and by gray, red, green, and chocolate-colored shales. The Fort Riley limestone member of the Barneston limestone, occurring as massive beds forming a rim near the tops of many slopes, underlies a dip slope which is extensive in the southwestern quarter of the county. The general thickness of the Council Grove group (Fig. 3) in Chase County is about 300 feet. Shale constitutes more than two-thirds of the total thickness. This group is characterized by highly colored shales in the Johnson and overlying shale formations and by thin limestones of various lithologies. Fusulinids are common fossils in the limestones and in some of the shales.

The upper few feet of rocks of the Admire group are exposed along Cottonwood River in eastern Chase County and near the head of Verdigris River in the southeastern part of the county.

SUBSURFACE ROCKS

Depths to some key horizons in two Chase County wells are listed in Table 14.

Pennsylvanian rocks.—Pennsylvanian rocks in Chase County are not greatly different from rocks of the same age in neighboring counties. The Wabaunsee and Shawnee groups are characterized by shale and relatively thin limestone beds. The thickness of the Wabaunsee section is about 475 feet and of the Shawnee about 500 feet. The Oread limestone, the basal formation of the Shawnee group, is about 75 feet thick. The Douglas group is almost entirely clastic material, but there is a persistent limestone approximately 100 feet below the top. This is probably the Haskell lime-

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stone. The thicknesses of Douglas rocks differ from place to place, which indicates that 50 or more feet of Missourian rocks was eroded locally before deposition of Douglas sediments. Sandstone, ranging from 200 to 250 feet in thickness, occurs commonly in the basal part of the Douglas section. In places where the Douglas rocks are relatively thin, 30 or more feet of rocks identified as belonging to the Pedee group is present. The combined Lansing and Kansas City groups comprise approximately 400 feet of nearly solid limestone. The Pleasanton shale is approximately 100 feet thick and the underlying Marmaton group is about 130 feet thick. Slightly more shale than limestone is present in the Marmaton section. About 350 feet of Cherokee shale is present in most of Chase County. The Cherokee is thin or absent in the Nemaha anticline area. Pennsylvanian beds lie upon Pre-Cambrian rocks in the vicinity of Elmdale. Lee, Leatherock, and Botinelly (1948, pl. 13) show in detail the graph of Permian and Pennsylvanian rocks in

TABLE 14.—*Depths in feet to some stratigraphic horizons in two Chase County wells*

Horizon	Alf M. Landon & Stanolind Oil & Gas Co. No. 1 Leith, NE SW NE 22-18-9E	George Martin No. 1 Winsor, SW SW NW 2-20-6E
Top Oread limestone	1,126	1,203
Top Heebner shale	1,153	1,260
Top Lansing group	1,456	1,474
Top Kansas City group	1,572	.....
Top Marmaton group	1,850	1,797
Top Fort Scott limestone	2,022	.....
Top Cherokee shale	2,106	1,993
Top Mississippian limestone	2,474	.....
Top Kinderhookian rocks	2,770	.....
Top Chattanooga shale	2,864	.....
Top Misener sandstone	2,878	.....
Top "Hunton" limestone	2,879	.....
Top Maquoketa shale	2,941	.....
Top Viola limestone	2,953	2,027
Top Decorah shale	3,037	.....
Top Simpson group	3,051	2,051
Top Arbuckle dolomite	3,116	2,116
Top Lamotte sandstone	.....	2,491
Top Pre-Cambrian rocks	.....	2,529
Total depth	3,155	2,532

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the Aladdin Petroleum Corporation No. 1 Drummond well, sec. 15, T. 20 S., R. 7 E.

Mississippian rocks.—Mississippian limestone formations and the Chattanooga shale have been removed by post-Mississippian erosion from the Nemaha anticline area in the northwestern part of Chase County (Lee, 1939, pl. 1; 1940; Lee, Leatherock and Botinelly, 1948, pl. 13; Jewett and Abernathy, 1945, pl. 3). The total thickness of Mississippian limestones in the county ranges from a featheredge to slightly more than 400 feet. The maximum thickness of the Chattanooga shale is about 150 feet.

Pre-Chattanooga rocks.—The "Hunton" limestone and the Maquoketa shale are seemingly absent from most of Chase County. The Viola limestone and other rocks as old as some part of the Arbuckle limestone have been eroded from most of the Nemaha anticline in the county (McClellan, 1930; Ockerman, 1935, fig. 2). Lee, Leatherock, and Botinelly (1948, pl. 13) show the pre-Chattanooga section in Chase County east of the Nemaha anticline as comprising (1) Kimmswick limestone, (2) Simpson formation, (3) Arbuckle dolomite, and (4) Lamotte sandstone. Bonneterre dolomite and Lamotte sandstone were found high on the upthrown side of the Nemaha fault in the Drummond well, sec. 15, T. 20 S., R. 7 E. Keroher and Kirby (1948, fig. 3) did not recognize Lamotte sandstone in Chase County but show Roubidoux dolomite occurring next above the Pre-Cambrian surface except in the northeast part of the county where Bonneterre dolomite is shown as being in contact with the basement rocks. According to Keroher and Kirby (1948, figs. 4, 8, and 9) the Jefferson City-Cotter section ranges from about 125 to 400 feet in thickness in the county; the Roubidoux dolomite ranges from slightly less than 100 to more than 150 feet in thickness; and the Bonneterre dolomite is present only in the northeastern part of the county where its maximum thickness is less than 50 feet.

Oil and Gas Developments

Several wells have been drilled into Pre-Cambrian rocks on the Nemaha anticline and several tests of Ordovician rocks have been made elsewhere in Chase County, but largely the county is rather poorly tested.

Locations of oil and gas fields and of areas that produced oil in 1952 are shown in Figure 24. Oil production in Chase County for

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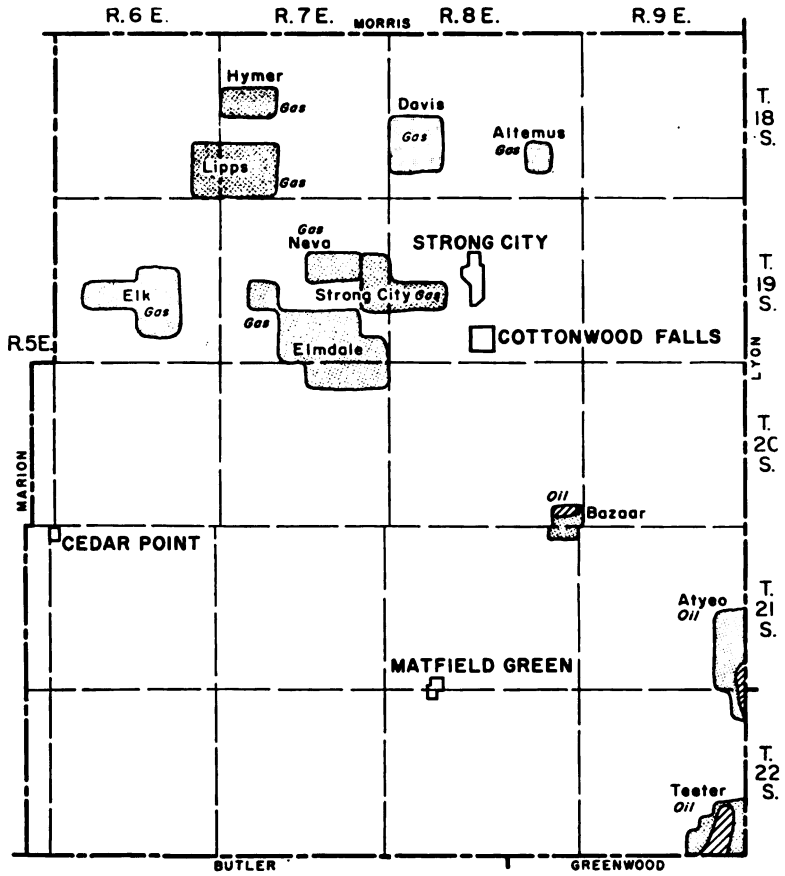

FIG. 24.—Map of Chase County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production.

1949 through 1952 is listed in Table 73. In Tables 2 and 3, Chase County oil production mostly is not separated from that of Greenwood and Lyon Counties.

The Altemus gas field, sec. 26, T. 18 S., R. 8 E., has one producing well, but no log is available. The well was located through oral communication with the inhabitants of the farm on which it is situated. The gas produced is for local farm use only. The Atyeo oil field, along the eastern boundary of Chase County in Ts. 21 and 22 S., extends into the county from Lyon County. The producing

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formation is a "Bartlesville shoestring sand" at an average depth of about 2,250 feet.

The **Bazaar,** a Lansing-Kansas City oil pool, was discovered by the Morrison Drilling Company No. 2 Norton well, sec. 36, T. 20 S., R. 8 E., in 1951. Initial daily production of 12 barrels of oil was reported. Earlier in the year the No. 1 Norton was abandoned as a dry hole. The producing zone in the **Bazaar** field is at a depth of 1,823 feet in the discovery well.

The **Davis** gas field, in T. 18 S., R. 8 E., is the largest gas producing area in the county today. The first producing gas well, drilled in 1929, had an initial production of 681,000 cubic feet. Most of the wells were drilled from 1940 to 1944, however. The field was discovered by the drilling of a well in sec. 19 which had an initial production of a few barrels of oil a day. This well was abandoned shortly after it was drilled but upon further extensive drilling for the same oil zone abundant quantities of gas were found in the Indian Cave sandstone and a sand in the Hamlin shale, both of early Permian age, at depths that ranged from 260 to 439 feet. The initial volume of gas in each well ranged from 50 to 1,000 thousand cubic feet per day. Three of the 36 drilled in this field have been dry. Three wells are abandoned gas wells, one is an abandoned oil well, and the remaining 29 wells are still producing gas today. The gas from this field is piped approximately 5 miles south into Strong City for use in that town. Part of the gas is piped a mile farther south into Cottonwood Falls for local use in that town. During the winter months the production is not high enough to supply the total needs of the two towns and as a result the supply must be supplemented by gas from the Cities Service pipe lines. The **Davis** gas field is the only field in the county on which open flow figures are recorded. Figures for 1948 through 1952 are: 1948, 42,845; 1949, 49,276; 1950, 54,397; 1951, 46,481; and 1952, 52,393 thousand cubic feet of gas.

The **Elk** gas field is in T. 19 S., R. 6 E. The earliest producing well of which the Survey has a record was drilled in January 1930 with an initial production of 786,000 cubic feet of gas per day. Two more wells were drilled in June of the following year and the other producing wells were drilled in a period extending from 1933 to 1939. The producing formation in this field is a sandy zone in the Hamlin shale (Admire group) of early Permian age at an average depth of 500 feet. The only dry hole of 18 holes drilled in this

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field extended to Pre-Cambrian granite. Nine wells have produced gas in the past but are now abandoned. Eight of the wells have gas in them today but are capped and not in production. As a result there is no production at the present time from the Elk field. Gas from this field was formerly piped to Florence, approximately 15 miles to the southwest in Marion County. This was abandoned in 1945, however.

The **Elmdale** gas field, in Ts. 19 and 20 S., R. 7 E., has only eight producing wells today. The field is said to have been discovered in the early 1920's but the year is uncertain. Forty-one wells produced gas in the past but are now abandoned. Six wells drilled in the field have been dry. None of these dry holes was drilled to the Pre-Cambrian granite at depths ranging from 1,805 to 2,810 feet. The Survey has no record of any of the producing or abandoned gas wells. They were located through the aid of Mr. W. F. Kline of Elmdale, and according to him two of the producing wells are approximately 500 feet deep and two are approximately 800 feet deep. The producing formations in this case would probably lie within the Wabaunsee group of late Pennsylvanian age. No open flow measurement is kept on these wells but the gas is piped into Elmdale for use within that town. Their supply is supplemented by three producing wells in the **Lipps** field to the north.

The **Hymer** gas field, T. 18 S., R. 7 E., has only two producing wells, neither of which the Survey has any record, but which were located through oral communication with the inhabitants of Hymer. Both wells are used for local farm use only.

The **Lipps** gas field, in T. 18 S., Rs. 6 and 7 E., was discovered in September 1925. The other wells were drilled in 1926 and 1927. The initial daily production ranged from 2,000 to 4,261,840 cubic feet of gas. The producing formation is the Ireland sandstone member of the Lawrence shale of Pennsylvanian age at an average depth of 1,200 feet. Two of the 37 holes drilled in the field penetrated the Pre-Cambrian granite. Of the 37 holes drilled, 11 were dry, 19 have produced gas in the past but are now abandoned, and 6 wells are producing gas today. The Cities Service Gas Company formerly piped the gas produced from this field to Emporia for use in that city. Now, however, gas from three of the producing wells is piped into Elmdale and the gas from the three remaining producing wells is for local farm use.

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Gas presently being produced from the **Littler** field is being used as a farm supply. Four wells formerly produced gas in the **Neva** field, T. 19 S., R. 7 E. The Geological Survey has no record of the wells except their locations. Until recently gas from one well was piped into Elmdale.

The **Strong City** gas field, in T. 19 S., Rs. 7 and 8 E., formerly produced gas from the Langdon shale of Pennsylvanian age and from the West Branch and Hamlin shales of Permian age. The largest wells were in the Langdon shale at about 450 feet. The first well was drilled in 1925, but no initial production figures are available. Several other wells were drilled in a period extending from 1937 to 1940. In all, 7 dry holes and 12 producing gas wells have been reported. Two of the dry holes are stratigraphic tests drilled in 1949 by the Amerada Petroleum Corporation.

The **Teeter** oil field extends into the southeast corner of Chase County from Greenwood County. Production is from the "Bartlesville sand" at an average depth of about 2,500 feet.

Recent developments.—The **Bazaar** pool, discussed above, is the only Chase County discovery of recent years. Drilling activity in the county during the past four years is indicated by Table 15, which lists data on dry wildcat wells.

TABLE 15.—*Data on dry wildcat wells drilled in Chase County, 1949 through 1952*

Company and farm	Location	Depth to top of Lansing, feet	Depth to top of Mississippian, feet	Depth to top of Viola, feet	Total depth, feet
	1949 Wells				
Aladdin Petro. Co. No. 1 Altemus	SE SE NE 26-18-8E	1,535	2,524	2,987	3,252
Amerada Petro. Corp. No. 1 Childs	NE NW NW 24-19-7E	1,147	absent	absent	1,918
Amerada Petro. Corp. No. 1 Jensen	NE NE NE 24-19-7E	1,191	absent	1,887	2,165
Amerada Petro. Corp. No. 1 Lostutter	NE NE NE 1-20-7E	1,532	absent	2,282	2,825
Amerada Petro. Corp. No. 1 Starkey	SE SE SE 14-20-7E	1,749	2,698	3,144	3,176
Amerada Petro. Corp. No. 1 Lostutter "A"	NW cor. Lot 7 6-20-8E	1,622	2,644	2,984	3,242
Aylward & Seibel No. 1 Hindren	S½ SW SW 15-21-6E	1,955	2,780	.....	3,497

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TABLE 15.—*Data on dry wildcat wells drilled in Chase County, 1949 through 1952, concluded*

Company and farm	Location	Depth to top of Lansing, feet	Depth to top of Mississippian, feet	Depth to top of Viola, feet	Total depth, feet
Amerada Petro. Corp. No. 1 Heter	NW NW NE 4-21-7E	1,744	2,670	.....	2,977
Ward McGinnis No. 1 Atyeo	S½ SE SE 36-21-9E	?	2,322	.....	2,384
	1950 Wells				
C. L. Seibel & Basee Drlg. Co. No. 1 Ronsick	NW NW NW 29-18-6E	1,450	.....	1,953 1,967* 2,018**	2,070
Alf M. Landon & Stanolind Oil & Gas Co. No. 1 Leith	NE SW NE 22-18-9E	1,456	2,474	2,953 3,051* 3,113**	3,153
Morrison Drlg. Co. et al. No. 1 Spain	NW SE NW 7-19-6E	1,450	.....	2,092 2,153* 2,248**	2,365
R. L. Mendenhall No. 1 Piper	SE NE NE 14-20-9E	1,453	2,454	.....	2,475
Aladdin Petro. Corp. & C. L. Carlock No. 1 Noller	NW SW NE 21-21-8E	1,710	2,654	3,131 3,202* 3,257**	3,361
Ward A. McGinnis No. 1 Crosbie	Cen. NW 23-22-9E	2,520	.....	.....	2,570
	1951 Wells				
Greeley Drlg. Co. No. 1 Thurston "A"	SE SE NE 17-19-7E	.....	.....	1,883 1,899* 1,921†	2,018
Mendenhall, Bramine, & Gohoring No. 2 Piper	SW SW SW 14-20-9E	.....	2,455	2,871 2,947* 3,023**	3,080
Ward A. McGinnis No. 1 Hedlung	NW NE SE 4-22-9E	.....	2,524	.....	2,570
Jackman & Jackman et al. No. 1 Evans	NE NE NE 14-22-9E	.....	2,517	.....	2,614
	1952 Wells				
Geo. Martin No. 1 Winsor	SW SW NW 2-20-6E	1,474	.....	2,027	2,532
R. E. Mendenhall No. 3 Piper	SW NW NW 14-20-9E	.....	2,445	.....	2,484

* Depth to top of Simpson, feet.
** Depth to top of Arbuckle, feet.
† Depth to granite wash, feet.

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CHAUTAUQUA COUNTY

Oil was discovered in the Peru field in Chautauqua County in 1900. Later large continuous areas in the vicinities of Sedan, Peru, and Chautauqua have been developed into oil and gas fields.

During 1952 Chautauqua County produced 798,706 barrels of oil. Natural gas production in 1952 amounted to 126,227 thousand cubic feet. Oil production statistics in the county during the years 1900 to 1952 inclusive are shown in Tables 2 and 3. Table 73 shows production in the various oil fields in the county for 1949 through 1952. There were two secondary recovery projects operated in 1952.

Figure 25 shows locations of oil and gas fields in Chautauqua County and the areas of oil production during 1952. Data on secondary recovery projects are listed in Table 4.

Geology

SURFACE ROCKS

The consolidated surface rocks of Chautauqua County consist of alternating beds of limestone and shale and some sandstone. The rocks exposed belong to the Council Grove and Admire groups of Permian age and the Wabaunsee, Shawnee, Douglas, Pedee, and Lansing groups of Pennsylvanian age. The youngest consolidated rocks, those of the Council Grove group, are in the northwestern part of the county in Ts. 30 and 31 S., R. 8 E.; the oldest outcropping rocks, those of the Lansing group, are at the surface in the southeastern part in T. 34 S., R. 13 E. (Moore and Landes, 1937).

Permian rocks.—The lower part of the Eskridge shale, Council Grove group (Fig. 3), is the youngest consolidated rock in Chautauqua County. The total thickness of the Council Grove group in the county is about 150 feet. Rocks of the Admire group, which are chiefly clastic materials, have a total thickness of about 90 feet.

Pennsylvanian rocks.—The Wabaunsee group (Fig. 4) comprises shale, sandstone, and thin beds of limestone. The total thickness of these rocks in Chautauqua County is about 550 feet. The Shawnee group consists of shale, sandstone, and limestone. The limestones are generally thicker than those of the Wabaunsee group. The average thickness of the Shawnee group is about 450 feet in Chautauqua County. The Douglas and Pedee groups, consisting

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chiefly of clastic materials, are about 300 feet thick. The Stanton limestone is the only formation of the Lansing group that crops out in the county. The upper part of the Stanton is exposed in the southeastern part of the county.

SUBSURFACE ROCKS

Depths to some key horizons in the Prairie Oil and Gas Company No. 1 Gordon Brown well, sec. 26, T. 34 S., R. 11 E., are listed in Table 16.

Pennsylvanian rocks.—The Lansing group is about 150 feet thick in Chautauqua County. The Kansas City group consists largely of limestone and contains some shale and sandstone. The sandstone in the upper part of this group is called "Layton sand." The total thickness of the Kansas City group in the county is about 450 feet. The Bronson subgroup of the Kansas City section is almost entirely limestone. The Pleasanton shale in the county has an average thickness of about 50 feet.

The Marmaton group consists of about 320 feet of alternating beds of limestone and shale and some sandstone. Important producing sandstones in the Marmaton are the "Old Red" or "Wayside" in the Nowata shale, the "Weiser" in the Bandera shale, and the "Peru" in the Labette shale.

TABLE 16.—*Depths to some stratigraphic horizons in the Prairie Oil and Gas Company No. 9 Gordon Brown well, SE¼ SW¼ NW¼ sec. 26, T. 34 S., R. 11 E., Chautauqua County*

Horizon	Depth, feet
Top Lansing group	575
Top Iola limestone	890
Top "Layton" or "Encil sand"	893
Top "Redd sand"	1,030
Base Fort Scott limestone	1,585
Top Mississippian limestone	1,890
Top Arbuckle rocks, Cotter-Jefferson City dolomite	2,208
Top Roubidoux dolomite	2,655
Top Gasconade-Van Buren	2,820
Top Eminence dolomite	2,953
Top Bonneterre dolomite	2,968
Top Lamotte sandstone	3,057
Top Pre-Cambrian rocks	3,083
Total depth	3,200

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The Cherokee shale is composed chiefly of shale (partly sandy), sandstone, and a few thin beds of limestone and coal. Its thickness in Chautauqua County ranges from 250 to 450 feet. The "Bartlesville sand" occurs as lenticular bodies lying at a depth of about 180 feet below the top of the Cherokee shale. The "Burgess sand" is the basal part of the Cherokee and fills depressions on the surface of the Mississippian limestone.

Mississippian rocks.—The Mississippian limestone in Chautauqua County ranges in thickness from less than 150 to more than 350 feet (Lee, 1939, pl. 1). The Mississippian section is thinnest over the axis of the Longton anticline in the northeastern part of the county and thickest in the west-central part. The "Warsaw," Reeds Spring, and St. Joe limestones, the Northview shale, and the Compton limestone are present in the eastern part of Chautauqua County. The Chattanooga shale is about 35 or 40 feet thick in eastern Chautauqua County. The "Warsaw" limestone and the Cowley formation, which lies directly on pre-Chattanooga rocks, are present in the western part of the county. Large quantities of oil and gas are produced in Chautauqua County from a porous zone in the upper part of the Mississippian limestone.

Ordovician and Cambrian rocks.—The total thickness of Lower Ordovician and Upper Cambrian rocks in the Prairie Oil and Gas Company No. 9 Brown well, in sec. 26, T. 34 S., R. 11 E., is 875 feet. Oil is produced from a porous zone in the upper part of the Cotter dolomite (upper part of the Arbuckle) of Ordovician age. This zone is locally called the "siliceous lime" and sometimes is erroneously designated as "Wilcox."

Keroher and Kirby (1948, pl. 6) made the following identifications from the cuttings of the Brown well: Jefferson City-Cotter dolomite, 447 feet; Roubidoux dolomite, 165 feet; Van Buren-Gasconade, 133 feet; Eminence dolomite, 15 feet; Bonneterre dolomite, 89 feet; and Lamotte sandstone, 26 feet. The top of the Arbuckle rocks (Cotter dolomite) was encountered at 2,208 feet in this well. The well was drilled a few feet into Pre-Cambrian rocks, which occur next below the Lamotte sandstone.

Oil and Gas Developments

Oil and gas are produced in Chautauqua County from the "Wayside sand" in the Nowata shale (known locally as the "Old Red

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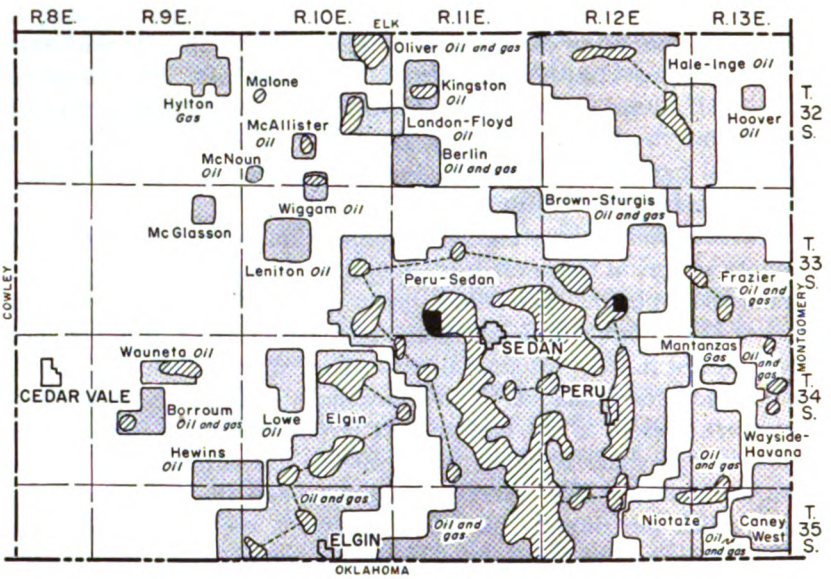

FIG. 25.—Map of Chautauqua County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

sand"); from the "Peru sand," in the lower part of the Marmaton group; from the Little Osage shale (locally called "Hancock") member of the Fort Scott limestone; from the "Bartlesville sand" in the middle part of the Cherokee shale; from the "Burgess sand" in the basal part of the Cherokee shale; from the upper part of the Mississippian limestone; and from the upper part of the Cotter dolomite of Ordovician age.

Oil and gas have been found in every township in Chautauqua County except in those along the western edge (Fig. 25). The largest oil-producing areas are near Sedan, Chautauqua, and Elgin. Most of the oil wells in the county are small producers but are noted for their long life; some of the wells produced for as much as 35 years or more.

The Peru, Sedan, Monett, and Chautauqua areas have been extended and now form one large area. This is called the **Peru-Sedan** field and covers most of the south-central part of the county. The **Hale-Inge** gas and oil field is in the northeastern part of the county; it extends northward into Elk County.

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In 1935, oil was discovered in the Arbuckle dolomite at a depth of 2,300 feet in the **Oliver** pool in T. 32 S., R. 10 E. Later oil was discovered in the Arbuckle dolomite in the vicinity of Monett and in the **McAllister** area. The dolomite was encountered at a depth of 1,790 feet in the Monett area. Gas and oil are also produced in these areas from the upper part of the "Mississippi lime." Oil and gas in the "Mississippi lime" and in the Arbuckle dolomite accumulated in anticlinal structures. Oil and gas accumulations in Pennsylvanian sandstones were controlled by changes in porosity and by minor structural elements. The oil and gas fields, as defined by the Nomenclature Committee of the Kansas Geological Society, are shown in Figure 25. Table 73 gives oil production in the various fields for 1949 through 1952.

The **Berlin** oil and gas field produced oil from the Mississippian "chat" according to available logs. Gas was found in this field in several sandstones in the Kansas City and Marmaton groups. Oil production in the **Borroum** oil and gas field is chiefly from the lower part of the Marmaton rocks at a depth of about 1,780 feet. Gas, according to available logs, occurs principally in the upper part of Mississippian limestone at a depth of about 2,120 feet. The last reported oil production from the **Brown-Sturgis** field was in 1950. Production was from "Peru sand."

The **Caney West** oil and gas field extends into southeastern Chautauqua County from Montgomery County. Oil occurs in the "Peru sand" and in sandstone in the middle and basal parts of the Cherokee group. In the **Elgin** oil and gas field, oil is produced from the "Peru sand." Gas production in the **Frazier** field is reported to be abandoned. Gas was found at a depth of about 550 feet, in lower Marmaton rocks at about 1,275 feet, and in the upper part of the Mississippian limestone. Oil production from the "Peru sand" has been increasing since resumption in 1948.

The **Hale-Inge** oil and gas field is in northeastern Chautauqua County and southeastern Elk County. Oil production is from the "Peru sand." Gas was found in this field in the "Peru sand," the "Oswego lime," and upper part of Mississippian rocks. The **Hewins** field is no longer producing. Gas and oil were found in upper Lansing or Pedee rocks at a depth of about 1,100 feet. The **Hoover** field has been abandoned. Former production probably was from the "Burgess sand" at a depth of about 1,550 feet. The **Hylton** gas field is in the northwestern part of Chautauqua County. Gas was

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found in this area in rocks of the Kansas City group at a depth of about 1,300 feet.

Production in the **Kingston** field is reported to be from Mississippian "chat" at a depth of about 1,750 feet. The **Landon-Floyd** oil field is one of the more important ones of the county. The **Leniton** oil field is no longer producing. Former production was from the "Peru sand." The **Lowe** field was abandoned several years ago. Production was from the "Peru sand." The **Malone** oil field was reactivated several years ago. The discovery well, NE¼ sec. 18, T. 32 S., R. 10 E., was completed in 1924. Oil was found in the upper part of the Arbuckle dolomite at 2,345 feet. Logs of the wells that produced gas in the **Mantanzas** gas field are not available. Gas probably occurs in "chat" at the top of Mississippian rocks.

The **McAllister** field yields oil from the Arbuckle dolomite at about 2,280 feet. Seemingly oil was first discovered in the field in 1925 in Chattanooga shale at about 2,230 feet. There has been no production reported from the **McGlasson** oil field since 1950. The **McNoun** field is inactive. Available records show that wells were plugged in 1928 and 1933. The **Niotaze** oil and gas field is in southeastern Chautauqua County. Production chiefly is from the "Peru sand" at a depth of about 825 feet. The **Oliver** oil field extends into Elk County. Production is from Arbuckle rocks, but the field formerly produced gas from the upper part of Mississippian limestone, and oil from the Little Osage shale in the Fort Scott formation.

The **Peru-Sedan** oil and gas field covers a large area in south-central Chautauqua County, much of which is active oil-producing territory (Fig. 25). Oil production chiefly is from the "Peru sand" at an average depth of about 1,000 feet. The **Wauneta** field produces oil from "Peru sand" and Mississippian rocks. The **Wayside-Havana** oil and gas field extends into Chautauqua County from Montgomery County. Oil and gas in this field occur in several Pennsylvanian sandstones, especially the "Wayside sand." Gas occurs in Mississippian rocks; wells having an initial production of 6 million cubic feet of gas per day have been reported. In the **Wiggam** oil field production is from sandstone in the upper part of the Cherokee rocks at a depth of about 1,600 feet. The sandstone locally is called "Wiser."

Recent developments.—Activities in Chautauqua County are increasing. It is expectable that rock-fracturing methods of well completion will extend considerably the present producing areas.

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CHEROKEE COUNTY

Cherokee County is the only county in southeastern Kansas where commercial quantities of oil have not been discovered. However, a few wells in this county supplied small quantities of gas for many years. The producing zone is the "Burgess sand" in the basal part of the Cherokee shale, which ranges in depth from a few feet to about 300 feet. Oil shows have been reported from the "Bartlesville sand" and from pre-Pennsylvanian rocks (probably Mississippian).

Geology

SURFACE ROCKS

Surface rocks in Cherokee County are Pennsylvanian and Mississippian in age. Cherokee is the only county in the State where Mississippian rocks are exposed.

Pennsylvanian rocks.—The Labette shale of the Marmaton group (Fig. 5) is the surface rock in the extreme northwestern part of Cherokee County where it lies beneath northwestward-trending dip slopes. The Fort Scott limestone crops out in a narrow belt to the south and east.

The Cherokee shale (Fig. 6) crops out in Cherokee County in a broad northeastward-trending belt 18 to 27 miles wide covering the entire county except the extreme northwestern and southeastern parts. The Cherokee consists of light- to dark-gray and black shale, sandstone, numerous coal beds, and a few thin beds of limestone. Its maximum thickness is about 500 feet. It increases in thickness to the southwest. The increase occurs principally in beds below the Ardmore (or Verdigris) limestone, which lies about 100 feet below the base of the Fort Scott limestone. Sandstone occurs in several different zones but most of these sandstone beds are not persistent. Some of them are shoestring sands, which are elongated channel fillings or bars. Results of recent studies by Wallace Howe, of the Missouri Geological Survey and formerly of the Kansas Geological Survey, will be published soon. Mr. Howe's report will show the Cherokee rocks divided into several new formations.

Mississippian rocks.—Rocks of Mississippian age (Fig. 6) are exposed in a small area in the southeastern part of Cherokee County. They consist of light-gray cherty limestones, medium to coarse in texture. They probably include a few feet of Spergen limestone of

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Chesteran age. The "Warsaw" limestone of Meramecian age and the Keokuk limestone of Osagian age comprise most of the exposed section. The total thickness of outcropping Mississippian rocks in Cherokee County is about 50 feet.

SUBSURFACE ROCKS

Many lead and zinc test holes have penetrated Mississippian rocks in Cherokee County and also many wells in this and adjacent counties have been drilled into the uppermost part of Arbuckle rocks. Many water wells in this area are drilled into the Roubidoux sandstone, but only a few wells have reached Pre-Cambrian rocks.

Depths to some stratigraphic horizons in two deep wells in Cherokee County are given in Table 17.

Mississippian rocks.—The divisions of the Mississippian in Cherokee County are the Spergen, "Warsaw," Keokuk-Burlington, Reeds Spring, and St. Joe limestones, the Northview shale, and the Compton limestone. The Spergen limestone is thin and is of local occurrence. The thickness of the Mississippian rocks in the county ranges from about 335 to 380 feet. Numerous sink holes have been formed in the northeastern part of the county by subsidence of the roofs

TABLE 17.—*Depths in feet to some stratigraphic horizons in two Cherokee County wells*

Horizon	Glower et al. No. 1 Forkner, NW SE NE 17-33-23E	Jayhawk Ordnance Works water well, NW SE NE 4-34-25E
Top Spergen limestone	316	...
Top "Warsaw" limestone	331	...
Top Burlington-Keokuk limestone	393	22
Top Reeds Spring limestone	528	157
Top St. Joe limestone	660	285
Top Northview shale	675	307
Top Compton limestone	680	312
Top Cotter dolomite	685	314
Top Jefferson City dolomite	792	419
Top Roubidoux formation	1,065	719
Top Gasconade dolomite	1,262	874
Top Eminence formation	1,496	...
Top Bonneterre dolomite	1,617	...
Top Lamotte sandstone	1,806	...
Total depth	1,862	901

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of solution caverns in a zone near the top of the Mississippian limestone. The Chattanooga shale is not known to be present.

Ordovician rocks.—In Cherokee County all Ordovician rocks younger than the Cotter dolomite were removed by erosion before deposition of Mississippian sediments. Ordovician formations in the county are the Cotter dolomite, including the Swan Creek sandstone member at its base; the Jefferson City dolomite; the Roubidoux formation; and the Gasconade and Van Buren dolomites (undifferentiated), including the Gunter sandstone member at the base. The thickness of the Cotter dolomite in Cherokee County ranges from about 70 to 140 feet. Its thickness is not uniform because of the erosional disconformity below Mississippian rocks. The Cotter dolomite is locally absent about 4 miles north of Cherokee County in Crawford County. The Jefferson City dolomite ranges in thickness from 275 to 300 feet in Cherokee County. The Roubidoux formation consists of sandstone and dolomite. Some of the dolomite is sandy. The Roubidoux has an average thickness of about 170 feet. The formation includes two sandstone members which bear large quantities of water. The upper member, in the middle part of the formation, is about 15 feet thick; the lower member, in the basal part of the formation, is about 25 feet thick. The depth to the Roubidoux formation ranges from about 715 feet in the eastern part of the county to about 1,200 feet in the western part. The undifferentiated Gasconade and Van Buren dolomites range in thickness from about 100 to 265 feet. The Gunter sandstone ranges in thickness from about 5 to 20 feet. An unconformity separates the Gunter sandstone from underlying Cambrian rocks.

Cambrian rocks.—The Cambrian rocks in Cherokee County consist of the Eminence and Potosi dolomites (undifferentiated), Bonneterre dolomite, and Lamotte sandstone. The undifferentiated Eminence and Potosi dolomites have an average thickness of about 150 feet. The rocks between the top of the Cotter dolomite and the base of the Potosi dolomite are conveniently termed Arbuckle. The Bonneterre dolomite is about 175 feet thick in four wells. The Bonneterre is transitional into the underlying Lamotte sandstone. The Lamotte has an average thickness of about 65 feet in three wells. In some wells in Cherokee and adjoining counties a zone of detrital igneous material is found at the base of the Lamotte sandstone. Interpretation of cuttings from the Ordovician and

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Cambrian sections of two wells in Cherokee County were shown by Keroher and Kirby (1948, pl. 6).

Pre-Cambrian rocks.—Pre-Cambrian rocks are about 1,900 feet below the surface in the western part of Cherokee County and about 1,800 feet below the surface in the eastern part. Pre-Cambrian rocks are encountered about 875 feet below sea level at Columbus, Kansas, and their top is nearly level from Columbus to Carthage, Missouri, about 30 miles to the east. A deep well 12 miles west of Columbus reached Pre-Cambrian rocks at about 1,087 feet below sea level. This is 212 feet lower than the top of the Pre-Cambrian rocks at Columbus.

CLAY COUNTY

Oil was discovered in "chat" at the top of Mississippian limestone in Clay County in 1928, after which production was maintained for about 2 years. Oil production was revived in the abandoned field in 1951, and a new pool was discovered the same year. According to Geological Survey records only 25 wells have been drilled in the county and 11 of them have been drilled in the past four years. The county offers very interesting possibilities.

Geology

SURFACE ROCKS

Cretaceous rocks.—Cretaceous sandstone, shale, and clay having a maximum thickness of approximately 250 feet are present in the western part of Clay County. These sediments overlap Permian rocks. Plummer and Romary (1942) have made preliminary studies of Cretaceous rocks in this part of Kansas.

Cretaceous rocks belonging to the Dakota and Kiowa formations have been identified in Clay County. Dakota sandstones and shales commonly lie on the Kiowa shale; locally they overstep the Kiowa and rest on Permian rocks. Massive sandstones are conspicuous in the Dakota formation, but the amounts of clay and sandstone are about equal. The maximum thickness of the Dakota in the county is approximately 200 feet. The Kiowa shale has a maximum observed thickness of about 50 feet. It consists almost entirely of dark rather fissile shale.

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Permian rocks.—Permian sediments, including the lower part of the Sumner group and the upper part of the Chase group, crop out in the southeastern half of Clay County. The oldest well-exposed bedrock is the Fort Riley limestone. Rocks of the Chase group (Fig. 3) in Clay County are about 350 feet thick. Massive limestones, some of which are flinty, and bright-colored shales are characteristic. The Wellington formation consists chiefly of red and gray shales and thin impure limestones.

SUBSURFACE ROCKS

Depths to some key stratigraphic horizons in three Clay County wells are listed in Table 18. The county lies west of the Nemaha anticline and on the east flank of the Salina basin. In terms of older structural provinces the county is in the central part of the North Kansas basin. In reference to pre-St. Peter structures, the

TABLE 18.—*Depths in feet to some stratigraphic horizons in five Clay County wells*

Horison	Frank Dieter et al. No. 1 Lippert, SW NE NE 28-6-4E	El Capitan Oil Co. No. 1 Crawford, SE SE SW 1-7-5E	Skow Bros. et al. No. 1 Gates, SE SW 16-9-4E	J. F. Boggess No. 1 Younkin, SW SE 21-9-4E	Derby Oil Co. No. 1 Neimoller, 19-10-3E
Top Shawnee group	.....	.....	970	1,050	1,200
Top Heebner shale	1,296	.....	.....	1,295	.....
Base Oread limestone	.....	.....	.....	1,335	.....
Top Lansing group	1,380	.....	1,245	1,390	1,620
Top Kansas City group	1,490	1,691	.....	.....	.....
Base Kansas City group	.....	.....	1,666	1,755	1,965
Top Mississippian limestone	.....	2,138	1,795	1,890	2,225
Top Kinderhookian rocks	1,800	.....	1,900	2,002	.....
Top Boice shale	.....	.....	1,095	....	2,305
Top "Hunton" limestone	1,992	2,353	2,085	2,194	2,493
Top Maquoketa shale	2,432	2,785	2,424	2,545	2,775
Top Viola limestone	2,483	2,838	2,475	2,583	2,846
Top St. Peter sandstone	2,753	3,079	2,629	2,745	2,999
Top Arbuckle rocks	.....	3,114	.....	.....	.....
Top Pre-Cambrian rocks	2,803* 2,828**	3,162†	.....	.....	.....
Total depth	2,829	3,255	2,662	2,792	3,110

* Schist. ** Granite. † Quartzite.

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county is on the southwest flank of the southeast Nebraska arch; the St. Peter sandstone is believed to be absent from the northeast part of the county and to lie on beveled Ordovician and Cambrian formations elsewhere (Lee, Leatherock, and Botinelly, 1948, panel 1).

Permian and Pennsylvanian rocks.—The average total thickness of rocks of the Permian and Pennsylvanian Systems in Clay County is about 2,000 feet. Rocks of the two systems are thickest in the southwest part of the county and are thinner in the northeast, the thickening being in the direction of the central part of the Salina basin. Lee, Leatherock, and Botinelly (1948, panel 3) have shown thicknesses of units within the Permian-Pennsylvanian section in the Salina basin. The interval from the base of the Florence limestone to the top of the Topeka limestone (top of the Shawnee group) ranges from slightly more than 900 feet in the northeast corner of the county to about 975 feet in the southwest corner. The interval from the top of the Topeka limestone downward to the base of the Hertha limestone (base of the Kansas City group) is about 650 feet in the northeast part to 750 feet in the southwest. The remainder of the Pennsylvanian rock section ranges from about 150 to 250 feet. The thickening is in the same direction.

Mississippian rocks.—Mississippian limestone underlies all of Clay County except that part north and east of a line that extends from near the northwest corner to a point about midway along the eastern border of the county. In that area Pennsylvanian rocks, commonly the "basal conglomerate," lie on the Boice or Chattanooga shale. The thickness of the Mississippian limestone increases toward the central part of the Salina basin and is about 150 feet in the southwest corner of the county. There is also an increased thickness in the southeast corner of the county in the synclinal area immediately east of the Abilene anticline. Sedalia, Gimore City, and Burlington-Keokuk formations are believed to be beveled by the pre-Pennsylvanian disconformity. The Chattanooga and Boice shales are believed to underlie all of Clay County being everywhere less than 200 feet thick and less than 100 feet in the northeast corner. Thicknesses of the Boice-Chattanooga and other subsurface stratigraphic divisions are shown by Lee, Leatherock, and Botinelly (1948, panels 1-4).

Devonian rocks.—The average thickness of Devonian dolomite in Clay County probably is about 100 feet, ranging from 50 feet in

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the southwest corner of the county to 150 feet in the northeast. The thickening is in the direction of the central part of the North Kansas basin. Devonian dolomite is 103 feet thick in the Skow Brothers et al. No. 1 Gates well, sec. 15, T. 9 S., R. 4 E.; and it is 72 feet thick in the Derby Oil Company No. 1 Neimoller well, sec. 19, T. 10 S., R. 3 E. An erosional disconformity separates Devonian and Silurian rocks, but collectively, in northeastern Kansas, they comprise the "Hunton" limestone.

Silurian rocks.—Beds of Silurian dolomite are beveled by the disconformity that lies between them and Devonian rocks. These rocks too are thickest in the northeast corner of Clay County and thinnest in the southwestern or western parts. Silurian rocks are 218 feet thick in sec. 15, T. 9 S., R. 4 E.; and 210 feet in sec. 19, T. 10 S., R. 3 E. The thickness of the "Hunton" in the El Capitan Oil Company No. 1 Crawford well, sec. 1, T. 7 S., R. 3 E. is 205 feet; in the J. F. Boggess et al. No. 1 Younkin well, sec. 21, T. 9 S., R. 4 E., the thickness is 351 feet.

Ordovician and Cambrian rocks.—The Maquoketa shale is 51 feet thick in the Lippert well, sec. 28, T. 6 S., R. 4 E.; it is 80 feet thick in the Crawford well, sec. 1, T. 7 S., R. 3 E. The thickness is 64 feet in the Gates well, sec. 15, T. 9 S., R. 4 E.; 38 feet in the Younkin well, sec. 21, T. 9 S., R. 4 E.; and is 72 feet in the Neimoller well, sec. 19, T. 10 S., R. 3 E. The Maquoketa shale is separated from the overlying Devonian limestone and from the Kimmswick dolomite, below, by disconformities.

The Kimmswick limestone commonly is referred to as the Viola and is logged as Viola by drillers. The formation logged as Decorah shale in some wells seemingly is the Platteville limestone (Lee, Leatherock, and Botinelly, 1948, p. 35). In the Lippert well, sec. 28, T. 6 S., R. 4 E., the Viola (Kimmswick) is logged as 205 feet thick and the Decorah shale as 65 feet. In the Crawford well, sec. 1, T. 7 S., R. 3 E., the interval from the top of the Viola to the top of the St. Peter sandstone is 241 feet. In the Younkin well, sec. 21, T. 9 S., R. 4 E., the same interval is 162 feet thick. In sec. 19, T. 10 S., R. 3 E., in the Neimoller well, the Kimmswick limestone is 153 feet thick and the thickness of the Platteville formation is 60 feet.

The St. Peter sandstone is believed to underlie all of Clay County. In sec. 28, T. 6 S., R. 4 E., where it seemingly rests on Pre-Cambrian rocks its thickness is 50 feet. It is 65 feet thick in sec. 1, T. 7 S., R. 3 E. In sec. 19, T. 10 S., R. 3 E., the thickness is 35 feet.

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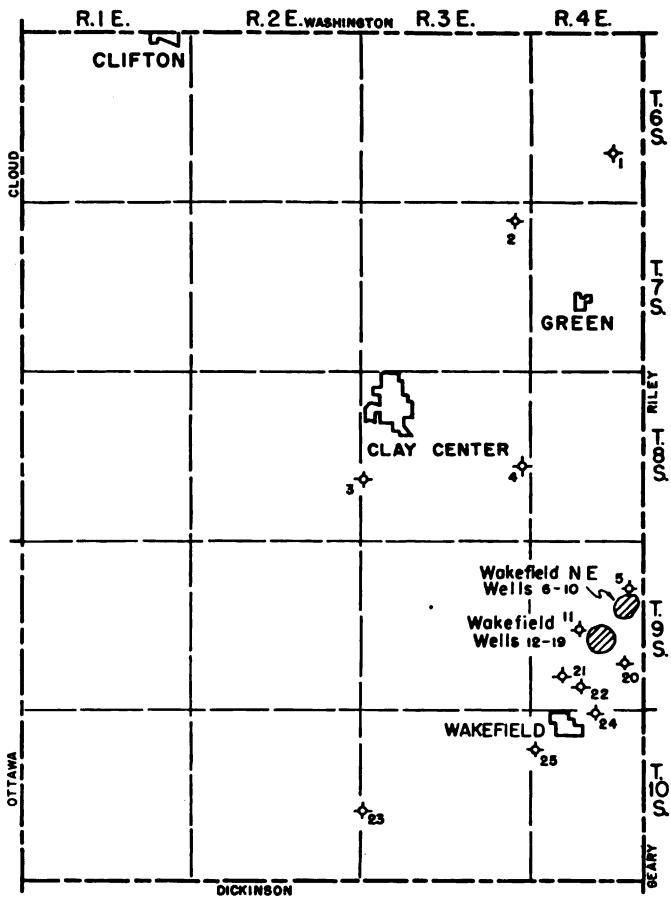

FIG. 26.—Map of Clay County showing oil pools and wells listed in Table 19.

Dolomite and limestone next below the St. Peter sandstone commonly are referred to as the Arbuckle. Lee, Leatherock, and Botinelly (1948, panel 1) indicate in a cross section that undifferentiated Jefferson City and Cotter dolomite is present under the southeast part of Clay County, but that in most parts of the county where Arbuckle rocks are present, it is the Roubidoux dolomite that lies below the St. Peter sandstone. Seemingly a thin section of Bonneterre dolomite underlies the Roubidoux. The maximum thickness of pre-St. Peter sedimentary rocks in the county is probably not more than 225 feet and they are absent from the northeast

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corner. In the Crawford well, sec. 1, T. 7 S., R. 3 E., 48 feet of Arbuckle rocks was logged. This probably is Bonneterre dolomite and is near the margin of pre-St. Peter sediments.

Oil and Gas Developments

The Roth and Faurot No. 1 Bradbury well, sec. 21, T. 9 S., R. 4 E., is the discovery well of the Wakefield oil pool and the discovery of oil in Clay County. The well, drilled in 1928, is reported to have produced 3,600 barrels of oil in 2 years. Oil was found in "chat" at the top of Mississippian limestone at a depth of 1,774 feet.

Recent exploration and developments.—Previous to the close of 1948 there had been 14 wells drilled for oil or gas in Clay County (Jewett, 1949, table 22). Eleven wells have been reported since;

Table 19.—*Data on wells drilled for oil and gas in Clay County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Frank Dieter et al. No. 1 Lippert	SW NE NE 28-6-4E	1951	2,829	Stratigraphic data in Table 18
2	El Capitan Oil Co. No. 1 Crawford	SE SE SW 1-7-3E	1949	3,255	Stratigraphic data in Table 18
3	Nebraska Oil Co. No. 1 Fevier	SW SW SW 19-8-3E	1931	2,860	Show of oil in "chat" 2,198–2,213; no log from 2,700–2,860 ft.
4	K. I. Turner No. 1 Concord	SW SE NE 24-8-3E	1950	3,000	Top of "chat" 2,010 ft.
5	K. I. Turner et al. No. 1 Hower	NE SE SW 10-9-4E	1952	1,935	Dry hole, Wakefield Northeast field
6	K. I. Turner No. 2 Tannehill	Cen. E½ NW 15-9-4E	1952	1,934	Pool well; 25 bbls. I.D.P., Wakefield Northeast field
7	K. I. Turner No. 1 Tannehill	Cen. NW 15-9-4E	1951	1,922	Discovery well; Wakefield Northeast field
8	El Capitan Oil Co. No. 1 Hill	NW NW SW 15-9-4E	1950	2,650	Top Viola, 2,604 ft.
9	Derby Oil Co. No. 1 McNeil	SW NW 15-9-4E	1929	2,156	Show of oil in "chat" 1,895 ft.
10	Skow Bros., Ritchey, & Wentworth No. 1 Gates	SE SE SW 15-9-4E	1929	2,662	Light show oil 1,825 ft; in "chat"; well stopped in St. Peter ss.
11	J. F. Boggess et al. No.1 Bradbury	NE NE 20-9-4E	1924	1,855	Top Mississippian, 1,787 ft.
12	Roth & Faurot No. 1 Bradbury	SW SE NW 21-9-4E	1928	1,777	50 bbls. initial daily prod. from "chat" 1,774 ft.
13	Veeder Supply & Devel. Co. No. 1 Glace	CNL 21-9-4E	1946	1,850	Top Mississippian, 1,787?; show of oil 1,787½ ft.
14	J. F. Boggess et al. No. 1 Younkin	SW SW SE 21-9-4E	1923	2,792	Stratigraphic data in Table 18

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TABLE 19.—*Data on wells drilled for oil and gas in Clay County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
15	Siedl Bros. No. 1 Younkin	SE NW 21-9-4E	1935	1,778	600 feet of oil in hole,1,777; top "chat," 1,772 ft.
16	Henderson & Holden & Skow Bros. No. 2 Younkman	NW SE 21-9-4E	1925	1,952	Show of heavy oil, 1,887–1,892; top "chat," 1,880 ft.
17	Mendenhall Drlg. Co. No. 1 Glaze	Cen. NE 21-9-4E	1950	1,824	A dry hole in Wakefield field
18	K. I. Turner No. 1 Glace	NE SW NE 21-9-4E	1951	....	Revival well, Wakefield field
19	K. I. Turner No. 2 Glace	SE NE NW 21-9-4E	1952	1,801	Pool well; 25 bbls. I.D.P., Wakefield field
20	Mahoney & Fehr No. 1 Wiese	NW SE NW 27-9-4E	1952	1,920	Dry hole; top Mississippian, 1,883 ft.
21	Nelson Synd. No. ? Peter Yarrow	SW SW 29-9-4E	?	2,443	Show of oil, 1,820; top Mississippian, 1,790 ft.
22	J. F. Boggess No. 1 Fleming	SE NE NE 32-9-4E	?	1,890	Top Mississippian, 1,770 ft.
23	Derby Oil Co. No. 1 Neimoller	NW SW 19-10-3E	1930	3,110	Stopped in St. Peter ss.; top Mississippian, 2,227 ft.
24	H. M. Rizor No. 1 Myers	NE NW NW 4-10-4E	1935	1,860	Oil & gas show 1,620 feet in Pleasanton gr.; top Mississippian, 1,760; stopped in Kinderhookian
25	Henderson & Holden No. 1 Faidley	SE SE NW 7-10-4E	?	2,070	Well stopped in Kinderhookian

data on all wells reported in the county are listed in Table 19. In 1949 a test well, the El Capitan Oil Company No. 1 Crawford, was drilled into Pre-Cambrian rocks in sec. 1, T. 7 S., R. 3 E. Three dry holes were reported in the county in 1950. In 1951, the K. I. Turner No. 1 Glace well, NE¼ SW¼ NE¼ sec. 21, T. 9 S., R. 4 E., revived production in the **Wakefield** field. Initial daily production of 6 barrels of oil was reported from the top of Mississippian limestone or "chat" at a depth of 1,785 feet. Also in 1951, the **Wakefield Northeast** pool was discovered by the K. I. Turner No. 1 Tannehill well, Cen. NW¼ sec. 15, T. 9 S., R 4 E. The top of Mississippian limestone was reached in the Tannehill well at 1,910 feet and production from that depth of 6 barrels of oil per day was reported. A dry wildcat also was drilled in Clay County in 1951. Four holes drilled in the county in 1952 resulted in a new oil well to each of the fields, a dry hole in the **Wakefield Northeast** field, and a dry wildcat, the Mahoney and Fehr No. 1 Wiese well in sec. 27, T. 9 S., R. 4 E.

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Commercial production in Clay County during 1951 and 1952 is not recorded.

The locations of wells that are listed in Table 19 and of the two oil fields in Clay County are shown in Figure 26.

COFFEY COUNTY

Oil was first discovered in Coffey County, near Le Roy, in 1903, but important production did not start in the county until 1916. Oil fields are confined to the southern and southwestern parts of the county. Oil is produced from Pennsylvanian and Mississippian rocks.

During 1952 Coffey County produced 85,651 barrels of oil, and 11,477 thousand cubic feet of gas. Table 73 shows oil production in the county from 1949 through 1952. Total production figures for Coffey County for the years 1914 to 1948, inclusive, are shown in Tables 2 and 3.

Oil fields and areas of 1952 oil production in Coffey County are differentiated in Figure 27.

Geology

SURFACE ROCKS

Much of the upland surface of Coffey County is mantled with relatively coarse flint gravel of probable late Tertiary age. Pleistocene alluvium partly fills the valleys of Neosho River and smaller streams. Surface bedrock of Pennsylvanian age belongs to the Virgilian and Missourian Series. The oldest exposed Pennsylvanian rocks occur in the southeastern part of Coffey County. However, the wide trench of Neosho River in this area causes difficulty in surface stratigraphic studies. The youngest bedrock is the White Cloud shale and the oldest exposed rock is the Stanton limestone.

Rocks in the lower part of the Wabaunsee group (Fig. 4) are present in the northwestern part of Coffey County. Several feet of White Cloud shale is exposed. This is underlain by the Howard limestone, which is about 15 feet thick. The Nodaway coal bed is a short distance below the most prominent part of the Howard limestone. The thickness of the Severy shale, lowest formation of the Wabaunsee group, is about 65 feet.

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Rocks of the Shawnee group (Fig. 4) are well exposed in many places in Coffey County. These rocks are characterized by scarp-forming limestones, light and dark shales, and lenticular sandstones. The total thickness of the group is about 400 feet. The Oread limestone lies below an extensive dip slope which ranges in width from about 5 to 15 miles and extends from the northeastern to the southwestern part of Coffey County. Other limestones in the group lie below narrower dip slopes. Various members of the limestone formations are easily recognized key beds.

Rocks of the Douglas group (Fig. 4) are chiefly shales and sandstones; in Coffey County this group ranges in thickness from about 200 to 275 feet. The group comprises the Lawrence and Stranger formations, which are separated locally by a disconformity. The Lawrence shale includes a local limestone, the Amazonia?, about 25 feet below the top of the formation, and the Williamsburg coal bed, a few feet above the Amazonia? limestone. Local unconformities occur in the Lawrence shale. Subsurface studies indicate that much cutting and filling took place during the time of deposition of the upper part of the Lawrence rocks. Throughout Kansas and in neighboring states, the Douglas rocks are separated from underlying older rocks by a major erosional unconformity.

A few feet of Weston shale, lowermost formation of the Pedee group (Fig. 5) crops out at the surface in the southeastern part of the county. Locally in the subsurface a maximum thickness of about 20 feet of Iatan limestone and about 40 feet of Weston shale is present. The Weston shale includes several feet of sandstone in its middle and upper parts. Well records show that Douglas rocks rest on Stanton limestone and that Pedee rocks were removed by pre-Douglas erosion in much of the county.

Dip slopes of the upper limestone members of the Stanton formation of the Lansing group extend into southeastern Coffey County. Exposures of these rocks are rather poor. The Lansing rocks are about 90 feet thick in the subsurface. About 10 feet of shale separates the Stanton and Plattsburg limestones.

SUBSURFACE ROCKS

Coffey County lies on the northwestern flank of the Chautauqua arch. Ordovician rocks dipping to the northwest were beveled by erosion and are buried under Mississippian sediments. The sub-

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surface section includes Pennsylvanian, Mississippian, Ordovician, Cambrian, and pre-Paleozoic rocks. Depths to some stratigraphic horizons reached in two wells drilled into Ordovician rocks in Coffey County are listed in Table 20.

Pennsylvanian rocks.—The thickness of rocks of Pennsylvanian age from the base of Oread limestone, which crops out in the southeastern part of Coffey County, to the base of the Cherokee shale is about 1,300 feet. Douglas rocks range from about 200 to 300 feet in thickness in the county. This difference in thickness is due to differential erosion of Lansing rocks before deposition of Douglas sediments. Lower Douglas rocks lie on formations which range downward from the Iatan limestone to the Stanton limestone. Rocks of the Lansing and Kansas City groups are similar in Coffey and adjacent counties. The combined thickness of these groups is about 430 feet. Because of the irregular surface upon which Pleasanton rocks lie, the thickness of the Pleasanton shale in the county ranges from about 100 to 150 feet. The Marmaton rocks range in thickness from about 150 to 200 feet. Locally, Pleasanton rocks lie upon a surface near the top of the Altamont limestone. In other places, however, all the Marmaton formations are present. Cherokee rocks are about 375 feet thick.

Mississippian rocks.—The Mississippian limestone formations in Coffey County range in total thickness from slightly less than 300 feet to a little more than 350 feet (Lee, 1939, pl. 1). The Chat-

TABLE 20.—*Depths in feet to some stratigraphic horizons in two Coffey County wells*

Horizon	White Eagle Oil & Refg. Co. No. 1 M. T. M. Co. SW W½ NE¼ 26-19-13E	——— No. ——Edd Schwab, SW NE 5-22-14E
Base Oread limestone	465	375
Top Lansing group	740	660
Base Kansas City group	1,175	1,110
Base Fort Scott limestone	.....	1,378
Top Mississippian limestone	1,730	1,784
Top Kinderhookian rocks	2,158	2,114
Top Viola limestone	2,236	2,184
Top Simpson group	2,270	2,196
Total depth	2,275	2,240

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tanooga shale is about 50 feet thick. The middle part of the Chattanooga is somewhat sandy.

Pre-Chattanooga rocks.—Rocks of Devonian age (unless the Chattanooga shale is in part Devonian) and of Silurian age are absent from Coffey County. The Viola limestone and the St. Peter sandstone (Ordovician) are absent from the southeastern part of the area. The maximum thickness of the Viola limestone probably is about 50 feet, and the St. Peter sandstone has about the same thickness. Arbuckle rocks are believed to underlie the St. Peter sandstone and rest directly on Pre-Cambrian rocks seemingly in all parts of the county. The average thickness of the Arbuckle is probably about 550 feet.

According to Keroher and Kirby (1948, figs. 3, 4, 5, 6, 8, 9) the Cotter-Jefferson City sequence ranges from about 200 feet in the northern part of Coffey County to more than 400 feet in the southwest part; the Roubidoux dolomite less than 100 feet; the Van Buren-Gasconade sequence from about 25 to 100 feet; the Eminence dolomite from a featheredge to 50 feet; the Bonneterre between 50 and 100 feet. These data are estimates made chiefly from records of wells in near-by counties.

Oil and Gas Developments

The **Dunaway** and **Virgil North** pools extend from Greenwood County into southwestern Coffey County; the **Winterscheid** pool extends into Coffey County from Woodson County. Oil is produced in these pools from the "Bartlesville sand."

In 1928 the Union Gas Corporation No. 1 Carter well in the NE¼ SE¼ sec. 8, T. 22 S., R. 14 E. was completed. An initial flow of 1,178,650 cubic feet of gas was reported at 1,355 feet. The producing formation is a sandstone in the upper part of the Cherokee shale. The pool is known as the **Carter** gas pool. At present there is no production in the Coffey County part of the **Evans** oil field.

The **Finnerty** field was opened in 1953 by the F. E. Lockhart and George White No. 1 Finnerty well, sec. 12, T. 21 S., R. 13 E. Oil was reported in the "Burgess sand" at a depth of 1,728 feet. Data on the initial potential of the well are not yet available.

The **Hatch** pool was discovered in 1930, when oil was found in a basal Pennsylvanian sandstone ("Burgess") at a depth of about 1,825 feet. The discovery well, in sec. 35, T. 21 S., R. 13 E., had an initial daily production of 80 barrels. In the same year a 15-barrel

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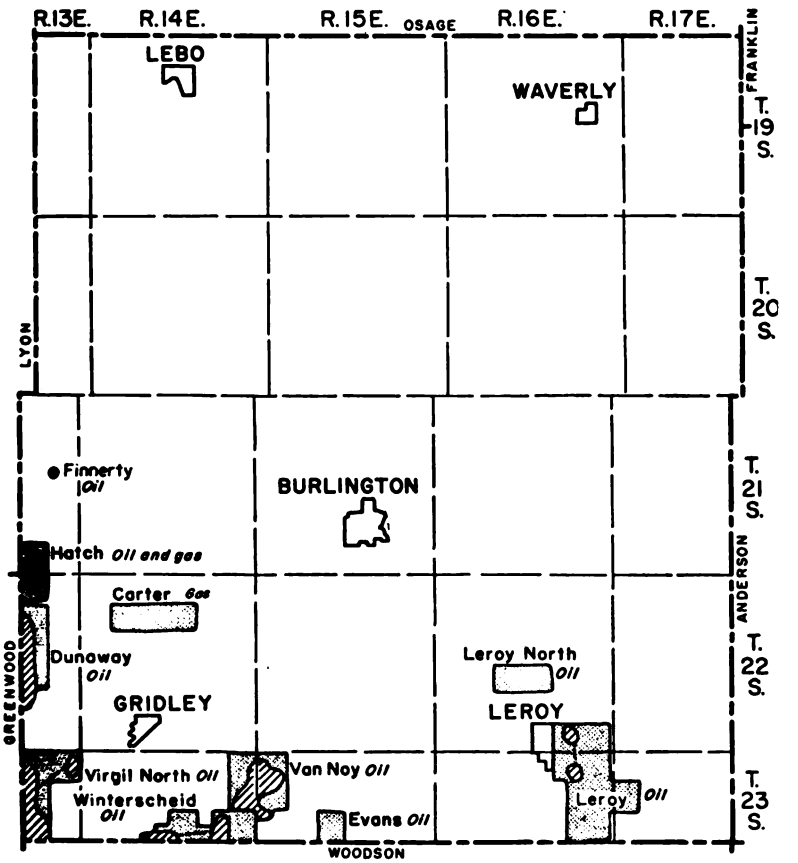

FIG. 27.—Map of Coffey County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; crossed lines show 1953 pool discovery.

oil well was completed in the section, and in 1935 a gas well having a reported initial flow of 300,000 cubic feet of gas per day was drilled in the section. No production has been reported from the field in recent years.

The **Leroy** is the oldest oil field in Coffey County. Oil was discovered in sandstone in the upper part of the Cherokee shale at a depth of 965 feet on the Crotts farm southeast of Le Roy in 1903 (Haworth, 1908, pl. 86). The well probably was in the SW¼ sec. 11, T. 23 S., R. 16 E. A dry hole drilled in 1904 in sec. 26, T. 22 S., R. 16 E. reached Mississippian limestone at 1,306 feet and had a

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total depth of 1,314 feet. No sandstone was logged in the Cherokee section. In 1905 the Sunflower Oil Company No. 1 Quiggle well, sec. 35, T. 22 S., R. 16 E., was reported as an oil well with production from 27 feet of sandstone at 963 feet. Seemingly this well has sometimes been regarded as the Leroy discovery. Production data from early wells in the area are not available, but in 1917 it was reported that no important oil pools had been discovered in Coffey County (Moore and Haynes, 1917, p. 253), although on January 1, 1916, the county was reported to have had 23 producing oil wells. Probably most or all of them were in the **Leroy** area. The field was extended into secs. 1 and 2, T. 23 S., R. 16 E., several years ago but logs of the wells are not available. Also a well in sec. 7, T. 23 S., R. 17 E. was reported as a gas well. For several years previous to 1951 no oil production was reported from the **Leroy** field. In 1951 resumption of production was reported, and the field became the scene of extraordinary activity in 1952 and 1953. The abandoned **Leroy North** oil field is in T. 22 S., R. 16 E. Logs of the wells are not available.

Oil in the **Van Noy** pool was found in the upper part of the Mississippian limestone at depths of about 1,540 feet. Two wells were reported to have had an initial production of 100 barrels of oil per day. Smaller production was found in other wells. Although oil was discovered here earlier, most of the drilling was done in 1935 and 1936. It is reported that in the **Van Noy** field there is some production from the "Peru sand."

Recent developments.—Most of the recent drilling in Coffey County has been in the established fields. In 1949 all reported drilling (23 wells, including 11 oil wells) was within field boundaries. In 1950, 17 oil wells and 10 dry holes (including 5 dry wildcats) were reported. Three dry wildcats and 19 pool wells were reported in 1951 and in 1952, 1 dry wildcat, 8 oil wells, and 7 pool wells were reported. Data on wildcat wells drilled since 1949 in the county are listed in Table 21. The **Leroy** field was especially active in 1953.

The dry hole drilled in the **Dunaway** field in 1951, in the NW¼ NW¼ SE¼ sec. 13, T. 22 S., R. 13 E., reached the top of Arbuckle rocks at a depth of 2,197 feet and was abandoned at 2,248 feet. The same year two wells were drilled into the Arbuckle in the **Van Noy** field, the Warren Ellis No. 3 Barngrover, NE¼ NW¼ NW¼ sec. 7, T. 23 S., R. 15 E. to 1,985 feet, and the W. E. Ellis et al. No. 1

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TABLE 21.—*Data on dry wildcat wells drilled in Coffey County, 1949 through 1952*

Company and farm	Location	Depth to Mississippian, feet	Total depth, feet
No wells reported in 1949			
	1950 Wells		
Stanolind Oil & Gas Co. No. 1 Butler	SE cor. SW 1-21-13E	1,753	2,291
Walter Neustadt, Jr. No. 1 "A" Sam Bahr	NW SE SE 33-22-14E	.....	1,370
Sunflower Drlg. Co. et al. No. 1 Sam Bahr	NW NW SE 33-22-14E	1,690	1,705
G. W. Jesse No. 1 Valenta	SW NE SE 4-23-14E	1,635	1,655
Ray Oil & Gas No. 1 Schoehleber	NW cor. NE 3-23-15E	1,472	1,640
	1951 Wells		
B. G. Gobel No. 1 McGrew	NE SW SE 20-20-14E	1,731	2,235
Arro Oil Co. et al. No. 1 Reynolds	SW SW SW 35-21-14E	.....	1,850
Leroy Grimm No. 1 Hammond	SE SE NW 13-22-14E	1,598	1,605
	1952 Well		
Thompson & Hartig No. 1 O'Narra	NE NE SE 14-21-13E	1,801	1,805

Gibson, Cen. S½ NE¼ sec. 6, T. 23 S., R. 15 E. (top Arbuckle, 1,898 feet) to 1,934 feet. The Viola was tested in the **Virgil North** field in 1951, when a well in the NW¼ SW¼ SE¼ sec. 11, T. 23 S., R. 13 E., was drilled to a total depth of 2,283 feet, reaching the top of the Mississippian at 1,803 feet and the Viola at 2,254 feet. The discovery of the **Finnerty**, a "Burgess sand" field, in sec. 12, T. 21 S., R. 13 E., in 1953 is noted above.

COWLEY COUNTY

Cowley County has been an important producer of oil and gas for many years. Gas was found near Winfield as early as 1902. Natural gas discovered near Dexter in 1903 attracted much interest because of its helium content; a plant for the extraction of the helium was built at Dexter in 1927. Although oil was discovered

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near Dexter in 1914, the first important oil field in the county, the Peacock, was opened in 1916. Extensive developments took place in the 1920's. The geology and oil and gas resources of the county have been described comprehensively by Bass (1929). More recently subsurface conditions in western Cowley County have been interpreted in a cross section from Marion County, Kansas, to Osage County, Oklahoma, by Lukert (1949).

In 1952 Cowley County produced 2,165,504 barrels of oil. Natural gas production during the year was 544,906 thousand cubic feet. Peak production of oil in the county was attained in 1925, when 7,038,874 barrels of oil was produced. Nearly 4 million barrels came from the Rainbow Bend field that year. Since 1925, production has been declining gradually; in 1926 it had dropped to 3,943,061 barrels; and in 1941 to 2,816,706 barrels.

Oil production in Cowley County during the years 1914 to 1952 inclusive is shown in Tables 2 and 3. Oil production in the county's various fields for 1949 through 1952 is shown in Table 73. Figure 28 shows the locations of oil and gas fields in Cowley County and areas that produced oil in 1952. Thirteen secondary recovery projects are being operated in the county. During 1949, 4 new fields were opened, 1 in 1950, 4 in 1951, 14 in 1952, and 8 in the first part of 1953.

Geology

SURFACE ROCKS

The geology of Cowley County with special reference to the occurrence of oil and gas was described by Bass (1929). Flint gravels, Recent to Tertiary (?) in age and 20 feet or less in thickness, are present at the surface in many parts of the county and are commercially important in several localities. The exposed bedrocks in Cowley County belong to the Sumner, Chase, Council Grove, and Admire groups of the Permian System and the Wabaunsee group of the Pennsylvanian System.

Permian rocks.—The youngest bedrock in Cowley County is the lower part of the Wellington shale which is present in most of the westernmost tier of townships. The rocks of the Chase group (Fig. 3) average about 375 feet in thickness and they occupy about half the surface of the county. The Herington limestone member of the Nolans formation is about 30 feet thick. Its basal part consists of

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about 5 feet of fossiliferous limestone; the remainder is dolomitic and less fossiliferous. It is a useful key bed. The Barneston limestones are especially conspicuous. The Florence member lies below extensive dip slopes and the Fort Riley member crops out in wall-like cliffs near the top of Flint Hills slopes. The Council Grove group has an average thickness of about 150 feet in the county. Some of the Council Grove limestones are thicker in Cowley and Butler Counties than in counties farther north. Flinty limestone is characteristic of some of the beds. The Admire group in Cowley County has a total thickness of about 40 feet; it consists chiefly of shale.

Pennsylvanian rocks.—The Burlingame limestone of the Wabaunsee group (Fig. 4), the oldest rock exposed in Cowley County, crops out in a very small area in the eastern part of T. 34 S., R. 8 E. Younger Pennsylvanian shales and limestones are exposed in a narrow band in the southeastern part of the county (Bass, 1929, pl. 1).

SUBSURFACE ROCKS

Depths to some stratigraphic horizons on a well in the SW¼ sec. 9, T. 35 S., R. 6 E. are listed in Table 22. The subsurface rocks of this county dip to the southwest at an average rate of about 22 feet per mile. Three parallel northeast-trending anticlines are the most pronounced structural features of the county. They are the Nemaha anticline in the extreme northwestern part of the county, the Winfield anticline in the west-central part, and the Dexter anticline in the southeastern part.

TABLE 22.—*Depths to some stratigraphic horizons reached in the Phillips Petroleum Company No. 1 Eckhart well, Cen. SW¼ sec. 9, T. 35 S., R. 6 E., Cowley County*

Horizon	Depth, feet
Base Oread limestone	1,575
Base Kansas City group	2,608
Top Mississippian limestone	3,105
Base Mississippian limestone	3,455
Base Chattanooga shale	3,480
Top Arbuckle rocks	3,480
Top Pre-Cambrian rocks	4,545
Total depth	4,547

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Pennsylvanian rocks.—The Wabaunsee group has an average thickness of about 400 feet in Cowley County. The Shawnee group has an average thickness of about 650 feet and consists of interbedded shale and limestone and some sandstone. The Douglas group consists of about 350 feet of shale, sandstone, limestone, and red beds. The Lansing group comprises about 400 feet of shale and minor amounts of sandstone and limestone. The sandstone yields oil and gas. The Kansas City group consists largely of shale and sandstone and some limestone. It averages about 200 feet in thickness. Sandstone beds in the upper part of this group are known as the "Layton sand." In the northern part of the county the Kansas City group is composed largely of gray limestone. Various beds in this group yield oil and gas. The "Layton sand" especially is of considerable importance as a reservoir rock.

The thickness of the combined Bronson, Bourbon, and Marmaton groups in Cowley County is about 300 feet. This part of the section is thickest in the southeastern part of the county. Shale, sandstone, and relatively thin beds of limestone are included. Oil and gas are produced from numerous zones between the Lansing and Cherokee rocks. The Cherokee shale ranges in thickness from slightly less than 300 feet in the eastern part of Cowley County to about 115 feet in the northwestern part (Bass, 1929). Local variations in thickness are common. The Cherokee shale is thin above the granite ridge, in the Dexter anticline, and locally above other structural highs in pre-Pennsylvanian rocks. The Cherokee is composed of shale, sandstone, and a few thin beds of limestone. Coal is frequently found associated with sandstone. Sandstone beds in the Cherokee are important oil and gas bearing zones. Studies by Bass and others (1937) indicate that the "Burbank" and "Bartlesville" sandstones are zones composed of numerous lenses of sandstone which occur within narrow trends in the Cherokee shale. The "Burbank sand" lies 50 to 100 feet above the "Bartlesville sand." Shoestring sand bodies in the lower part of the Cherokee shale in Cowley County are called "Bartlesville sand" by geologists and drillers. The "chat," consisting of weathered fragments of chert, lies on Mississippian rocks.

Mississippian rocks.—Mississippian rocks in Cowley County range in total thickness from 225 to 450 feet; they consist chiefly of limestone. Thinning of Mississippian beds in structural highs and thickening of the beds in structural lows in the county have been

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pointed out by Bass (1929) and by Lee (1939). There is a close relation between thinning of Mississippian rocks and occurrence of oil and gas in anticlines. Oil occurs in Mississippian limestones in porous zones most of which are in the upper 100 feet. Oil is produced in the Mississippian rocks in the Dexter, Geuda Springs, and Murphy pools.

The Chattanooga shale underlies the Mississippian limestones. Locally the Chattanooga was removed by erosion before deposition of younger rocks. Its maximum thickness in Cowley County is about 200 feet.

Ordovician and Cambrian rocks.—Undifferentiated Ordovician and Cambrian rocks, known as the Arbuckle limestone, underlie the Chattanooga shale (or the Mississippian limestone where the Chattanooga is absent) in all of Cowley County except a small area in the northwestern and southwestern corners where rocks of the Simpson formation underlie the Chattanooga. Many wells have penetrated several hundred feet of strata below the Mississippian rocks. The Arbuckle rocks consist of alternating beds of thick limestone and shale. Well records indicate that the maximum thickness of these Ordovician and Cambrian rocks in Cowley County is more than 1,000 feet. Oil and gas are produced from a porous zone near the top of the Arbuckle rocks.

Keroher and Kirby (1948, figs. 3, 6, 8, 9) indicate that (1) the Jefferson City-Cotter sequence in Cowley County ranges in thickness from about 450 to more than 650 feet, increasing from the northeast to the southwest; (2) the Roubidoux dolomite's thickness range is from slightly less than 100 feet in the northern part to about 150 feet in the southwestern part of the county; (3) the Van Buren-Gasconade sequence ranges from slightly more than 100 to more than 200 feet in thickness, increasing toward the southwest; (4) the Bonneterre dolomite is not present in the northern and western parts of the county, and has a maximum thickness in the county of about 50 feet in the southeast part. It is believed that the Van Buren-Gasconade dolomite lies on Pre-Cambrian rocks in the northern and western parts of Cowley County and that the Bonneterre dolomite is the first formation above the basement rocks in the eastern and southern parts. Bass (1929, p. 25) reported Pre-Cambrian rocks at a depth of 4,545 feet in sec. 9, T. 35 S., R. 6 E.; at 4,005 feet in sec. 18, T. 33 S., R. 7 E.; and at 3,420 feet in sec. 36, T. 31 S., R. 2 E.

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Oil and Gas Developments

Oil and gas wells are widely distributed in Cowley County, but most of the producing pools are in the western half (Fig. 28). Much of the oil and gas in the county occurs in structural highs, although some of the most pronounced structures are barren. Gas is produced from a shallow sand in the lower part of the Permian, from sandstones in the Kansas City and Lansing groups, from shoestring sand bodies in the Cherokee shale locally called "Bartlesville," from some porous zones in the upper part of the Mississippian limestone, and from porous zones in the upper Ordovician limestones. The Graham No. 1 well in the NE¼ sec. 9, T. 33 S., R. 3 E., which was completed in July 1924 and had an initial production of 900 barrels per day, was the first commercial producer from the Ordovician ("siliceous") limestone in the county.

Gas was discovered in the **Arkansas City** area in 1906. Much gas was produced from a sandstone in the Admire shale encountered at depths ranging from 650 to 850 feet. Some of the gas wells in this area had a maximum open flow of about 8 million cubic feet of gas a day. These wells were abandoned in 1920. Gas has also been produced southeast of Arkansas City in sec. 4, T. 35 S., R. 4 E. from a sandstone in the Kansas City group.

In 1952 the **Arkansas City West** field was opened in T. 34 S., R. 3 E. Initial daily production from "Bartlesville sand" was rated at 58 barrels of oil. The **Baird** pool, in T. 34 S., R. 3 E., produces oil from the "Bartlesville sand." The **Baird East** pool, also in T. 34 S., R. 3 E., was discovered in 1940. Production is from the "Bartlesville sand." The depth to the "Bartlesville" in this area is about 3,200 feet. A well in T. 35 S., R. 4 E., opened the **Bergkamp,** a "Bartlesville sand" pool, in 1952. Production of 74 barrels of oil per day was reported from a zone between 3,202 and 3,225 feet. Another "Bartlesville sand" pool, the **Bergkamp Northwest,** was discovered in T. 35 S., R. 4 E. in 1952. The producing formation lies between 3,208 and 3,211 feet; initial production of the discovery well was reported to be 25 barrels of oil per day.

The **Biddle** field is in T. 32 S., Rs. 4 and 5 E. Oil production is from the "Stalnaker sand" at about 2,300 feet and from limestone in the Kansas City group at about 2,000 feet. Small amounts of gas have been produced in this field from the Admire shale at a depth of about 600 feet. In T. 31 S., R. 5 E. the **Bogner** pool, in Mississip-

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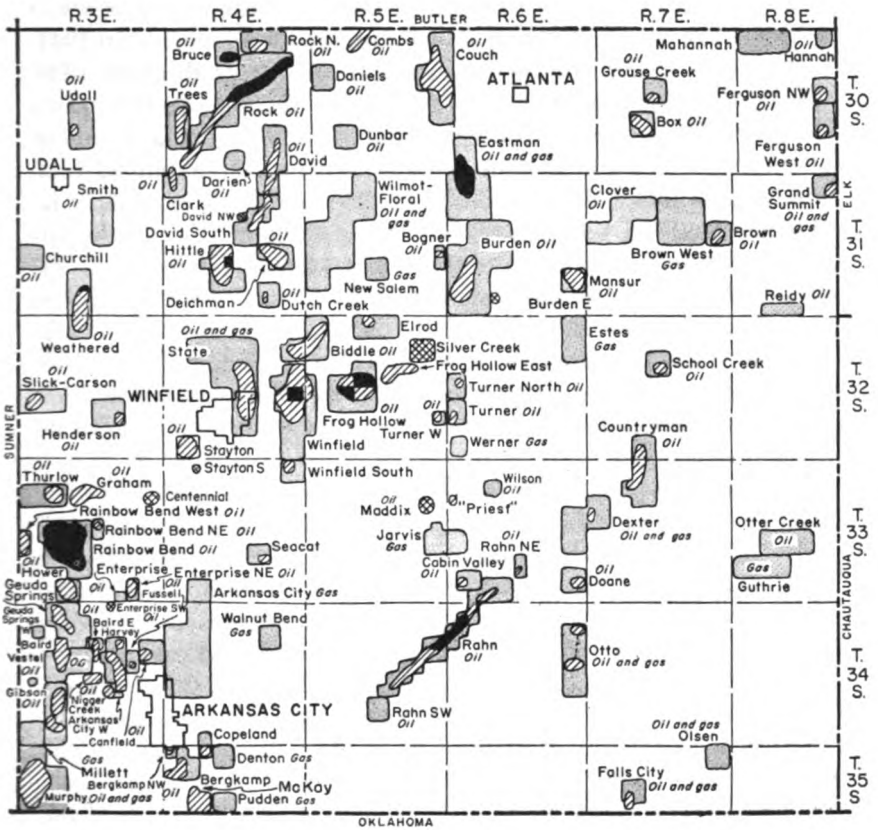

FIG. 28.—Map of Cowley County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black; crossed lines show 1953 pool discoveries.

pian limestone between 2,999 and 3,053 feet, was discovered in 1952. Initial production of 25 barrels of oil per day was reported. The **Box** field was opened in 1948 when Mississippian limestone production was found in T. 30 S., R. 7 E. The producing zone in the discovery well is at 2,842 feet. The top of Mississippian limestone was logged at 2,840 feet. The **Brown** pool, in T. 31 S., R. 7 E., was discovered in 1922. Some wells produce oil from a limestone in the Kansas City group and others produce gas from the same zone. The **Brown West** gas field was opened in 1951 in T. 31 S., R. 7 E. Daily production of 2 million cubic feet of gas was found in sandstone in the Douglas group from 1,568 to 1,600 feet.

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In 1950 oil production from the Arbuckle limestone was revived in the **Bruce** field in T. 30 S., R. 4 E., originally discovered in 1941. Initial daily production of 40 barrels of oil was established. The **Burden** oil pool was discovered in 1926 in T. 31 S., R. 6 E. Production is from the "Bartlesville sand" which lies at a depth of about 2,800 feet and has an average thickness of about 35 feet. The **Burden East** field was opened in 1953 in T. 31 S., R. 6 E. The "Layton sand" in the Kansas City group contains the newly discovered oil pool at a depth of 2,194 feet. Initial production of 80 barrels of oil per day was assigned. The **Cabin Valley,** a "Layton sand" pool, between 2,188 and 2,197 feet, was found in 1952 in T. 33 S., R. 6 E. The discovery well was rated as having 25 barrels of oil per day production. Later in the year the "Layton sand" at 2,651 feet was reported as a new producing zone with production of 40 barrels of oil daily.

The **Canfield** pool, in "Bartlesville sand" between 3,375 and 3,379 feet, was found in 1952 in T. 34 S., R. 3 E. The daily production of the well was rated at 13 barrels of oil. The **Centennial** pool, a "Bartlesville" pool, was found in 1953 in T. 33 S., R. 3 E. Initial daily production of 25 barrels of oil per day comes from a zone between 3,231 and 3,265 feet. The **Churchill** oil field extends from Sumner County into Cowley County in T. 31 S., R. 3 E. Oil occurs in "Stalnaker sand" in the upper part of the Lansing group. The Cowley County part of the field is abandoned. The depth to the pay zone ranges from about 1,950 to 1,980 feet. One well, drilled in 1927, had an initial daily production of 125 barrels of oil.

The **Clark** pool, discovered in 1914 in T. 31 S., R. 4 E., produces from the "Bartlesville sand," which averages about 15 feet in thickness and is about 2,800 feet below the surface. The **Clover** pool in T. 31 S., R. 7 E. produced oil from Kansas City and Mississippian rocks at depths of 2,200 and 2,800 feet, respectively. The **Combs** field was opened in 1945 in T. 30 S., R. 5 E. "Bartlesville sand" production of 50 barrels of oil per day was found at about 2,828 feet. A well in T. 35 S., R. 4 E. discovered the **Copeland** pool in 1952. Production is from Mississippian limestone in a zone between 3,211 and 3,224 feet.

The **Couch** pool, in T. 30 S., R. 5 E., was discovered in 1940. Oil production is from the "Bartlesville sand" at a depth of about 2,800 feet. In the **Countryman** pool, in Ts. 32 and 33 S., R. 7 E., production is from the "Layton sand," which is encountered at a depth of

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about 1,950 feet and is 12 feet thick. The abandoned **Daniels** oil field is in T. 30 S., R. 5 E. Probably the first oil well drilled in the field was a small producer completed in 1928 in the NW¼ sec. 18. At least two additional oil wells and several dry holes were drilled later. Oil occurs in the field in sandstone near the base of the Cherokee shale ranging in depth from 2,818 to 2,867 feet.

The **Darien** pool, discovered in 1939 in T. 30 S., R. 4 E., produced oil from the Arbuckle, which is about 3,300 feet below the surface. No production has been reported from this field since 1946. The **David** pool, in Ts. 30 and 31 S., R. 4 E. was discovered in 1935. Oil production is from the "Bartlesville sand" at a depth of about 2,900 feet. The **David Northwest,** a "Bartlesville sand" pool, was found in 1953 in T. 31 S., R. 4 E. Production was found at a depth of 2,930 feet in the discovery well, which had an initial daily potential of 50 barrels of oil. Oil was discovered in the **David South** field in T. 31 S., R. 4 E. in 1938. Production is from the Arbuckle dolomite at a depth of 3,463 feet and from the "Bartlesville sand" at a depth of about 3,000 feet.

Production data from the **Denton** field, T. 35 S., R. 4 E., are not available. Gas probably was produced from sandstone in the Douglas group at a depth of about 1,930 feet and from Mississippian "chat" at about 3,200 feet. The **Deichman** pool, in T. 31 S., R. 4 E., discovered in 1941, produces oil from the "Bartlesville sand" at a depth of about 2,800 feet. Shallow gas was discovered near **Dexter** in 1903 (Haworth and McFarland, 1905, p. 191). The shallow gas wells had open flows of 3 to 6 million cubic feet of gas and rock pressures of 110 pounds (Bass, 1929, p. 167). Oil was discovered in Cowley County near Dexter in 1914. The **Dexter** field, which had no production from 1949 to 1951, produced oil in 1952 from Mississippian limestone at a depth of 2,750 feet. The **Doane** pool, which produces from "Mississippi lime," was discovered in 1947. The initial daily production of the discovery well was reported as 25 barrels.

The **Dunbar** oil pool was discovered in 1938. In 1943 one well produced from Kansas City-Lansing rocks; the pool was abandoned in 1944. The **Dutch Creek** pool, in "Bartlesville sand" between 2,924 and 2,938 feet, was opened in 1952 in T. 31 S., R. 4 E. The daily potential was rated at 2 barrels of oil. The **Eastman** oil pool was discovered in January 1924. Large amounts of gas were produced with the oil during the first few years after discovery of the

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pool. One well is reported to have had an initial open flow of 35 million cubic feet. Production is from the "Bartlesville sand" at a depth of about 2,800 feet. The "Bartlesville" has a maximum thickness of 100 feet and is separated from the Mississippian limestone by about 100 feet of shale. The producing formation is a shoestring sand. Present production is by secondary recovery.

The **Elrod** field was revived in 1951 by the McNab and Duncan No. 1 Elrod well, sec. 4, T. 32 S., R. 5 E. Six barrels of oil and 6 barrels of water per day were reported from the "Layton sand" at a depth of 2,411 feet. The **Enterprise** field was opened in 1948 with a "Bartlesville sand" well in T. 33 S., R. 3 E. No production was reported in 1952. The **Enterprise Northeast** pool was found in "Bartlesville sand" between 3,335 and 3,347 feet in 1952 in T. 33 S., R. 3 E. Initial daily production was rated at 443 barrels of oil. The **Enterprise Southwest** field, in T. 34 S., R. 3 E., was opened in 1953 when "Bartlesville" production was found at a depth of 3,360 feet. Initial production of 42 barrels of oil per day was assigned. Gas has been produced in the **Estes** field, T. 32 S., R. 6 E., from sandstone that lies slightly lower than the base of the Kansas City section, at an average depth of about 2,500 feet.

Gas was discovered in the **Falls City** field in January 1916. The first well had an initial open flow of 7 million cubic feet of gas from a sandstone at a depth of 1,480 feet. The first oil well was drilled in January 1919. Oil is now produced from the "Stalnaker sand" at a depth of about 2,000 feet. The **Ferguson Northwest,** a Kansas City limestone pool, was discovered early in 1950 in T. 30 S., R. 8 E. Production is between 2,200 and 2,211 feet. An initial production of 45 barrels of oil per day was assigned in a producing test. The **Ferguson West** pool, in T. 30 S., R. 8 E., was discovered in 1934. Oil is produced from sandstones in the Bronson subgroup at depths of about 2,000 feet. The **Frog Hollow,** a "Bartlesville sand" pool at about 3,000 feet, was discovered in 1937 in T. 32 S., R. 5 E. Present productive acreage amounts to about 400 acres. The **Frog Hollow East** pool, in T. 32 S., R. 5 E., was discovered in 1941. Oil production is from the "Bartlesville sand" at a depth of about 3,000 feet.

In the **Fussell** pool, discovered in 1952 in T. 34 S., R. 3 E., the producing zone is in "Bartlesville sand" between 3,348 and 3,360 feet. Initial daily production of the discovery well was rated at 50 barrels of oil. A new producing zone, in Kansas City rocks between

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2,839 and 2,845 feet, was announced in the **Fussell** field early in 1953. The **Geuda Springs** pool, discovered in 1936, produces from the "Bartlesville sand." The pool is in T. 34 S., R. 3 E. A small oil well, completed in 1945, in sec. 7, T. 34 S., R. 3 E., is regarded as the discovery well in the **Geuda Springs West** oil field, although in 1925 a well that was abandoned found a daily potential of 10 barrels of oil in basal Pennsylvanian sediments at a depth of 3,378 feet. The field is now abandoned.

The **Gibson** pool, discovered in 1941 in T. 34 S., R. 3 E., produces oil from the "Bartlesville sand" at a depth of about 3,300 feet. The **Gibson South,** a "Bartlesville sand" field, was opened in 1952 in T. 34 S., R. 3 E. Initial daily production of 80 barrels of oil was found between 3,383 and 3,388 feet. Later in the year a well found production in Mississippian rocks between 3,400 and 3,412 feet. The field is now combined with the **Gibson.** The **Graham** oil pool was discovered in T. 33 S., R. 3 E. in 1924 when a well was drilled to the Arbuckle at a depth of 3,518 feet. This well had an initial daily production of 1,000 barrels. By the end of 1925, 38 wells had been drilled in the field; 21 were producing from the Arbuckle, 12 were producing from the "Layton sand," and 4 were dry holes.

In the **Grand Summit** field, discovered in 1926, gas was found at a depth of about 1,800 feet in the upper part of the Kansas City rocks, and oil was found about 200 feet lower, also in the Kansas City group. The wells had initial daily productions of about 5 million cubic feet of gas and about 25 barrels of oil. No gas is now being produced. The **Grouse Creek** oil pool, which produces from Mississippian rocks at 2,890 to 2,917 feet, was discovered in 1951 in T. 30 S., R. 7 E. An initial daily potential of 15 barrels of oil was assigned the discovery well. A small gas well, drilled in 1936 in T. 33 S., R. 8 E., probably was the discovery well of the **Guthrie** gas pool. Gas occurs there in a zone between 2,285 and 2,316 feet, in rocks in the lower part of the Kansas City group, or in the upper part of the Desmoinesian section.

A well in T. 34 S., R. 3 E. in 1952 opened the **Harvey** pool, in "Bartlesville sand" from 3,278 to 3,296 feet. The initial daily production of the discovery well was rated at 2,382 barrels of oil. The discovery well of the **Harvey Northwest** pool, T. 34 S., R. 3 E. was a maximum well (3,000 barrels of oil daily). The pool has been combined with the **Harvey.** The "Bartlesville sand" is between 3,298 and 3,318 feet. In the **Henderson** field, in T. 32 S., R. 3 E.,

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oil was discovered in 1942. Production is from the Kansas City limestone at a depth of about 2,690 feet and from the Arbuckle rocks at a depth of about 3,419 feet. The **Hittle** has been one of Cowley County's most prolific oil fields. Probably the Trees Oil Company No. 1 Hittle well, sec. 21, T. 31 S., R. 4 E., drilled in 1926, is the discovery well of the **Hittle** Kansas City pool. It was completed for 200 barrels of oil per day from a sandstone in the Kansas City group between 2,383 and 2,394 feet. The **Hittle** Arbuckle pool was discovered in 1928 but was not developed extensively until 10 years later. The oil pool is in the top of Arbuckle rocks, at about 3,300 feet.

The **Hower** pool, discovered in 1935, is in T. 33 S., R. 3 E. Production in this pool is from "Bartlesville sand" at about 3,320 feet. Gas formerly was produced in the **Jarvis** field, T. 33 S., Rs. 5 and 6 E., from shallow sandstone in lower Permian rocks. A "Bartlesville sand" pool, the **McKay,** was found in 1952 in T. 35 S., R. 4 E. The discovery well had an initial daily production of 138 barrels of oil. The reservoir lies between depths of 3,314 and 3,345 feet. In 1953 a well in T. 33 S., R. 5 E. opened the **Maddix** pool in Mississippian limestone at a depth of 3,084 feet. Initial daily production of 8 barrels of oil was reported.

The **Mahannah** pool, in T. 30 S., R. 8 E., discovered in 1918, produced from the "Burgess sand" at a depth of about 2,730 feet. The pool was abandoned in 1945. The **Mansur** oil and gas field was opened in 1949 in T. 31 S., R. 6 E. Gas was found in the "Layton sand" at 2,170 feet and in limestone in the Kansas City group at 2,470 feet. Initial daily gas production was reported as 1,180 thousand cubic feet. Two oil wells were drilled the same year and also produced from the "Layton" at 2,170 feet. Gas has been produced in the **Millett** field, T. 34 S., R. 3 E., from sandstone in the Wabaunsee group at a depth of about 1,530 feet. The **Murphy** pool, in T. 35 S., R. 3 E., was discovered in 1933. The oil is produced from the "chat" at the top of the Mississippian limestone at an average depth of 3,300 feet.

The **New Salem** gas pool, discovered in 1949 in T. 31 S., R. 5 E., found gas in the "Layton sand" between 2.295 and 2,309 feet. Initial daily production was reported as 1,500 thousand cubic feet. The **Nigger Creek,** a "Bartlesville" pool was discovered in 1951 in T. 34 S., R. 3 E. The initial daily production of the discovery well was 35 barrels of oil. The producing zone is between 3,281 and

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3,302 feet. Oil was discovered in the **Olsen** field in T. 35 S., R. 7 E. in 1922. Initial productions between 50 and 75 barrels a day were obtained from a sandstone in the Marmaton group at a depth of about 2,375 feet. Some wells produced as much as 18 million cubic feet of gas from a sandstone in the Lansing group at a depth of about 1,700 feet. No production has been reported since 1946.

The **Otter Creek** pool, in T. 33 S., R. 8 E., was discovered in 1943. Production is from Kansas City-Lansing rocks. Oil in the **Otto** oil and gas field was found in T. 34 S., R. 6 E., in the "chat" at a depth of 3,017 feet. Gas was found in several wells at depths ranging from about 1,100 to 1,450 feet. Some of the gas contains helium. Oil production was reported in 1952 from one well in the **"Priest"** field (Priest lease), sec. 7, T. 33 S., R. 6 E. Production probably came from Mississippian limestone at a depth of about 3,075 feet. The **Pudden** field, T. 35 S., R. 4 E., probably produced gas from sandstones in the lower part of the Shawnee group and in the Douglas group.

The **Rahn** pool, discovered in 1939, is in T. 34 S., Rs. 5 and 6 E. Production is from the "Bartlesville sand," which is about 30 feet thick and about 2,900 feet below the surface. The producing sandstone is a shoestring more than 2 miles in length and less than a quarter of a mile in width. The **Rahn Northeast** pool, in the "Bartlesville" in a zone from 2,902 to 2,934 feet, was discovered in T. 33 S., R. 6 E. in 1949. Initial daily potential was rated at 120 barrels of oil. The **Rahn Southwest** pool was discovered in 1944 in T. 34 S., R. 5 E. Production is from the "Bartlesville sand" which is 52 feet thick and occurs about 3,019 feet below the surface.

The **Rainbow Bend** field was discovered by a well drilled on the Johnson farm, in sec. 20, T. 33 S., R. 3 E. in December 1923. It came in as a flowing well having an initial production of about 337 barrels per day. Production is from the "Burgess sand" in the basal part of the Cherokee shale. The "Burgess" ranges in thickness from 5 to 35 feet and lies at a depth of about 3,200 feet. The producing sand occurs in a structural high which conforms generally with the structure of the underlying Mississippian limestone. The Mississippian limestone is about 100 feet thinner on the axis of the fold than on the flanks. In 1952 the pool had 100 producing oil wells and the production was 155,038 barrels. The **Rainbow Bend Northeast** field was opened in 1945 in T. 33 S., R. 3 E. Production is from the "Bartlesville sand." The **Rainbow Bend West** field, a

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westward extension of the **Rainbow Bend** field, produces from the "Burgess sand" and from the Arbuckle dolomite at a depth of about 3,500 feet.

The **Reidy** pool, in T. 31 S., R. 8 E., was abandoned in 1943. Production was from a limestone in the Kansas City group. The **Rock** oil pool, in T. 30 S., R. 4 E., was discovered in 1937. Production is from the "Bartlesville sand," which is about 45 feet thick and about 2,800 feet below the surface. The **Rock North** pool, in T. 30 S., R. 4 E., was discovered in 1937. Oil production is from the "Bartlesville sand" at a depth of about 2,800 feet. The **School Creek** pool, which produces oil from the "Bartlesville sand," was found in 1947. The initial daily production of the discovery well was reported as 20 barrels. The **Seacat** pool was discovered in 1945. Production is from the "Mississippi lime." A well drilled in 1953 in T. 32 S., R. 5 E., opened the **Silver Creek** field. Production is from the "Bartlesville" sandstone at a depth of 3,006 feet. Initial production was 75 barrels of oil daily.

The **Slick-Carson** field, T. 32 S., R. 3 E., was discovered in 1925. Production is from the "Layton sand" in the upper part of the Kansas City group at a depth of about 2,700 feet and from the Arbuckle limestone at a depth of about 3,450 feet. The **Smith** pool, in T. 31 S., R. 3 E., was discovered in 1917. Production is from the "Bartlesville sand" at an average depth of 3,000 feet. The discovery well of the **State** field, in T. 32 S., R. 4 E., drilled in 1926, had an initial production of nearly 12,000 barrels of oil per day from the Arbuckle limestone at a depth of 3,500 feet (Bass, 1929, p. 142). Most of the production in this field is from the Arbuckle, but several wells produce oil from the "Layton sand" at a depth of about 2,300 feet.

The discovery well of the **Stayton** oil pool was drilled in T. 32 S., R. 4 E., in 1949. Production was found in the "Bartlesville sand" at 3,122 feet. The **Stayton South,** a "Bartlesville" sandstone pool at 3,165 feet, was discovered in 1953 in T. 33 S., R. 4 E. Initial daily production of the discovery well was reported to be 234 barrels of oil. Oil production was revived in the **Thurlow** field, T. 33 S., R. 3 E., in 1949. The field was opened in 1927 by a well drilled in sec. 7. Oil production is from a Simpson sand ("Wilcox") at a depth of about 3,480 feet. The largest well in the field had an initial production of about 480 barrels of oil per day. This is regarded as a stratigraphic trap pool on the flank of the Chautauqua arch, where about 40 feet of Chattanooga shale lies on beveled

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Simpson beds. The **Trees** pool, in T. 30 S., R. 4 E., discovered in 1934, produces from the "Bartlesville sand" at a depth of about 2,975 feet. It is about 25 feet thick.

The **Turner** pool was discovered in 1937 in T. 32 S., R. 6 E. Production is from the "Layton sand" at a depth of about 2,332 feet. The **Turner North** field was opened in 1948 with a "Layton sand" well in T. 32 S., R. 6 E. Initial production was reported as 15 barrels of oil per day. The **Turner West,** a Mississippian limestone pool, at a depth of 3,054 feet, was discovered in T. 32 S., R. 5 E. in 1952. The initial daily production of the well was 16 barrels of oil.

The **Udall** oil field was opened in 1926, when a domal structure that lies on the axis of the Nemaha anticline was drilled. The field is in T. 30 S., R. 3 E. The first well found oil at 1,850 feet in sandstone in the upper part of the Douglas group. A little later another well in the field found a second pool in the "Stalnaker sand" at 2,050 feet. Some oil has been found in the same area in sandstone near the base of the Cherokee section and shows of oil were reported from Mississippian "chat." The **Vestal** gas pool, T. 34 S., R. 3 E., was discovered in 1931. The gas occurs in Wabaunsee rocks at a depth of about 1,475 feet. A gas well rated at 2,300 thousand cubic feet of gas per day, drilled in sec. 11, T. 34 S., R. 4 E. in 1940, probably was the discovery well in the **Walnut Bend** gas field. Gas occurs chiefly in Mississippian "chat" at a depth of 3,080 feet. Some gas was encountered at 600 feet and at 2,776 feet.

Oil was discovered in 1935 in the **Weathered** field, Ts. 31 and 32 S., R. 3 E. Production is from Arbuckle limestone, Mississippian limestone, Lansing-Kansas City, and "Stalnaker sand." Gas was found in the **Werner** field, T. 32 S., R. 6 E., in 1928. The discovery well was rated at more than 2 million cubic feet of gas per day. In 1936 a second gas well, rated at 3 million cubic feet per day, was put down. Gas occurs in sandstone, probably in the lower part of the Douglas group, at a depth of about 1,860 feet. The log of the larger gas well, which was deepened to 3,190 feet, shows free oil in Mississippian "chat" between 3,079 and 3,084 feet, and 10-foot coal beds at 3,025 and 3,050 feet. The **Wilmot-Floral** field has not reported production since 1948.

The discovery well of the **Wilson** oil field, T. 33 S., R. 6 E., was drilled in 1938. Oil occurs there in the Arbuckle limestone at a depth of about 3,520 feet. The largest well reported in the field was a flowing well with initial daily production of 1,368 barrels of

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oil completed in 1939. No production in the field has been reported for several years.

The **Winfield** oil pool was found in 1914. Haworth (1903, pp. 37-38) reported that gas was discovered about a quarter of a mile east of Winfield in 1902. In the **Winfield** field, which comprises 5,000 acres, oil is produced from a sandstone in the Admire group at a depth of about 600 feet, from the "Peacock sand" at about 1,400 feet, from the "Layton sand" at about 2,300 feet, from the "Bartlesville sand" at about 3,050 feet, and from the Arbuckle limestone at about 3,300 feet (Ver Wiebe, 1943a, p. 351). Much gas is produced from the "Peacock sand." The **Winfield South** pool was discovered in 1945 in T. 33 S., R. 4 E. Oil production is from the "Hoover sand."

Recent discoveries.—In the past few years Cowley County has become outstanding in eastern Kansas for new oil and gas discoveries. In 1949 four new pools were discovered, in 1950 there was one discovery and one revival, in 1951 four discoveries and

TABLE 23.—*Data on dry wildcat wells drilled in Cowley County, 1949 through 1952*

Company and farm	Location	Depth to Kansas City, feet	Depth to Mississippian, feet	Depth to Arbuckle, feet	Total depth, feet
	1949 Well				
H. D. Amos & Thrifty Drlg. Co. No. 1 Wilson	NE NE NW 16-30-6E	2,206	2,906	.....	2,926
	1950 Wells				
Wakefield and Ross No. 1 McKay	SE SW NE 1-30-3E	2,223	2,814	3,193	3,214
Ann Parker No. 1 Kruger	SW SE NW 6-30-3E	2,538	3,063	3,416	3,468
Wood River Oil & Refg. Co. No. 1 Kropp	SW SE SW 26-30-3E	2,464	3,043	3,407	3,433
Buffalo Oil Co. et al. No. 1 Groene-Rahn	NW NW SE 1-32-3E	2,428	3,026	3,360	3,380
S. Cooper et al. No. 1 Ogilbee	SW NE NE 7-32-4E	.....	.....	.....	2,032
Saco Oil Co. et al. No. 1 Webb	NE NW SE 9-34-8E	.....	.....	.....	2,445
Barbara Oil & Gas Co. No. 1 Bell	SW NE NE 20-34-8E	.....	2,768	.....	2,780
	1951 Wells				
E. H. Adair Oil Co. No. 1 Joy	NE NE SE 10-30-3E	.....	.....	.....	2,372

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Taylor, R. W. Holcomb & Murfin No. 1 Hulme	E½ SE NW 14-30-6E	2,205	2,900	.....	2,915
Palmer Oil Corp. No. 1 McEwen	NE SE NW 35-30-6E	2,195	2,952	.....	3,007
E. M. Wahlenmarie No. 1 Wahlenmarie	NE SE SW 24-34-4E	.....	3,346	.....	3,355
Carter Oil Co. No. 1 Warren	NW SW NW NE 4-35-5E	2,635	3,131	.....	3,181
Carter Oil Co. No. 1 Winchell	SW SW NE 6-35-5E	2,671	3,201	.....	3,213
Watson Drlg. Co. No. 1 Coburn	NW SE NW 8-35-5E	2,540	3,056	.....	3,060
Flynn Oil Co. No. 1 Warren	NE NE NE 15-35-5E	.....	3,140	.....	3,177
	1952 Wells				
The Palmer Oil Corp. No. 1 Williams	NE NE SW 14-30-3E	2,464	3,093	.....	3,186
White & Ellis Drlg. Co. No. 1 Snodgrass	NE NE NE 36-30-6E	2,170	2,972	.....	3,045
White & Ellis Drlg. Co. No. 2 Snodgrass	NW SW NE 36-30-6E	.....	2,884	.....	2,917
Beaumont Petro. Co. No. 1 Riding	NW NW NW 3-30-7E	2,137	2,889	.....	2,955
H. J. Uhl No. 1 Schoup	SW SW NW 21-31-3E	2,528	3,105	.....	3,155
The Palmer Oil Corp. No. 2 Bogner	SE SW NE 24-31-3E	2,308	3,020	.....	3,498
Laura Jane Oil Co., Inc. No. 1 Hammil	S½ SE SW 19-31-4E	2,410	2,958	.....	2,965
Earl F. Wakefield No. 1 Bernstorf	SW NW SW 33-31-4E	2,496	3,024	.....	3,033
Hill & Hill No. 1 Ireton	SW SW NE 11-32-3E	2,554	3,086	.....	3,415
Earl F. Wakefield No. 1 Weigle	NW NE NE 7-32-6E	2,452	3,147	.....	3,180
Russell Cobb No. 1 Kroth	SE SW NE 12-33-3E	2,785	3,231	.....	3,268
Time Petro. Co. No. 1 Murat	NW NW NE 25-33-3E	2,801	3,337	.....	3,353
Russell Cobb No. 1 Thompson	SE SW SE 17-33-4E	2,708	3,233	.....	3,244
Martin & Cash Drlg. Co. No. 1 Collinson	NE NE SW 21-33-4E	.....	3,164	.....	3,177
Earl F. Wakefield No. 1 Morris	SE SE SE 33-33-4E	2,683	3,249	.....	3,285
Watson Drlg. Co., Inc. No. 1 Jarvis Ranch	NW Lot 8 7-34-8E	2,115	2,694	.....	2,714
Aladdin Petro. Corp. No. 1 Marshall	SE NE NW 2-35-3E	2,815	3,413	.....	3,465
Aylward Drlg. Co. No. 1 Brandenburg	SE NE SW 3-25-3E	2,829	3,428	.....	3,455
Aladdin Petro. Corp. No. 1 Tudhope	NW NW SE 11-35-3E	2,835	3,424	.....	3,474

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one revival, in 1952, 14 discoveries, and during the first half of 1953, 7 discoveries. These are discussed in detail above. Five of the new pools are Mississippian pools. The others derive oil from Pennsylvanian rocks. In addition, 35 dry wildcat wells were drilled from 1949 through 1952.

Most of the new wells in Cowley County are being completed by rock fracturing methods. It is expectable that the number of successful completions in 1953 will greatly exceed those of any recent previous year.

The new pools are listed in Table 1. Data on dry wildcats are given in Table 23. Production for the Cowley County oil fields for 1949 through 1952 and summary of pool wells drilled are given in Table 73.

CRAWFORD COUNTY

There are several small oil and gas pools in the western part of Crawford County. Oil and gas are produced from the "Bartlesville sand" which ranges in depth from 300 feet in the southwestern part of the county to 600 feet in the northwestern part. Oil was discovered in the northwestern part of Crawford County in 1917. Gas has been produced for many years in the vicinities of Walnut, Monmouth, and McCune.

Crawford County produced 47,097 barrels of oil in 1952. Natural gas production during the year was 29,270 thousand cubic feet. The amount of early oil production in the county is unrecorded; production figures for the years 1941 to 1948 inclusive are given in Table 3. Production in the various fields in Crawford County for 1949 through 1952 is given in Table 13.

Three reported water-flooding projects are operating in Crawford County (Fig. 2, Table 4). Figure 29 shows the locations of oil and gas fields in Crawford County as they have been defined by the Kansas Nomenclature Committee. Areas of 1952 oil production are indicated on the figure.

Geology

SURFACE ROCKS

The consolidated rocks exposed in Crawford County belong to the Pennsylvanian System. They consist of alternating beds of

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limestone and shale, about 15 beds of coal, and several beds of sandstone. The rocks have an average westerly dip of about 12 feet per mile. The Hertha limestone or a few feet of the overlying Ladore shale, which crops out in the extreme northwestern part of the county, is the youngest consolidated rock in Crawford County. The Cherokee shale which crops out in the southeastern part of the county is the oldest exposed rock.

The Pleasanton shale (Fig. 5) is exposed in the northwestern part of Crawford County. It consists of about 75 feet of shale, some very thin limestone, and a sandstone 3 or 4 feet thick in the basal part. Marmaton rocks are exposed in Crawford County and are about 250 feet thick. Shale ranging in color from light gray through bluish and dark gray to black is the predominant rock of the Cherokee shale (Fig. 6). It is clayey, silty, micaceous, sandy, or carbonaceous. There are several sandstones, a few thin limestones, and 15 or more beds of coal. Measured thicknesses of the Cherokee shale in Crawford County range from 316 to 455 feet.

SUBSURFACE ROCKS

Depths at which some stratigraphic horizons were reached in the LaSalle Oil Company No. 1 Gobl well, in the SE¼ NW¼ sec. 20, T. 28 S., R. 25 E., Crawford County, are given in Table 24.

TABLE 24.—*Depths to some key horizons in the La Salle Oil Company No. 1 J. Gobl well, SE¼ NW¼ sec. 20, T. 28 S., R. 25 E., Crawford County*

Horizon	Depth, feet
Top "Warsaw" limestone	350
Top Burlington-Keokuk limestone	425
Top Reeds Spring-St. Joe limestone	550
Top Northview shale	660
Top Compton limestone	705
Top Cotter-Jefferson City dolomite	725
Top Roubidoux formation	970
Top Gasconade-Van Buren formation	1,135
Top Gunter sandstone member	1,330
Top Eminence dolomite	1,340
Top Bonneterre dolomite	1,512
Top Lamotte sandstone	1,700
Top Pre-Cambrian granite	1,838
Total depth	1,862

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Mississippian rocks.—The Mississippian rocks in Crawford County are composed of limestone, some of which is flinty, and shale. The "Warsaw," Burlington-Keokuk, Reeds Spring, and St. Joe limestones, the Northview shale, and the Compton limestone are formations that have been identified. The Chattanooga shale, which commonly lies at the base of the Mississippian, is very thin or is locally absent in the county. Mississippian rocks range in thickness from 300 to 400 feet. They lie unconformably on Ordovician rocks.

Ordovician rocks.—Silurian, Devonian, and the upper part of Ordovician rocks are absent in Crawford County, but deep wells have penetrated a thick section of interbedded limestone and sandstone of Ordovician age. The formations of the Ordovician present in the county are the Cotter dolomite, the Jefferson City dolomite, the Roubidoux sandstone, and the Gasconade-Van Buren dolomites, including the Gunter sandstone. The Cotter dolomite is absent in the eastern part. The total thickness of Ordovician rocks ranges from about 685 feet in the northeastern part of the county, where the Cotter is absent, to 800 feet in the southwestern part, where the Cotter is about 100 feet thick. The Roubidoux sandstone has an average thickness of about 175 feet and is an important fresh water-bearing sandstone.

Cambrian rocks.—Cambrian rocks have a total thickness of about 430 feet in the northeastern part of Crawford County and about 340 feet in the southwestern part. Cambrian formations identified are the Eminence and Bonneterre dolomites and the Lamotte sandstone.

Pre-Cambrian rocks.—Cuttings from wells that have penetrated Pre-Cambrian rocks in Crawford County seem to consist of hard red unaltered granite. The average depth to Pre-Cambrian rocks is about 2,000 feet.

Oil and Gas Developments

Many oil and gas wells have been drilled in Crawford County over a period of 50 or more years. Gas has been found in sandstones in the Cherokee shale and in Mississippian "chat." All oil discoveries have been in sandstones in the Cherokee shale.

The abandoned **Brazilton** oil field, T. 28 S., R. 22 E., probably produced oil from the "Bartlesville sand." Plugging records of two old wells show total depths of 342 and 388 feet respectively. The **Fair Oak** oil pool, discovered many years ago, yields from the

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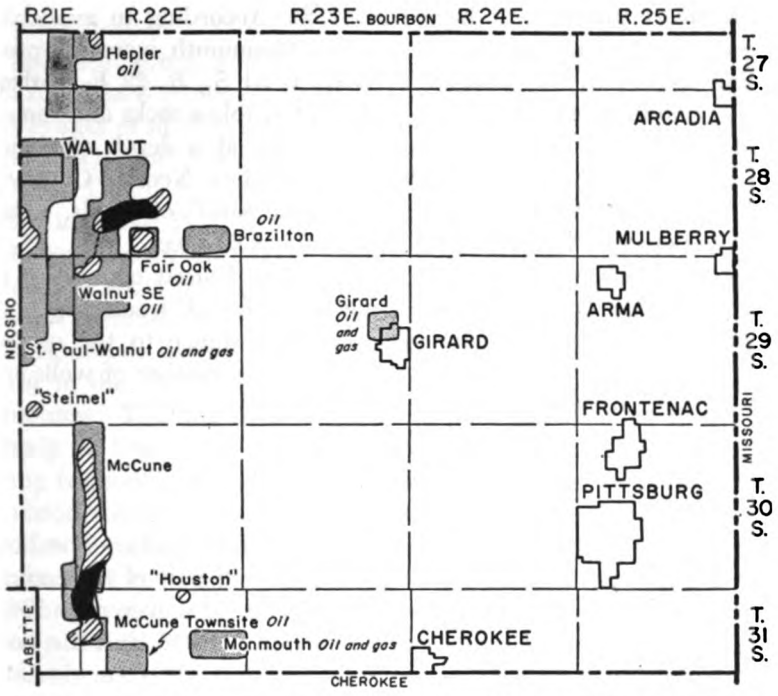

FIG. 29.—Map of Crawford County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

"Bartlesville sand" at a depth of about 385 feet. Gas and probably some oil were produced formerly in the **Girard** area, probably in sec. 14, T. 29 S., R. 23 E. Gas was discovered there on W. F. Higgie's land, on January 1, 1904, at a depth of 490 feet.

The **Hepler** oil field extends into the northwest part of Crawford County from Bourbon County. Oil occurs in the "Bartlesville sand" at about 600 feet. Oil is being produced on the **Houston** lease, sec. 3, T. 31 S., R. 22 E., from a sandstone in the Cherokee shale at a depth of about 200 feet. The **McCune** oil pool, discovered in 1932, produces from the "Bartlesville sand" at a depth of about 300 feet. Several hundred oil wells have been drilled in the field. Some had initial daily production records of 100 barrels of oil, but the rate of decline was rapid. A water-flooding project was operated in the field from September 1937 to August 1939. The cumulative oil production was reported as 862 barrels per acre. Another second-

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ary recovery project was begun in 1952. According to available records the **McCune Townsite** and the **Monmouth** were gas-producing areas. In the **Monmouth** field, T. 31 S., R. 22 E., rather small amounts of gas have been found in Cherokee rocks and somewhat larger amounts in Mississippian "chat" at a depth of about 350 feet. The **St. Paul-Walnut** (extending into Neosho County) and the **Walnut Southeast** are "Bartlesville sand" oil fields. The average depth to the producing zone is about 600 feet.

Recent developments.—As in other eastern Kansas counties it is expectable that newly developed methods of rock fracturing may become instrumental in bringing more importance to the oil industry in Crawford County. A relatively large number of wells are being drilled in 1953.

DICKINSON COUNTY

Oil has been found in four areas in Dickinson County. The Lost Springs field was extended into the southeastern part of the county several years ago and the Bonaccord pool was discovered in 1943. The Lost Springs North pool was discovered in 1945, and the Lost Springs Northeast in 1947.

The county produced 108,313 barrels of oil in 1952. Production in the county from 1943 to 1952 inclusive is shown in Table 3. Table 73 shows production in the four oil fields during the years 1949 to 1952 inclusive. Figure 30 shows locations of the oil fields in Dickinson County and of areas that produced oil in 1952.

Geology

SURFACE ROCKS

Cretaceous rocks crop out in a small area in the northwestern corner of Dickinson County. The consolidated bedrock at the surface in the remainder of the county is Permian in age. The exposed Permian section extends from the lower part of the Wellington shale of the Sumner group to the lower part of the Barneston limestone of the Chase group (Fig. 3). The valley of Smoky Hill River contains a rather thick fill of alluvium, and dune sand covers a few square miles a short distance west of Abilene on the north side of the river.

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SUBSURFACE ROCKS

Lee, Leatherock, and Botinelly (1948, pl. 14) have shown in detail subsurface geology as revealed by two Dickinson County wells: the Franks et al. No. 1 Huffman, sec. 11, T. 13 S., R. 1 E.; and the Empire Oil and Refining Company No. 1 Duffy, sec. 3, T. 12 S., R. 3 E. Depths to some stratigraphic horizons in the two wells are listed in Table 25.

Pennsylvanian rocks—The top of Pennsylvanian rocks in Dickinson County is about 600 feet below the base of the Barneston limestone. The Wabaunsee group, consisting chiefly of shale and relatively thin limestone beds, is about 350 feet thick. Lenticular sandstones occur in the basal part, lying on or a few feet above the Topeka limestone. The Shawnee group, about 350 feet thick, is composed largely of limestone, especially in the lower part. The Douglas group is about 100 feet thick in the county. One or more lenticular sandstone bodies occur in the Douglas section, which in some wells consists entirely of sandstone and in others entirely of shale. The thickness of the combined Lansing and Kansas City groups, which are composed chiefly of limestone, is about 375 feet. A rather persistent thin shale about 225 feet from the top of the Lansing group probably marks the top of the Kansas City group. The basal part of the Linn subgroup (base of the Kansas City group of some older

TABLE 25.—*Depths in feet to some stratigraphic horizons in two Dickinson County wells*

Horizon	The Empire Oil & Refining Co. No. 1 Duffy, NE SW SE sec. 3, T. 12 S., R. 3 E.	Fred Franks et al. No. 1 Huffman, NW NW SW¼ sec. 11, T. 13 S., R. 1 E.
Top Topeka limestone	1,090	.....
Base Oread limestone	1,420	.....
Top Lansing group	1,525	1,778
Base Kansas City group	1,910	2,124
Top Mississippian limestone	2,085	2,455
Top Kinderhookian rocks	2,245	.....
Top "Hunton" limestone	2,425	2,807
Top Maquoketa shale	2,715	.....
Top Viola limestone	2,750	3,048
Top Simpson formation	2,883	3,162
Top Arbuckle rocks	2,955	3,233
Total depth	2,980	3,262

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reports) is probably marked by a persistent zone of sandstone and conglomerate approximately 300 feet below the top of the Lansing group. The Pleasanton shale in Dickinson County is about 35 feet thick, and the Marmaton and Cherokee rocks range from about 60 to 150 feet in thickness. About 35 feet of shale which occurs locally above the Mississippian limestone is probably Cherokee shale.

Pennsylvanian rocks in Dickinson County overlap and overstep Mississippian limestone beds, as indicated by the thicker lower Pennsylvanian and Mississippian section in the western part of the county.

Mississippian rocks.—The Mississippian limestones in Dickinson County range from about 100 to 150 feet in total thickness. The Keokuk and Burlington limestones, Gilmore City limestone, and Sedalia dolomite have been identified (Lee, Leatherock, and Botinelly, 1948, pl. 14). They are underlain by about 150 feet of Chattanooga shale.

Pre-Chattanooga rocks.—About 165 feet of "Hunton" limestone seemingly underlies all of Dickinson County. The Maquoketa shale is about 75 feet thick in the county. It is underlain by about 100 feet of Viola limestone. About 90 feet of sandstone, gray and red shale, and limestone occur below the Viola limestone and above the Arbuckle rocks. These rocks comprise the Simpson group, and often are correlated with the St. Peter formation. It is probable, however, that the St. Peter sandstone comprises only the approximate lower half. The undifferentiated Arbuckle rocks in Dickinson County consist of about 250 feet of limestone and dolomite.

Oil Developments

An active drilling campaign took place in Dickinson County in 1919 and 1920 but all tests were unsuccessful. Later the **Lost Springs** field was extended from Marion County into southeastern Dickinson County. In 1943 the **Bonaccord** oil pool was discovered; the **Lost Springs North** pool was found in 1945; and the **Lost Springs Northeast** in 1947.

The **Bonaccord** oil field is in T. 14 S., R. 1 E. The discovery well, which was completed in 1943, had a daily potential production of 223 barrels of oil from the "Burgess sand," the top of which was encountered at 2,483 feet. Later two additional producing

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wells were drilled; smaller initial productions were reported for the later wells.

The **Lost Springs** oil field extends from Marion County into T. 16 S., R. 4 E., Dickinson County. Production is from the "chat" in the upper part of the Mississippian limestone. The **Lost Springs North** field, T. 16 S., R. 4 E., was discovered in 1945. Production is from

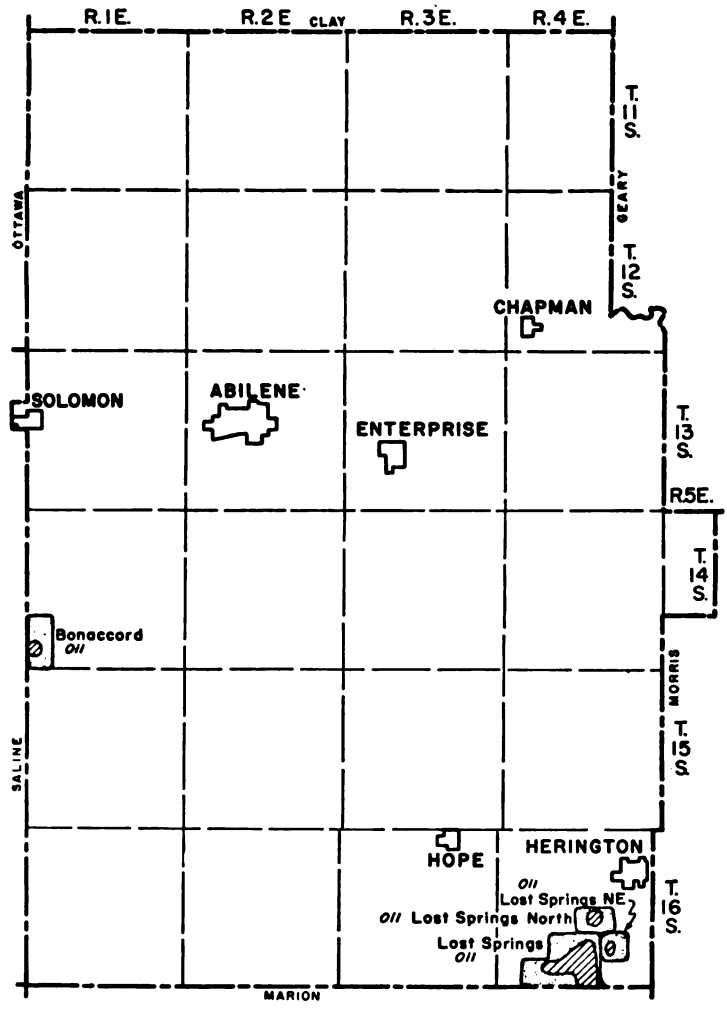

FIG. 30.—Map of Dickinson County showing oil pools as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production.

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TABLE 26.—*Data on dry wildcat wells drilled in Dickinson County, 1949 through 1952*

Company and farm	Location	Depth to Lansing, feet	Depth to Mississippian, feet	Depth to Simpson, feet	Depth to Arbuckle, feet	Total depth, feet
No wells reported in 1949						
		1950 Wells				
Frank Dieter No. 1 Bennett	SW SW NE 3-11-1E	.....	.....	.....	.....	545
Mouser Drlg. Co. No. 1 Langenecker	SW SW NW 34-12-2E	.....	2,293	3,040	3,093	3,112
Youker & Son No. 1 Larson	SW SW NW 16-16-3E	.....	2,552	3,030	3,083	3,100
		1951 Wells				
Broadbeck & Marts et al. No. 1 Marts	SW NW SE 28-11-3E	1,572	2,131	2,871	2,970	2,985
Continental Oil Co. No. 1 Rees	NE NW SW 6-14-2E	1,766	2,354	3,030	3,126	3,187
Nimrod Oil Co. et al. No. 1 Foster	NE NE NE 29-14-4E	1,671	2,204	.....	.....	2,253
Continental Oil Co. No. 1 Howie	SW SW NE 10-15-1E	1,839	2,473	3,159	3,245	3,292
Continental Oil Co. No. 1 Dougan	SW SE NE 20-16-1E	2,087	2,708	3,348	3,425	3,483
		1952 Well				
Sterling Drlg. Co. et al. No. 1 Hill	NW NE NW 34-14-3E	.....	2,292	.....	.....	2,365

the upper part of the Mississippian limestone or "chat." Two oil wells were drilled in 1945, one in 1946, and three in 1947. No later drilling has been reported in the field.

The most recent oil discovery in Dickinson County was in 1947 when the **Lost Springs Northeast** pool was found in T. 16 S., R. 4 E. Production is from the upper part of Mississippian limestone at a depth of 2,301 feet in the discovery well, whose initial daily production was rated at 100 barrels of oil.

Recent developments.—Nine dry wildcat wells have been drilled in Dickinson County from 1950 through 1952. No wildcat wells were reported in 1949. Data on these wells are listed in Table 26.

DONIPHAN COUNTY

Oil and gas in commercial quantities have not been found in Doniphan County. As in other northeastern Kansas counties, not

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enough wells have been drilled into deeper rocks to condemn the area.

Geology

SURFACE ROCKS

Glacial drift covers much of the surface of Doniphan County. All the consolidated rocks that are exposed or are present immediately below the drift are of Pennsylvanian age. The outcropping Pennsylvanian rocks in the county include beds from the Reading limestone in the Wabaunsee group to the upper part of the Lawrence shale in the Douglas group (Fig. 4). Their total thickness is about 630 feet.

SUBSURFACE ROCKS

Pennsylvanian rocks.—The Pennsylvanian section in the western part of Doniphan County is about 2,000 feet thick; in the eastern part, where the surface rocks are older, the total thickness of Pennsylvanian rocks is about 1,500 feet.

Mississippian rocks.—The total thickness of Mississippian limestone formations in Doniphan County ranges from about 250 feet in the northwestern corner to more than 300 feet in the southeastern part (Lee, 1939, pl. 1). According to Lee and Payne (1944, figs. 7, 17), the Ste. Genevieve limestone lies next below Pennsylvanian rocks throughout most of the area. The rock next below the Pennsylvanian in a narrow north-south belt in the west-central part of the county is believed to be the St. Louis limestone. Spergen limestone is the uppermost Mississippian formation in the northwestern

Table 27.—*Depths to some horizons in the Jack Garden Construction Company No. 1 Ross Elliott well, SE¼ SW¼ sec. 31, T. 3 S., R. 20 E., Doniphan County*

Horizon	Depth, feet
Top Lansing group	501
Base Kansas City group	860
Top Mississippian limestone	1,680
Top Misener sandstone	2,174
Top "Hunton" limestone	2,195
Top Viola limestone	2,632
Top Arbuckle rocks	2,898
Total depth	2,950

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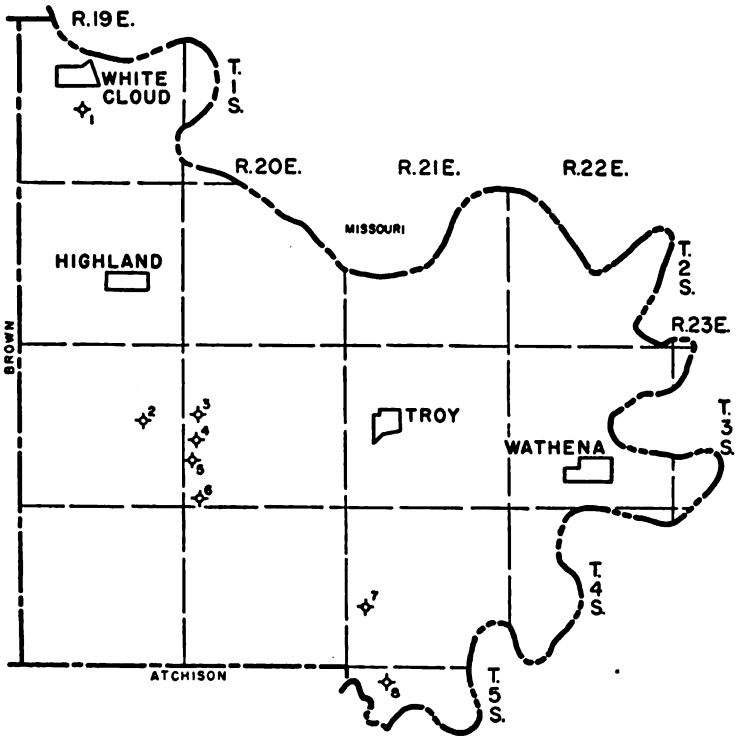

FIG. 31.—Map of Doniphan County showing location of wells listed in Table 28.

part of the county. The "Warsaw," Burlington, Gilmore City, Sedalia, and Chouteau limestones are believed to comprise the remainder of the Mississippian limestone section in the county (Lee, 1940, pl. 8; Lee and Payne, 1944, fig. 17).

According to Lee (1943, fig. 14), the thickness of the Chattanooga shale in Doniphan County increases westward from about 100 feet to more than 150 feet.

Pre-Chattanooga rocks.—According to Lee (1943, fig. 12), the interval between the base of the Chattanooga shale and the top of the Maquoketa shale in Doniphan County ranges from about 300 feet in the southeastern part to nearly 550 feet in the northwestern part. The interval from the top of the Maquoketa shale to the top of the St. Peter sandstones ranges from about 275 to 350 feet. The increase in thickness is toward the northwest (Lee, 1943, fig. 11).

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TABLE 28.—*Data on wells drilled for oil and gas in Doniphan County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Valley Petro. Co. No. 1 Mann	SE NW 21-1-19E	?	2,315	Top Mississippian, 1,975; Chattanooga, 2,205; "Hunton," 2,281 ft. stopped in "Hunton"
2	Doniphan Oil & Gas Co. No. 1 Albers	Cen. SW SE 14-3-19E	1919	1,725	Top Mississippian, 1,715 ft.
3	Gall et al. No. 1 Caudel	NW NW SE 18-3-20E	1944	2,090	Stopped in "Hunton" ls.
4	.....No. 1 Stout	19-3-20E	?	1,500	Stopped in Cherokee sh.
5	..... No. 2 Stout	SW NE NW 30-3-20E	?	2,120	Top Mississippian, 1,775; Chattanooga, 2,010; stopped in Chattanooga sh.
6	Garden Construction Co. No. 1 Elliott	SE SW 31-3-20E	1941	2,950	Stratigraphic data in Table 27
7	Southwest Oil & Gas Co. No. 1 Nity	SE cor. 19-4-21E	?	1,571	Stopped in Cherokee rks.
8	Diamond Prospecting Co. Doniphan well	5-5-21	1878	998	Diamond drill hole, stopped in Cherokee sh.

The thickness of rocks between the top of the St. Peter sandstone and Pre-Cambrian rocks ranges from about 450 feet in the northwestern part of the county to 650 feet or more in the eastern part (Lee, 1943, fig. 9). Depths to some stratigraphic horizons in sec. 31, T. 3 S., R. 20 E. are listed in Table 27.

OIL AND GAS EXPLORATION

Doniphan County has been very inadequately tested for oil and gas. Data on eight wells in the county are given in Table 28. Locations of the wells are shown in Figure 31.

No drilling for oil or gas in Doniphan County has been reported since 1944.

DOUGLAS COUNTY

Small quantities of oil and gas have been produced in Douglas County for a number of years; the Baldwin oil pool was discovered in 1919. Oil production is from the "Squirrel sand" and is restricted to the Baldwin area in the southeastern part of the county. The "Squirrel sand" is in the upper part of the Cherokee shale

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and is about 800 feet below the surface in southeastern Douglas County. Early developments in the county were discussed by Ockerman (1935, pp. 48-50).

The estimated amount of oil production in Douglas County in 1952 is 1,580 barrels. There are about 16 producing wells. The oil is used locally as fuel oil.

Early oil production in Douglas County is mostly unrecorded. In 1927, the county is reported to have produced approximately 24,000 barrels (Table 2). Yearly production during the period 1941 to 1952 inclusive is shown in Table 3.

Table 73 shows the estimated production in the Baldwin field in the years 1949 through 1952. Figure 32 shows locations of oil and gas fields as defined by the Kansas Nomenclature Committee, areas of oil production in 1952, and locations of wells that have been drilled in the county outside the fields and of which the Geological Survey has records. The wells are listed in Table 30.

Geology

SURFACE ROCKS

The exposed consolidated rocks in Douglas County are of Pennsylvanian age, and belong to the Shawnee, Douglas, Pedee, and Lansing groups. The youngest of these is the Topeka limestone and the oldest is the Plattsburg limestone or perhaps a few feet of the Bonner Springs shale. Glacial drift is attenuated in the northern part of the county. The valleys of Kansas River and Wakarusa Creek are filled with sand and gravel to depths as great as 80 feet or more, and several alluvial terraces border their flood plains (Davis and Carlson, 1952).

The Deer Creek and Oread limestones of the Shawnee group (Fig. 4) cap prominent escarpments. Lenticular sandstones are common in the upper parts of the Calhoun, Tecumseh, and Kanwaka shales. Several limestones are useful key beds for surface or shallow subsurface structural mapping in the western part of the county. The thickness of the Shawnee group in Douglas County is about 300 feet. The Douglas group is composed chiefly of shale and sandstone. The Haskell limestone, in the middle part of the Douglas section, is a useful key bed in most parts of the area. Thick lenticular sandstones occur both above and below the Haskell limestone. A disconformity below the Ireland sandstone cuts out

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the Haskell limestone in the southeastern part of the county. The thickness of the Douglas group in the county ranges from about 200 to 270 feet.

Post-Missourian erosion removed Pedee rocks from the northeastern part of Douglas County, but about 60 feet of shale lying between the Stanton limestone and the Tonganoxie sandstone in the southeastern part of the county is correlated with the Weston shale of the Pedee group. In the same area a thin limestone is believed to be the Iatan. Rocks of the Lansing group are exposed in the northeastern part of the county in the vicinity of Eudora and eastward along the south side of Kansas River Valley. The Stanton limestone is well exposed there. The thickness of Lansing rocks in Douglas County is about 100 feet.

SUBSURFACE ROCKS

Douglas County lies on the southeastern flank of the North Kansas basin. The Chattanooga shale oversteps Devonian rocks, the Maquoketa shale, and the upper beds of the Kimmswick limestone from the northwest (Lee, 1943, fig. 7). Depths to some key stratigraphic horizons in six wells in Douglas County are shown in Table 29.

Pennsylvanian rocks.—Pennsylvanian rocks in Douglas County older than those of the Lansing group are known only through study of well logs and cuttings. The total thickness of the Lansing and Kansas City groups in the county is about 350 feet. The thickness of the Pleasanton-Marmaton-Cherokee section ranges from about 700 feet in the eastern part of the county to slightly more than 800 feet in the northwestern part.

Mississippian rocks.—The total thickness of Mississippian limestone formations in Douglas County ranges from about 250 feet to slightly more than 400 feet (Lee, 1943, fig. 16). The Spergen (?), "Warsaw," Burlington, Sedalia, and Chouteau formations are believed to be present in the county (Lee, 1940, pl. 4). The Chattanooga shale ranges in thickness from about 50 feet in the southeastern and southwestern parts of Douglas County to about 100 feet in the northwestern part (Lee, 1943, fig. 14).

Devonian rocks.—In the Smith et al. No. 1 Smith well, sec. 28, T. 12 S., R. 19 E., 70 feet of Devonian limestone was identified, but in the Duffens et al. No. 1 Stanley well, sec. 3, T. 14 S., R. 21 E.,

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TABLE 29.—*Depths in feet to some stratigraphic horizons in six Douglas County wells*

Horizon	Smith et al. No. 1 Smith, SW SW SE 28-12-19E	Volcanic Oil Co. No. 1 Jackman, NE SE 34-12-19E	Skelly Oil Co. No. 1 Middlekauff, SW NE NE 21-13-19E	G. J. Neuner et al. No. 1 Emmett, SE NW 6-14-18E	Pure Oil Co. No. 1 Leuf, NW NW SE 31-14-19E	R. F. Duffens No. 1 Stanley, NW NE NW 3-14-21E
Top Douglas group	68	.....	.....	.....	.....	.....
Top Lansing group	358	.....	.....	.....	340	.....
Top Pleasanton group	695	708	.....	.....	765	392
Top Cherokee shale	913	955	.....	.....	1,025	.....
Top Mississippian ls.	1,498	1,465	1,263	1,638	1,493	1,074
Top Kinderhookian rocks	1,802	1,804	1,539	.....	1,732	1,492
Top "Hunton" limestone	.....	1,902	1,596	1,959	1,762?	.....
Top Viola limestone	1,890	1,929	1,685	2,050	.....	.....
Top Simpson sandstone	2,025	2,025	.....	3,151	1,919	1,663
Top Arbuckle rocks	2,134	2,080	1,842	2,225	1,975	1,711
Top Lamotte sandstone	.....	.....	.....	2,810	.....	2,456
Pre-Cambrian rocks	.....	.....	.....	2,825	.....	2,463
Total depth	2,382	2,210	1,855	2,832	2,110	2,503

the Chattanooga shale lies on the Kimmswick limestone (Middle Ordovician).

Ordovician and Cambrian rocks.—Rocks of Silurian age are believed to be absent in Douglas County and the Maquoketa shale (Upper Ordovician) is present only in a small area in the northwestern part of the county (Lee, 1943, fig. 11). In the Smith et al. No. 1 Smith well, 115 feet of Kimmswick limestone was penetrated, and in the Duffens No. 1 Stanley well, 104 feet of Kimmswick (including probably some Decorah at the base) was identified. The Smith well was drilled through 10 feet of Decorah shale and 75 feet of St. Peter sandstone. A thickness of 54 feet of St. Peter sandstone was found in the Stanley well. Thicknesses of units of the Arbuckle identified in this well are: undifferentiated Cotter and Jefferson City dolomites, 106 feet; Roubidoux formation, 167 feet; undivided Gasconade and Van Buren dolomites, including a slight thickness of Gunter sandstone in the basal part, 206 feet; Eminence dolomite, 175 feet; and Bonneterre dolomite, 91 feet (Lee, 1943, fig. 5). Seven feet of Lamotte sandstone lies on Pre-Cambrian crystalline rocks in this well.

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Oil and Gas Developments

Although several deep test wells have been drilled in Douglas County, oil and gas have not been found in rocks older than the Cherokee shale. Known structural conditions in rocks older than the Chattanooga shale, however, suggest the probability that stratigraphic traps may exist in Devonian or Kimmswick rocks. Data on Douglas County wells, records of which are available, are given in Table 30.

The **Baldwin** oil field extends from southeastern Douglas County into Franklin County. Oil production is from the "Squirrel sand" about 800 feet below the surface. The field was discovered in 1919 in T. 15 S., R. 20 E. Wells were reported to have had average initial production of about 20 barrels of oil per day although in some daily production as high as 220 barrels was reported. Peak production is

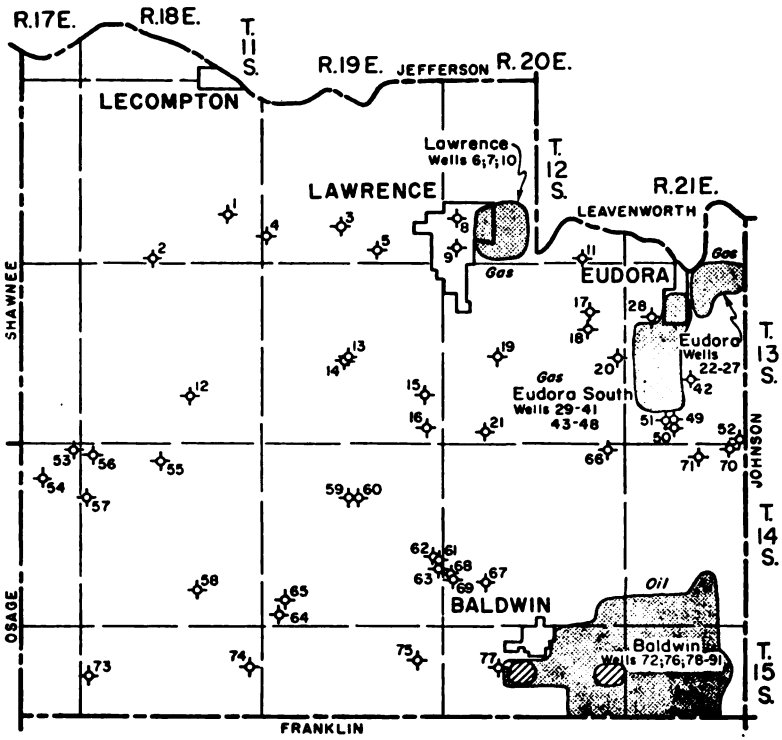

FIG. 32.—Map of Douglas County showing oil and gas fields and locations of wells listed in Table 30. Diagonal lines show areas of 1952 oil production.

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TABLE 30.—*Data on wells drilled for oil and gas in Douglas County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Volcanic Oil Co. No. 1 Gorrill	SE SE NE 26-12-18E	1945	2,146	Top Mississippian, 1,516; top "Hunton," 1,968; top Simpson, 2,130 ft.
2	..... No. 1 Wulfkuhle	SE SE SW 33-12-18E	....	1,320	Stopped in basal part of Cherokee rks.
3	Smith et al. No. 1 Smith	SW SW SE 28-12-19E	1927	2,382	See Table 29
4	Sagamore Oil & Gas Co. No. 1 David Williams	NW NW 31-12-19E	1942	1,680	Top Mississippian, 1,528 ft.
5	Volcanic Oil Co. No. 1 Jackman	NE NE SE 34-12-19E	1945	2,208	See Table 29
6	Kerlyn Oil Co. No. 1 Wise	SE SW 28-12-20E	1940	1,588	
7	J. M. Huber Corp. No. 1 Hickman	SE SE 29-12-20E	1944	742	
8	.....	30-12-20E	1887	1,380	Near old A.T.& S.F. freight depot, Lawrence; reported to have flowed salt water
9	.....	31-12-20E	1887	600	Near Lykin's Mill on New Hampshire St., Lawrence
10	J. M. Huber Corp. No. 1 Community	NW NW NW 33-12-20E	1945	1,813	108 M cu. ft. gas; discovery well
11	Forrester et al. No. 1 Altenborn	SW SE 35-12-20E	1940	1,605	
12	Russell et al. No. 1 John Harrel	SW SW NE 27-13-18E	1929	1,200	Stopped in Cherokee gr.
13	Skelly Oil Co. No. 1 Middlekauff	SW NE NE 21-13-19E	1944	1,855	See Table 29
14	Skelly Oil Co. No. 2 Middlekauff	SW NE NE 21-13-19E	1944	1,271	Top Mississippian, 1,267 ft.
15	Apperson et al. No. 1 Howard	SE NW 25-13-19E	1941	1,205	Top Mississippian, 1,195 ft.
16	..... No. 1 C. W. Wells	36-13-19E	?	1,030	
17	Douglas Oil & Gas Synd. No. 2 Gage	NE NE SE 11-13-20E	1940	1,120	Top Mississippian, 1,102 ft.
18	Reynolds & Eaton No. 1 Gage	NW NE NE 14-13-20E	1933	760	Stopped in Cherokee gr.
19	Kerlyn Oil Co. No. 1 Whedon	NE NE 20-13-20E	1940	719	Stopped in Cherokee gr.
20	Baysinger et al. No. 1 Grosdidier	SE NE NE 24-13-20E	1939	845	Stopped in Cherokee gr.
21	..... Doolittle	SE NE SW 32-13-20E	?	1,300	"Much gas" reported between 900 and 1,300 ft.
22	..... No. 1 Flagger	NE SE 3-13-21E	?	575	Oil show at 555; gas at 568 ft.
23	T. A. Goff No. 1 Henry Kurtz	SE SE NE 3-13-21E	?	644	Gas reported at 622 ft.
24	T. A. Goff No. 1 McCoy	SW NE 3-13-21E	1941	623	

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25	T. A. Goff No. 1 Neis	NW SW 3-13-21E	1940	577	Gas well; gas from 570 to 577 ft.
26	R. F. Duffens No. 1 Lothholtz	NE NW SW 4-13-21E	1941	801	Dry hole; stopped in Cherokee gr.
27	..... No. 2 Moll	SW SW SW 4-13-21E	?	344	
28	Goff Oil & Gas Co. No. 1 Gerstenberger	SE SE SE 7-13-21E	1936	885	Stopped in Cherokee gr.
29	Goff Oil & Gas Co. No. 1 Gage	NW NW NW 8-13-21E	1937	880	Stopped in Cherokee gr.
30	..... No. 1 Oberholtzer	8-13-21E	?	385	
31	..... No. 2 Oberholtzer	8-13-21E	?	383	Gas reported at 363 ft.
32	..... No. 1 Pilla	8-13-21E	?	411	
33	..... No. 1 Chas. Richards	8-13-21E	?	342	
34	..... No. 1 J. Rothberger	NW cor. 8-13-21E	1905	360	
35	Utilities of Kansas No. 1 Ott	SW SE SW 17-13-21E	1930	1,220	Top Mississippian, 1,070 ft.
36	J. M. Edwards No. 1 Rosenau	SW SW 17-13-21E	1942	787	Stopped in Cherokee gr.
37	J. M. Edwards No. 1 Durr	SE NE 18-13-21E	1942	830	Stopped in Cherokee gr.
38	J. M. Edwards No. 2 Durr	SE NE SE 18-13-21E	1942	900	Stopped in Cherokee gr.
39	Hannan et al. No. 1 Adir	NE NE SE 19-13-21E	1929	692	350 M cu. ft. gas from 682 to 692 ft.
40	Hannan et al. No. 1 Bartz	NW NW NW 20-13-21E	1929	685	180 M cu. ft. gas from 662 to 672 ft.
41	Hannan et al. No. 2 McBride	SW cor. 20-13-21E	1929	511	550 M cu. ft. gas from 493 to 511 ft.
42	..... No. 1 McBride	SW SW SW 20-13-21E	?	766	Gas from 655 to 670 ft; abd.
43	Goff Oil Co. No. 3 Emilie Genterbarger	SW NE NW 29-13-21E	1937	734	Dry hole; stopped in Cherokee gr.
44	..... No. 1 Gerstenberger	NW NW 29-13-21E	?	678	Gas well; abd.; gas from 655 to 674 ft.
45	..... No. 2 Gerstenberger	SE NW 29-13-21E	1903?	1,104	Gas reported at 839; top Mississippian, 1,075 ft.
46	John S. Holmes No. 1 Griffin	SW SW SE 29-13-21E	commenced 1942	703	Dry hole; stopped in Cherokee gr.
47	J. M. Edwards et al. No. 1 H. Bohnsack	NE NE NE 30-13-21E	1941	786	Gas well; plugged back to 696 ft.
48	Reynolds & Eaton No. 1 Faust	NE NE 30-13-21E	1933	710	Dry hole; stopped in Cherokee gr.
49	Holmes et al. No. 1 Gabriel-Woodard	NE NW NE 32-13-21E	1942	358	Gas well
50	..... No. 2 Gerstenberger	32-13-21E	?	600	Gas reported from 347 to 353 ft.; gas and oil from 476 to 481 ft.; gas and oil from 590 to 600 ft.
51	Conholbar et al. No. 1 Chas. Schohror	NE NE NW 32-13-21E	1942	712	Gas well; gas from 709½ to 712 ft.

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TABLE 30.—*Data on wells drilled for oil and gas in Douglas County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
52	Kaw Valley Devel. Co. No. 1 Samuel Stanley	SE SE 34-13-21E	?	902	Stopped in Cherokee gr.
53	G. J. Neuner No. 1 Thurber	NE NE NE 1-14-17E	1950	2,058	Abandoned in Viola ls.
54	Wm. Lorenzen No. 1 Geo. Sullivan	NE NE 11-14-17E	1937	677	
55	Landsprecht & Baker No. 1 Griffin	NW SE 4-14-18E	1939	2,116	See Table 29
56	G. J. Neuner et al. No. 1 Emmitt	SE NW 6-14-18E	1949	2,832	Stratigraphic data in Table 29
57	Kinney Oil & Refg. Co. No. 1 Losey	NW SW SW 7-14-18E	1918	1,000	Log not available; oil show reported
58	W. H. Hazlett et al. No. 1 Featherston	SE SE 27-14-18E	1932	1,337	Stopped in Cherokee gr.
59	S. W. Forrester et al. No. 1 Ice	SW SE SE 9-14-19E	1940	935	Tools lost in hole
60	W. H. Hazlett et al. No. 1 Wm. Churchbaugh	SW SW 10-14-19E	1933	1,276	Stopped in Cherokee rks.
61	..... No. 1 Pardee	SE SE SE 24-14-19E	?	1,238	Stopped in Cherokee rks.
62	..... No. 2 Pardee	SE SE 24-14-19E	?	1,235	
63	..... No. 1 Pardee	NE NE NE 25-14-19E	?	1,022	Gas well; 1,000 M cu. ft. from 992 to 1,000 ft.
64	Pure Oil Co. No. 1 Leuf	NW NW SE 31-14-19E	1932	2,110	See Table 29
65	Sperry Oil & Gas Co. No. 1 Rappard	SE N½ NE 31-14-19E	?	1,070	Stopped in Cherokee gr.; tools left in hole?
66	Conholbar Synd. No. 1 Stout	NE NE NW 1-14-20E	1942	527	Dry hole
67	Hayhurst, Rich & Lloyd	NE SW 29-14-20E	1927	1,204	Dry hole; stopped in Cherokee gr.
68	..... No. 1 Tucker	NW 30-14-20E	?	978	750 M cu. ft. gas from 969 to 978 ft.
69	..... No. 2 Tucker	NE SE NW 30-14-20E	?	1,005	Show of gas 999 to 1,005 ft.
70	R. F. Duffens No. 1 Stanley	NW NE NW 3-14-21E	1941	2,503	See Table 28
71	Sagamore Oil & Gas Co. No. 1 Freund	SE NW 4-14-21E	1942	853	Dry hole; stopped in Cherokee rks.
72	..... No. 1 Dwyer	SE 33-14-21E	?	876	Dry hole; stopped in Cherokee rks.
73	L. L. Russell No. 1 Dodder	CNL SW 7-15-18E	1932	1,333	Stopped in "Bartlesville sand"
74	Frank Hill No. 1 Butell	NE SW NE 12-15-19E	1927	1,430	Heavy oil reported from 945 to 950 ft.; top Mississippian, 1,345 ft.
75	Sterline Synd. No. .... Butell	SE NW NW 12-15-19E	?	1,170	Stopped in Cherokee rks.

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76	Hemminger No. 1 Lancaster	NW NE NW 2-15-20E	1936	762	Stopped in Cherokee rks.
77	Russell Hays No. 1 Eichman	SE SE NE 8-15-20E	1940	880	Stopped in Cherokee rks.
78	Stearns & Streeter No. 2 Smith	NW SW 9-15-20E	....	869	
79	Webster, Stearns et al. No. 1 Smith	NE NW SW 9-15-20E	1921	847	
80	Webster & Stearns No. 2 Smith	SE SE NW 9-15-20E	1921	857	
81	C. T. Edwards et al. No. 1 Webster	SW SE NW 9-15-20E	?	845	Gas reported at 605 ft.
82	..... No. 4 Webster	SW SE NW 9-15-20E	1937	829	
83	Russell Hays No. 5 Webster	SE SW NW 9-15-20E	1939	847	Initial daily production 5 bbls. oil from 826 to 847 ft.
84	Russell Hays No. 1 Jordan	NW NW SE 10-15-20E	1937	860	Dry hole
85	Russell Hays No. 2 Jordan	Cen. NW 10-15-20E	1937	860	Dry hole
86	F. G. Hill No. 1 Finety	Cen. S SE 11-15-20E	1935	900	Dry hole
87	..... No. 3 Howard	N½ SE 11-15-20E	?	887½	Oil sand from 842 to 877½ ft.
88	..... No. 1 S. L. Preston	SE SW NW 12-15-20E	?	842½	Oil sand from 827½ to 842½ ft.
89	J. H. Lemon No. 1 Lidikey	SE NW SE 4-15-21E	1936	810	Dry hole
90	J. H. Lemon No. 2 Lidikey	CNL SE SW 4-15-21E	1936	750	Dry hole
91	Russell Hays No. 1 Hays	SW NE SW 6-15-21E	1937	884	Dry hole

reported to have been reached in 1927, when the field yielded 23,900 barrels of oil. Gas was discovered east and north of Baldwin, and a field was developed about 25 years ago. Initial daily production from the "Squirrel sand" was as high as 1 million cubic feet. The gas field has been abandoned for many years.

The **Eudora** and **Eudora South** gas pools are in T. 13 S., R. 21 E. The **Eudora** pool extends into Johnson County. Production in these pools is from the "Squirrel sand" at a depth of about 700 feet. Gas is used only for local farm consumption.

The **Lawrence** gas-producing area lies northeast of Lawrence. Gas was discovered in 1944 in the Huber No. 1 Community well in T. 12 S., R. 20 E. The "Squirrel sand" at a depth of 670 feet yields this gas. The well was gauged at 85,000 cubic feet of gas per day. The field is not now producing commercially.

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Recent developments.—A few shallow holes have been drilled in the past few years, especially in the northeast part of the county. In 1949 a deep test, the G. J. Neuner et al. No. 1 Emmett well, in sec. 6, T. 14 S., R. 18 E. reached Pre-Cambrian rocks at 2,825 feet. Some other stratigraphic data on this well are listed in Table 29. Another deep wildcat was drilled in 1950. It is the G. J. Neuner No. 1 Thurber, sec. 1, T. 14 S., R. 17 E. The following tops were reported: Mississippian limestone, 1,638 feet; Kinderhookian rocks, 1,800 feet; "Hunton" limestone, 1,950 feet; Viola limestone, 2,048 feet. The well was abandoned at 2,058 feet. No deep test wells in Douglas County were reported in 1951 or in 1952.

ELK COUNTY

The first gas well in Elk County is reported to have been completed on the Johnson farm near Elk Falls on July 4, 1901. Oil was discovered near Longton in 1902, and oil and gas are still produced in this area. Gas production in Elk County has been relatively important since about 1921. Most of the gas has been produced in the southern half of the county. The southwestern part of the county is the principal oil-producing area.

Elk County produced 175,746 barrels of oil in 1952. Production in the county during the years 1902 to 1948 inclusive is shown in Tables 2 and 3. Table 73 gives the production of the various oil fields for 1949 through 1952. Oil and gas fields and areas of 1952 oil production in Elk County are shown in Figure 33. Two waterflooding projects are operating in the county (Fig. 2, Table 4).

Peak oil production in Elk County was attained in 1927, when nearly 900,000 barrels was produced.

Geology

SURFACE ROCKS

The youngest consolidated rocks exposed in Elk County belong to the Chase group. They crop out in the western part of the county. The oldest rocks exposed belong to the Douglas group and crop out in the eastern part of the county.

Permian rocks.—Only the lower formations of the Chase group (Fig. 3), the Matfield shale and the Wreford limestone, are present in Elk County. They cap the hills in the western part. The Council

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Grove group consists of about 125 feet of limestone and shale. Rocks of the Admire group consist of shale, thin beds of limestone, and some coal. They have a total thickness of about 90 feet.

Pennsylvanian rocks.—The Wabaunsee group (Fig. 4) consists of shale, sandstone, and thin beds of limestone; it has a total thickness of about 300 feet in Elk County. The average thickness of the Shawnee group is about 425 feet. The Douglas group consists chiefly of shale and sandstone, and includes thin beds of limestone and some coal. The Douglas rocks have a total thickness of about 300 feet. Only the upper part of the group crops out in the county.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons as shown by the log of the Halstead and Company No. 1 Osborne well, NW¼ NW¼ sec. 8, T. 31 S., R. 11 E., are given in Table 31.

Pennsylvanian rocks.—The total thickness of rocks between the top of the Pedee group and the base of the Cherokee shale is about 1,300 feet in Elk County. The Lansing group has a total thickness of about 150 feet. It consists of two limestones and a shale. Oil and gas are produced from three sandstones in the Vilas shale. The upper of these sandstones is known as the "Bush-Denton" or "Ferguson," the middle as the "Longton" or "Webb," and the lower as the "Encill sand." The Kansas City group has a thickness of about 440 feet in the county and consists chiefly of limestone and shale. A sandstone in the upper part of the group known as "Layton" yields oil and gas. The Pleasanton rocks consist chiefly of shale and sandy shale and are about 60 feet thick.

TABLE 31.—*Depths to some key horizons in the Halstead and Company No. 1 Osborne well, SW¼ NW¼ NW¼ sec. 8, T. 31 S., R. 11 E., Elk County*

Horizon	Depth, feet
Base Kansas City group (top Pleasanton)	1,355
Base Marmaton group (top Cherokee)	1,610
Top Mississippian limestone	1,904
Top Chattanooga shale	2,157
Top Cotter dolomite (Arbuckle)	2,200
Top Pre-Cambrian rocks	2,950
Total depth	2,987

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Marmaton rocks in Elk County are about 250 feet thick; they consist of alternating beds of limestone and shale and include some sandstone and coal beds. Oil and gas have been found in the "Old Red" or "Wayside sand" in the Nowata shale, the "Weiser sand" in the Bandera shale, and "Peru sand" in the Labette shale, and in the Little Osage shale member of the Fort Scott formation. The Cherokee shale section is about 300 feet thick in the county. Oil- and gas-bearing sandstones in the Cherokee include the "Bartlesville" about 180 feet from the top of the Cherokee and the "Burgess" near its base.

Mississippian rocks.—The total thickness of Mississippian limestones in Elk County ranges from 150 to 350 feet (Lee, 1939, pl. 1). The formations are the "Warsaw," Keokuk, Burlington, Reeds Spring, and St. Joe limestones and Northview-Compton formations (undivided shale and limestone) (Lee, 1940). Lee (1939, pl. 1) has shown that the Mississippian rocks are thinner over anticlinal structures. Examples are the Dexter-Otto anticline, which extends into the northwestern part of Elk County, and the Longton anticline in the eastern part of the county. Oil and gas are produced from a weathered zone in the upper part of the Mississippian. The thickness of the Chattanooga shale in Elk County is about 50 feet (Lee, 1940, pl. 3).

Ordovician and Cambrian rocks.—The Ordovician and Cambrian rocks in Elk County have not been completely subdivided. The Cotter dolomite, which lies directly below the Chattanooga shale, is the youngest Ordovician rock in the county. Oil and gas are produced from a porous zone in the upper part of the Cotter. The thickness of the Ordovician and Cambrian rocks ranges from about 750 to 1,165 feet.

Pre-Cambrian rocks.—Pre-Cambrian rocks were penetrated at a depth of 2,950 feet in the Halstead and Company No. 1 Osborne well in the NW¼ sec. 8, T. 31 S., R. 11 E.

Oil and Gas Developments

Oil and gas accumulations in Elk County have been found to be due to the presence of anticlinal structures. No shoestring sands are known.

Important gas-producing areas are **Longton** and **Elk City.** Most of the gas is produced from the "Encill sand" in the Kansas City group, the "Burgess" and "Bartlesville" sands in the Cherokee

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group, and the Mississippian limestone. Some production is from the "Peru," "Wayside," and "Weiser" sands in the Marmaton group. The average depth to the "Encill sand" in the central part of the county is about 1,300 feet. The maximum open flow production of some gas wells in these areas was more than 90 million cubic feet per day. The initial rock pressure was about 550 pounds.

The **Adams** gas pool, T. 29 S., Rs. 12 and 13 E., has been abandoned for several years. The **Arbuckle** field, now abandoned, discovered in T. 31 S., R. 9 E., produced from the "Burgess sand" at about 2,250 feet. Initial production of the discovery well was about 150 barrels daily. The **Bunyard** field, T. 28 S., R. 12 E., formerly produced oil from the lower part of the Kansas City group at about 1,130 feet. Some gas has been produced in the area from the upper part of the Mississippian limestone at about 1,740 feet. The **Bush-Denton** field yields oil from the "Stalnaker sand" at about 2,300 feet. Some gas has been produced in the same area which was opened in 1920.

The **Clear Creek** oil and gas pool, sec. 18, T. 30 S., R. 12 E., has been abandoned for many years. The **Collyer** oil field produces from sandstone in the Kansas City group and from the Fort Scott formation at about 1,286 and 1,518 feet respectively. The field was opened in 1924. The **Dory** is a Mississippian limestone pool at a depth of about 2,570 feet. The **Dunkleberger** field yields oil from the Kansas City group at about 1,300 feet and from Mississippian limestone at 1,970 feet.

The total production from the **Elk City** field in T. 31 S., R. 13 E., has been about 21½ billion cubic feet of gas. The producing formation is the "Burgess sand," which has an average thickness of about 33 feet and is at a depth of about 1,360 feet. The "Bartlesville sand" in this area has a thickness of about 30 feet and lies at an average depth of about 1,330 feet. The total open flow from 70 producing wells was 1¾ billion cubic feet. The open flows ranged from 15 to 90 million cubic feet. The initial rock pressure was 520 pounds. Minor amounts of oil have been produced from Ordovician rocks in the field. No oil production was reported during 1952, however.

The **Elk Falls,** T. 31 S., R. 11 E., and the **Ewers,** T. 31 S., R. 8 E., gas fields are now abandoned. The **Ferguson East** oil pool is in Ordovician rocks at about 2,900 feet. Former oil production in the **Fleak** field, sec. 21, T. 30 S., R. 11 E., probably was from the "Peru sand." In 1950 oil production was revived in the Arbuckle limestone

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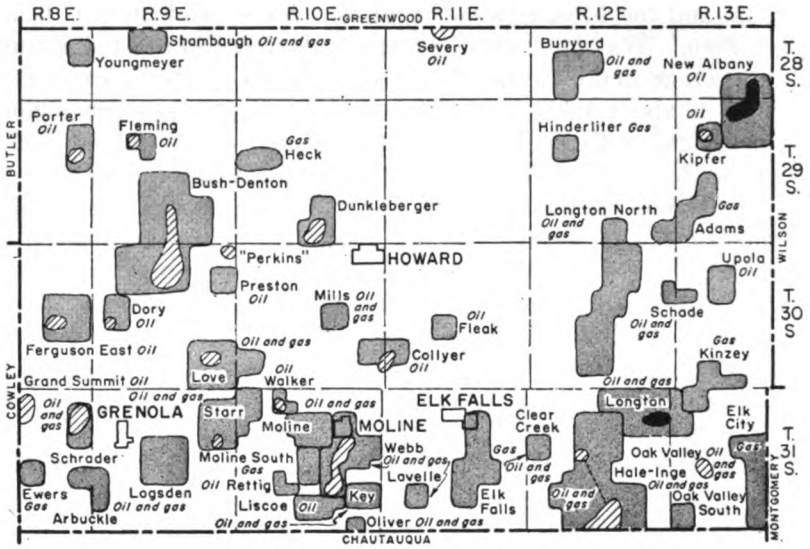

FIG. 33.—Map of Elk County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

Fleming pool by the Pack Oil Co. and Murfin Drilling Co. No. 1 Radar well, sec. 8, T. 29 S., R. 9 E. The producing zone lies at a depth of 2,656 feet.

In the **Grand Summit** field, which is partly in Cowley County, production is from a zone in the Kansas City group at a depth of about 2,000 feet. The **Hale-Inge** field, extending into Chautauqua County, is one of the oldest in the area. It was opened in 1907 with oil production from the "Peru sand" at 1,160 feet. The **Heck** and **Hinderliter** gas pools are no longer active. The **Key,** an Arbuckle limestone field in T. 31 S., R. 10 E., has been abandoned for several years. The depth to the reservoir is about 2,270 feet. Gas has been produced from the "Burgess sand" and from the top of Mississippian rocks in the area. The **Kinzey** gas field, in Ts. 30 and 31 S., R. 13 E., is no longer productive. Oil production in the **Kipfer** field was resumed in 1952. No production has been reported for the **Lavelle** oil and gas field for several years. Oil was produced in the **Liscoe** field from "Wilcox sand" (Misener or Arbuckle) at a depth of about 2,300 feet. The field was opened in T. 31 S., R. 10 E. in 1926. Initial production of three wells in sec. 34 ranged from 30 to 100 barrels of oil daily. The **Logsden** field, opened in 1927 in T. 31 S., R.

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9 E., formerly produced from the "Burgess sand" at about 2,272 feet. Production was last reported in 1951.

In the **Longton** field, in T. 31 S., R. 12 E., which is reported to have been found as early as 1902, oil occurs in the upper part of Mississippian limestone. A considerable amount of gas has been produced in the area. The **Longton North** field has been principally a gas field. It lies along the northern part of the Longton ridge or anticline. A part of the **Longton** area has been used as a gas storage reservoir. Gas was stored in a sandstone near the top of the Kansas City group in an area of 1,150 acres in T. 31 S., R. 12 E. The sand has an average thickness of about 34 feet and lies at a depth of about 660 feet. The pool had produced a total of 3 billion cubic feet of gas. The initial rock pressure was 260 pounds. The total initial open flow from 25 wells was 30 million cubic feet.

The **Love** is a Mississippian limestone pool in the southeastern part of T. 30 S., R. 9 E. The reservoir is at a depth of about 2,350 feet. The **Mills** oil field, T. 30 S., R. 10 E., formerly produced oil from the upper part of the Mississippian limestone at about 2,000 feet. Oil occurs in the **Moline** field in the "Burgess sand" at about 2,000 feet and in the upper part of Mississippian limestone at 2,030 feet. The **Moline South** field formerly produced gas. The **New Albany** field produces oil from the "Wayside sand" at about 560 feet. The field is in Ts. 28 and 29 S., R. 13 E.

Oil production was reported for the **Oak Valley** pool in 1952 for the first time in several years. No production was reported for **Oak Valley South,** however. The **Oliver** field has produced small amounts of oil but mostly gas from the upper part of the Mississippian limestone at a depth of about 2,000 feet. Oil produced recently on the Perkins lease, sec. 1, T. 30 S., R. 9 E., may be regarded as extending the **Preston** field. According to available records oil was discovered in the "Bartlesville sand" at 2,020 feet, in 1925. The **Porter,** an Arbuckle and Kansas City limestone field in T. 29 S., R. 8 E., was opened in 1923. The Kansas City reservoir is at a depth of about 2,050 feet; oil occurs in the Arbuckle at about 3,000 feet. The discovery well of the **Rettig** pool in T. 11 S., R. 10 E. had initial production of 35 barrels of oil daily from the lower part of the Kansas City group at a depth of 1,550 feet.

The **Schade** field has not reported production for some time. Oil production in the **Schrader** field is from the upper part of the Mississippian limestone at a depth of about 2,325 feet. The field was

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opened in 1928. Oil occurs in the **Severy** field, which extends into Greenwood County, in the Kansas City group at a depth of about 1,200 feet. The **Shambaugh** oil pool, T. 28 S., R. 9 E., is in the upper part of the Arbuckle limestone at a depth of about 2,850 feet. The field is no longer producing. The **Starr** field, T. 31 S., Rs. 9 and 10 E., was first discovered in 1937. Production is from Mississippian rocks at about 2,330 feet. The field was abandoned in 1951 but began production again in 1952. Production has not been reported for the **Upola** oil field for several years.

The **Walker** oil field produces from Kansas City rocks at about 1,550 feet and from the Mississippian at 2,225 feet. The **Webb** field, opened in 1925, has been unique inasmuch as oil is produced from rocks in the Kansas City group at about 1,300 feet; Fort Scott limestone, 1,650 feet; Mississippian limestone, 1,975 feet; and from the Arbuckle at about 2,300 feet. Other fields in the southern part of T. 31 S., R 10 E. should perhaps be regarded as joined with the **Webb.** Oil was discovered in the **Youngmeyer** field in 1941 in T. 28 S., R. 8 E. Production was from the upper part of the Mississippian limestone at 2,916 feet. The field is no longer producing.

Recent developments.—Three dry wildcat wells in Elk County in 1950 were drilled in sec. 32, T. 28 S., R. 10 E. They are Holl et al. No. 1 Simmons, NW¼ NW¼ NE¼, which reached the top of Mississippian limestone at a depth of 2,219 feet and was abandoned at 2,233 feet; the Glasco and Holl No. 2 Simmons, Cen. E½ NE¼, drilled to 1,572 feet; and the Berry and Ellis No. 1 Simmons, SW¼ SE¼ NE¼, abandoned at 2,250 feet, after having drilled into Mississippian rocks at a depth of 2,194 feet. Another 1950 wildcat, the John Carlson No. 1 Farnsworth, NE¼ NE¼ SW¼ sec. 24, T. 30 S., R. 11 E., was abandoned at a total depth of 2,117 feet.

It is expectable that rock-fracturing methods of well completion will become more and more important in Elk County. The revival of the **Fleming** (Arbuckle) pool during 1950 is significant.

FRANKLIN COUNTY

Franklin County has been producing oil and gas for nearly 50 years. The oil fields lie generally in the eastern half of the county in the vicinities of Rantoul, Peoria, and Wellsville. There are scattered gas fields near Ottawa and in the northwestern part of the county. All oil and gas production has been from rocks of Penn-

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sylvanian age. The producing rocks lie at an average depth of about 750 feet.

Franklin County produced 406,698 barrels of oil in 1952. Oil production in the county during the years 1904 to 1952 inclusive, is given in Tables 2 and 3. Table 73 shows the production in the various producing areas for 1949 through 1952. Nine water-flooding projects are operating in the county (Table 4). Gas production in the county has practically ceased.

The oil and gas fields and areas of 1952 oil production in Franklin County are shown in Figure 34.

Geology

SURFACE ROCKS

The consolidated outcropping rocks in Franklin County are of Pennsylvanian age. There are some unconsolidated surficial beds ranging in age from Tertiary (?) to Recent on the uplands and in the stream valleys. The youngest bedrocks in Franklin County are the Lecompton limestone and a few feet of the overlying Tecumseh shale (Fig. 4). These rocks are exposed in the northwestern part of the county. The oldest exposed rocks are along stream valleys in the southeastern part of the county.

The Douglas group (Fig. 4) consists chiefly of clastic material, including a large amount of sandstone. The Ireland sandstone member of the Lawrence shale is more fully developed in Franklin County than in counties farther north. The Douglas rocks in Franklin and neighboring counties have been described by Bowsher and Jewett (1943). The Weston shale of the Pedee group (Fig. 5) ranges in thickness from a featheredge to 75 feet or more in Franklin County. A thin limestone exposed a few miles west of Wellsville is believed to be correlated correctly with the Iatan limestone. The Weston shale is quarried and made into lightweight aggregate at a plant south of Ottawa.

The Stanton limestone of the Lansing group (Fig. 5) comprises about 45 feet of limestone and shale. The Rock Lake shale member near the top consists largely of sandstone, and the Eudora shale, near the base of the formation, is chiefly black platy shale. The Stoner limestone member, middle part of the Stanton formation, forms rather prominent bluffs and is generally less than 20 feet thick. The Vilas shale, which ranges in thickness from 2 to 10 feet

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or more, contains thin limestone beds in places where it is thickest. The Plattsburg limestone in Franklin County ranges from about 16 to 24 feet or more in thickness and is composed largely of massive limestone which is buff when weathered. The lower unit, the Merriam limestone member, although generally thin or even absent, locally is thicker than the upper member, the Spring Hill limestone.

The oldest exposed rocks in Franklin County are those in the upper part of the Kansas City group (Fig. 5). Rocks older than the Chanute shale are not exposed in the county and the Westerville limestone is seemingly absent. The upper few feet of the Chanute shale, the Iola limestone, the Lane shale, the Wyandotte limestone, and the Bonner Springs shale are exposed along streams in the southeastern part of the county. Rocks of this group are characterized by the thick Lane and generally thick Bonner Springs shales and by the conspicuous scarp-making Wyandotte limestone. The Bonner Springs shale ranges in thickness from as little as 5 feet in sec. 1, T. 19 S., R. 21 E., to 56 feet or more elsewhere. The Bonner Springs formation contains much sandstone. The Wyandotte limestone, about 30 feet thick, is somewhat variable in lithology but consists mostly of irregularly bedded light-colored fossiliferous limestone.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons in a Franklin County well are listed in Table 32.

Pennsylvanian rocks.—Pennsylvanian rocks below the base of the Oread limestone are about 1,300 feet thick in Franklin County. The

TABLE 32.—*Depths to some stratigraphic horizons in the B. O. Hollett No. 1 Koontz well, Cen. SE¼ NE¼ sec. 21, T. 18 S., R. 19 E., Franklin County*

Horizon	Depth, feet
Top Lansing group	30
Base Kansas City group	457
Top Mississippian limestone	1,229
Top Chattanooga shale	1,489
Top "Hunton" limestone (Devonian)	1,548
Top St. Peter sandstone	1,579
Top Arbuckle limestone	1,598
Total depth	1,618

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presence locally of as much as 100 feet of Weston shale presents a situation somewhat different from that in some near-by areas. This condition is due to the difference in the amount of material removed by erosion from the top of Missourian rocks before deposition of Douglas beds. Lansing, Kansas City, Pleasanton, and Marmaton rocks in Franklin County are not different particularly from the same rocks in near-by counties. Cherokee rocks are about 350 feet thick in Franklin County. The "Squirrel sand," in the upper part of the Cherokee section, is the most prolific oil and gas reservoir that has been found in the county.

Mississippian rocks.—The total thickness of Mississippian limestones in Franklin County is about 300 feet. The "Warsaw" limestone is believed to be the uppermost Mississippian formation present in most of the county, but the Spergen limestone has been identified in the northeastern part (Lee and Payne, 1944, fig. 17). In the central-western part, post-Mississippian erosion reached the upper part of the Burlington-Keokuk section. According to Lee (1940, pl. 8), the Chouteau and Sedalia limestones underlie all of the county.

The Chattanooga shale, of Late Devonian or early Mississippian age, is believed to be present under all of Franklin County. The thickness is about 50 feet. In most of the county, the Chattanooga shale is in contact with the Viola dolomite. The Viola is absent in the southeastern part, however, and there the Chattanooga lies on the St. Peter formation. The St. Peter is believed to be absent in the extreme southeastern corner of the county and the Chattanooga rests upon Arbuckle rocks in this area.

Older Paleozoic rocks.—Devonian and Silurian rocks are believed to be absent in most of Franklin County, but a few feet of Devonian limestone has been identified in the northern part of the area. The Kimmswick and Decorah formations (Middle Ordovician) are present in all but the southeastern part of the county. The greatest thickness of these rocks is about 100 feet. Except in the southeastern part, the St. Peter sandstone is covered by younger Ordovician rocks. The extreme southeastern corner of the county seems to be high enough on the Chautauqua arch for the St. Peter sandstone to have been removed before burial under the Chattanooga shale. The thickness of the St. Peter sandstone ranges from a few feet to about 50 feet. Arbuckle rocks thicken eastward in Franklin County, a condition that was brought about by pre-St. Peter beveling of the upper

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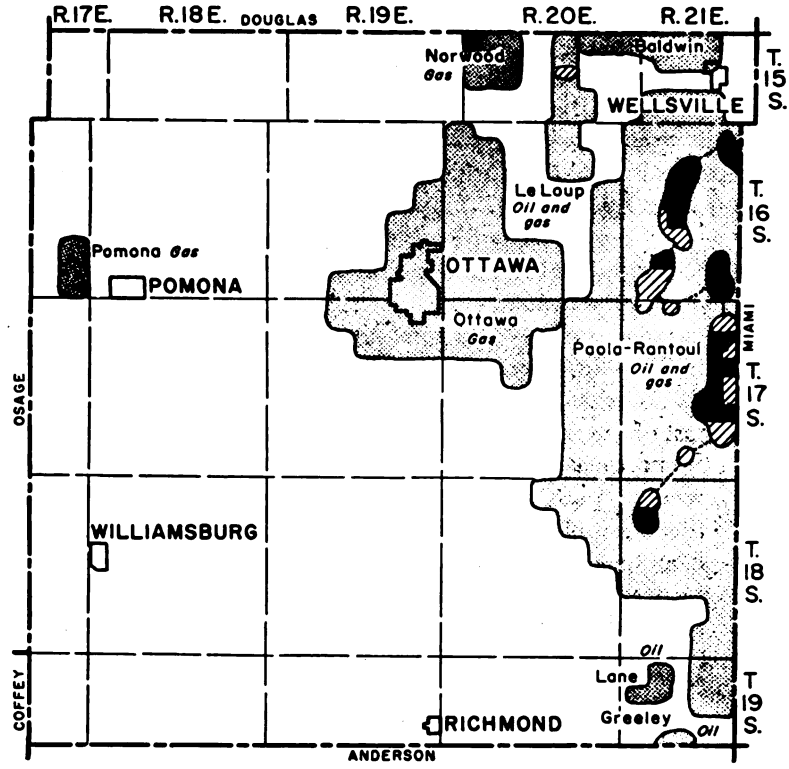

FIG. 34.—Map of Franklin County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

formations. The thickness of Arbuckle rocks is believed to range from about 450 to about 800 feet.

According to Keroher and Kirby (1948, figs. 3, 5, 6, 8, 9) the (1) Jefferson City-Cotter dolomite sequence in Franklin County ranges in thickness from 150 feet in the northeastern corner of the county to about 275 feet in the southwestern corner; (2) the Roubidoux dolomite is less than 100 feet thick; (3) the Van Buren-Gasconade sequence ranges in thickness from 100 feet in the southwestern corner of the county to 200 feet in the northeastern corner; (4) the Eminence dolomite ranges from 50 feet in the southwestern corner to slightly more than 150 feet in the northeast; (5) the Bonneterre has an average thickness of about 100 feet and lies on Pre-Cambrian

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rocks except in the northeastern part of the county where the Lamotte sandstone is believed to be present.

Oil and Gas Developments

Oil and gas were first produced commercially in Franklin County about 1904. In 1905, 55 oil wells and 4 gas wells were completed. The first production was near Rantoul.

Most of the oil and gas production in Franklin County is from an area that is included in the **Paola-Rantoul** field as designated by the Kansas Nomenclature Committee. This area includes most of the eastern half of Franklin County and a large part of Miami County. Some gas has been produced from scattered pools in the western part of Franklin County (**Pomona, Ottawa, Norwood,** and **LeLoup**). Occurrence of both oil and gas is chiefly in the "Squirrel sand" in the upper part of the Cherokee shale but other Pennsylvanian sandstones, including the "Prue" and "Bartlesville," are productive.

Many wells were drilled in Franklin County in the early 1920's, but little attention was given to geologic conditions and there were many dry holes. Initial daily production of some wells was as high as 250 barrels, however. No production was reported from the Franklin County part of the **Baldwin** field, which lies mainly in Douglas County. A small amount of oil was reported produced from the **Le Loup** field in 1952. The **Lane** oil pool, T. 19 S., R. 21 E., has been abandoned for many years.

Recent activities in Franklin County have been almost entirely in connection with water-flooding operations in the **Paola-Rantoul** field. Data on nine water-flooding operations in Franklin County are listed in Table 4. It is estimated that 377,877 barrels of oil was produced by secondary recovery methods in 1952.

GEARY COUNTY

Neither oil nor gas has been discovered in Geary County, but there has not been sufficient testing to prove the area barren. This county has an area of 407 square miles, but according to available records only 18 test holes have been drilled. The geology of Geary County has been described in a report by Jewett (1941).

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Geology

SURFACE ROCKS

With the exception of loess, alluvium, and other unconsolidated surficial deposits of Pleistocene age, the surface rocks in Geary County are of early Permian (formerly called Big Blue) age. The youngest Permian rock in the county is the Winfield limestone or perhaps the lower few feet of the Odell shale. The oldest exposed bedrock is the Eskridge shale which crops out along Deep Creek in the northeastern part of the county.

The Winfield limestone of the Chase group (Fig. 3) occurs only in the northwestern and southwestern parts of Geary County. The total thickness of rocks of the Chase group in the county is about 350 feet. Approximately the lower 300 feet is well exposed at numerous places in the slopes of the Flint Hills. In Geary County, as elsewhere along the outcrop line of Wolfcampian beds in Kansas, rocks of the Chase group are characterized by highly colored shales and thick flinty limestones. Limestone beds in the lower part of the Fort Riley member of the Barneston formation form a very noticeable natural "rim rock" near the crest of the Flint Hills in a large part of the county.

Rocks of the Council Grove group (Fig. 3) have an aggregate thickness of approximately 300 feet in Geary County. Rocks in the upper part of this group are well exposed in the slopes of the Flint Hills. Rocks older than the Eskridge shale do not crop out in the county. The Council Grove rocks are characterized by highly colored shales and by limestones that weather light to nearly white in color and contain little or no flint. The individual limestone members do not exceed 10 feet in thickness.

SUBSURFACE ROCKS

Depths to some horizons in the three wells that have been drilled into Pre-Cambrian rocks in the county are listed in Table 33.

Geary County lies on the west flank of the Nemaha anticline. Studies by Lee (1943, figs. 15, 16) indicate that the Mississippian limestone formations and the Chattanooga shale were removed from the extreme northeastern part of the county by pre- or early Pennsylvanian erosion. In most of the county the Chattanooga shale is believed to lie on the "Hunton" limestone, but in the extreme eastern part the Chattanooga or younger rocks lie on the Viola lime-

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TABLE 33.—*Depths in feet to some horizons in three wells in Geary County*

Horizon	Wright et al. No. 1 Younkin, NW NW NE 17-11-5E	Pioneer Petro. Co. No. 1 Chase Ranch, SE SE SE 10-12-7E	H. H. Hetzer No. 1 Sullivant, NE NE NE 36-13-5E
Top Howard limestone	1,045	.....	.....
Top Topeka limestone	1,115	.....	.....
Base Oread limestone	1,421	1,345	.....
Top Lansing group	1,495	1,425	.....
Top Kansas City group	.....	.....	1,605
Base Kansas City group	1,870	.....	.....
Top Mississippian limestone	2,002	2,015	2,060
Top Kinderhookian	2,070	2,095	.....
Top "Hunton" limestone	2,295	2,250	2,339
Top Maquoketa shale	2,609	2,618	.....
Top Viola limestone	2,695	2,660	2,730
Top Simpson	2,815	2,730	2,792
Top Arbuckle	2,890	2,860	.....
Top Lamotte sandstone	.....	2,905	.....
Top Pre-Cambrian	2,940	2,920	3,030
Total depth	3,240	3,638	3,043

stone. Lee, Leatherock, and Botinelly (1948, pl. 14) have shown geologic conditions in the northwest part of Geary County as inferred from studies of cuttings from wells in adjoining areas. The cross section prepared by those geologists shows Cherokee shale overstepping beveled Mississippian formations.

Permian and Pennsylvanian rocks.—The maximum thickness of Permian rocks in Geary County is about 750 feet. The total thickness of Permian and Pennsylvanian rocks ranges from about 1,500 feet in the extreme northeastern part of the county to about 2,250 feet in the southwestern part (Moore and Jewett, 1942, fig. 2).

Mississippian rocks.—According to Lee and Payne (1944, fig. 17), the total thickness of Mississippian limestone formations in Geary County ranges from a featheredge to more than 100 feet. According to Lee, Leatherock, and Botinelly (1948, pl. 14), the "Warsaw" (?), Gilmore City, and Sedalia limestones are the Mississippian limestone formations that are probably present in the northern part of the county. The Chattanooga shale ranges in thickness from a featheredge to more than 200 feet (Lee, 1943, fig. 14).

Pre-Chattanooga rocks.—In Geary County the "Hunton" limestone has an average thickness of about 300 feet. The Maquoketa shale

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is about 85 feet thick and is underlain by about 120 feet of Viola dolomite. The Simpson (St. Peter) sandstone includes a few feet of greenish shale in the upper part, a sandstone, and about 45 feet of red shale in the lower part. The total thickness of the Simpson is about 75 feet. About 10 feet of sandstone overlying granite in the Pioneer Petroleum Company No. 1 Chase Ranch well, in the SE cor. SE¼ sec. 10, T. 12 S., R. 7 E., is believed to be the Lamotte sandstone.

Three wells in Geary County have been drilled into Pre-Cambrian rocks. The Pioneer Petroleum Company No. 1 Chase Ranch well reached granite at 2,920 feet. The Wright et al. No. 1 Younkin well, at the Cen. N. line NE¼ NW¼ sec. 17, T. 11 S., R. 5 E., reached granite at 2,940 feet. The Hetzer No. 1 Sullivant well, NE¼ NE¼ NE¼ sec. 36, T. 13 S., R. 5 E., encountered Pre-Cambrian rocks at 3,030 feet.

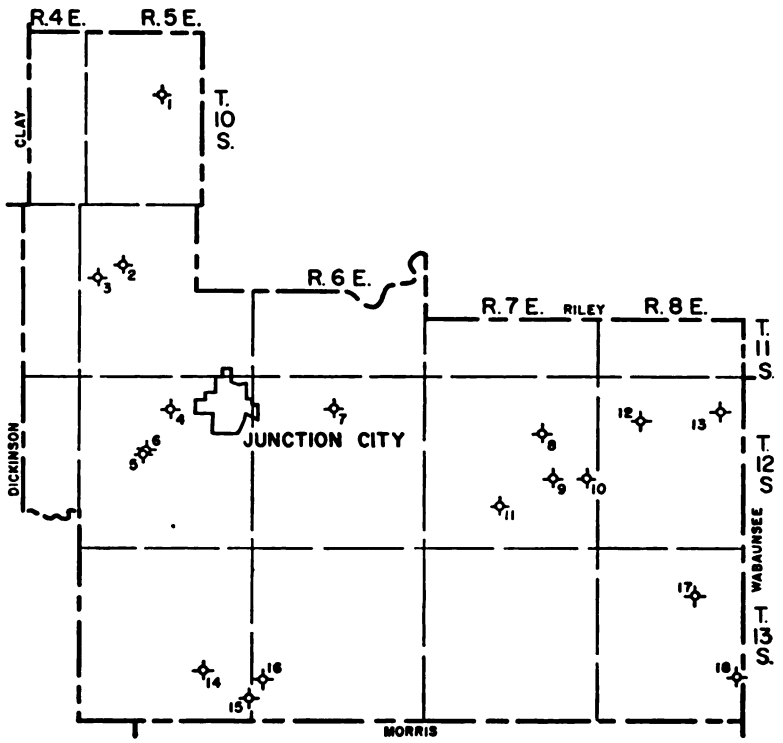

FIG. 35.—Map of Geary County showing location of wells listed in Table 34.

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Oil and Gas Exploration

Neither oil nor gas has been discovered in Geary County. Table 34 gives data on test drilling for oil and gas in the county, and Figure 35 shows the locations of 18 test wells in the county of which the Geological Survey has records.

Table 34.—*Wells drilled for oil and gas in Geary County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Lowest formation penetrated
1	Brinkley et al. No. 1 Fawley	NW NW NE 16-10-5E	1927	2,501	Maquoketa
2	Wright et al. No. 1 Younkin	CNL NE NW 17-11-5E	1930	3,240	Pre-Cambrian
3	Kerby & Wright No. 1 Kurtze	CNL SW SE 18-11-5E	1927	2,652	"Hunton"
4	Carter Oil Co. No. 1 Munson	NE NW NW 10-12-5E	1905	1,930	Mississippian
5*	Junction City Mining & Drlg. Co.	SE NE SW 16-12-5E	about 1904	1,700	
6*	Junction City Mining & Drlg. Co.	SE NE SW 16-12-5E	about 1904	.....	
7	Pay Rock Oil Co., Inc. No. 1 Whittaker	E½ NE NE 9-12-6E	1949	2,658	Viola
8	Pioneer Petro. Co. No. 1 Chase Ranch	SE SE SE 10-12-7E	1929	3,638	Pre-Cambrian
9	F. G. Holl No. 1 Smiley	NE NE SW 7-12-7E	1952	2,362	"Hunton"
10	F. G. Holl et al. No. 1 Eseli	NW NW SE 24-12-7E	1952	2,656	Arbuckle
11	Pioneer Petro. Co. No. 1 Zumbrum	SW SW NE 28-12-7E	?	1,895	Cherokee
12	F. G. Holl No. 1 Poole	NE NE SE 7-12-8E	1952	2,167	"Hunton"
13	Scheu & Teague No. 1 Aye	NW SW NW 10-12-8E	1939	2,239	Maquoketa
14	Manhattan Oil Co. No. 1 Foster	SW NE NW 26-13-5E	1927	2,382	"Hunton"
15	H. H. Hetzer No. 1 Sullivant	NE NE NE 36-13-5E	1949	3,043½	Pre-Cambrian
16	Liberty-Texas Co. No. 1 Foster	NE NE SW 30-13-6E	1926	2,412	Marmaton?
17	Empire Gas & Fuel No. 1 Stellwagen	NE SE SW 9-13-8E	1917	2,763	"Hunton"?
18	L. E. Dornes et al. No. 1 Fechner	SE NE 27-13-8E	1933	1,220	Douglas group

* Data on wells 5 and 6 from Mr. F. R. Newsome, Junction City, Kansas; two wells are about 300 feet apart.

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GREENWOOD COUNTY

Many wells were drilled in Greenwood County in 1918, but oil production did not become important until 1921. The geology and development of the shoestring oil fields of Greenwood County have been discussed by Cadman (1927) and Bass (1936).

Greenwood County produced 6,834,217 barrels of oil in 1952. Oil production in the county during each year from 1916 to 1948 is shown in Tables 2 and 3. Table 73 gives production in the various fields for 1949 through 1952. Figure 36 is a map of Greenwood County showing locations of oil and gas fields as defined by the Kansas Nomenclature Committee and locations of areas that yielded oil in 1952.

Secondary recovery of oil by water injection is an important phase of the oil industry in Greenwood County. Forty-nine water-flooding projects are being operated in the county (Table 4, Fig. 2). It is estimated that more than 4½ million barrels of oil was produced by secondary recovery methods in 1952.

Geology

SURFACE ROCKS

Permian rocks.—The Florence flint, Matfield shale, and Wreford limestone in the lower part of the Chase group (Fig. 3) crop out in the extreme northwestern part of Greenwood County. The thickness of these rocks is about 175 feet. The Council Grove group has an average thickness of about 300 feet in the county, and the Admire group is about 150 feet thick.

Pennsylvanian rocks.—The average thickness of the Wabaunsee group (Fig. 4) in Greenwood County is about 420 feet. The Shawnee group has an average thickness of about 425 feet. The upper part of the Lawrence shale of the Douglas group is exposed in the extreme southeastern part of the county.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons in the Breitkrautz well are listed in Table 35.

Pennsylvanian rocks.—The Douglas group includes beds of shale, sandstone, and thin limestone, and is about 300 feet thick in Greenwood County. The Pedee group consists of shale and some sand-

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TABLE 35.—*Depths to key horizons in the Burge, Trott et al. No. 1 Breitkrautz well, NW¼ SE¼ SW¼ sec. 4, T. 24 S., R. 10 E., Greenwood County*

Horizon	Depth, feet
Top Lansing group	1,360
Top Mississippian limestone	2,447
Top Chattanooga shale	2,804
Top Arbuckle	2,916
Top Roubidoux sandstone	3,391
Top Bonneterre dolomite	3,463
Top Pre-Cambrian	3,480
Total depth	4,820

stone and is unconformably overlain by sandstone and shale of the Douglas group. It is convenient to designate the combined Douglas and Pedee rocks as Douglas-Pedee where the boundary cannot be recognized. The Lansing group consists of about 360 feet of shale and limestone. The Kansas City group consists largely of limestone but includes some shale and sandstone, especially in the upper part; the lower part, the Bronson subgroup, consists almost entirely of limestone. Its average thickness is about 450 feet. The Pleasanton shale has an average thickness of about 60 feet. The Marmaton group consists of about 250 feet of alternating limestone and shale. The Cherokee shale consists of light and dark-gray shale, black shale, lenses of sandstone, and a few thin beds of limestone and coal. Sandstone lenses occur locally near the top of the Cherokee. Sandstone lenses called "Cattleman" occur 50 to 75 feet above the top of the "Bartlesville shoestring sands," which are about 100 feet above the base of the Cherokee. Common thicknesses of the "Bartlesville" are between 50 and 100 feet. Locally the "Bartlesville" rests on Mississippian rocks (Bass, 1936, p. 23). In the eastern part of the county a sandstone is present at the base of the Cherokee shale. It is separated from the overlying "Bartlesville sand" by shale.

Mississippian rocks.—Mississippian limestones in Greenwood County range from about 250 to 400 feet in total thickness (Lee, 1940). They consist of limestone, cherty limestone, and shale. The "Warsaw," Keokuk, Burlington, Reeds Spring, and St. Joe limestones and the Northview-Compton shale have been identified in a well in sec. 33, T. 25 S., R. 10 E. (Lee, 1940). The Mississippian

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limestones are underlain by the Chattanooga shale which ranges in thickness from about 40 to 100 feet. The Chattanooga rests unconformably on Ordovician rocks.

Ordovician and Cambrian rocks.—Ordovician and Cambrian rocks in Greenwood County have a total thickness of about 700 to 1,000 feet. The Chattanooga shale is directly underlain by Viola limestone. The Viola limestone and Arbuckle rocks are separated by the St. Peter (Simpson) sandstone. Arbuckle rocks consist of massive beds of dolomite, limestone, and sandstone which are commonly referred to as "siliceous lime."

Keroher and Kirby (1948, pl. 6) studied well cuttings from the Burg, Trott, et al. No. 1 Breitkrautz well, sec. 4, T. 24 S., R. 10 E. They identify 475 feet of undifferentiated Jefferson City-Cotter dolomite, 72 feet of Roubidoux dolomite, and 17 feet of Bonneterre dolomite. The Bonneterre was found to be lying on Pre-Cambrian rocks. They (Keroher and Kirby, 1948, fig. 10) inferred that westward from a point a short distance west of the well whose cuttings were studied, the Roubidoux dolomite lies on Pre-Cambrian rocks, and that the Van Buren-Gasconade dolomites, the Gunter sandstone member of the Van Buren, and the Eminence dolomite pinch out in places southeast of the well.

Oil and Gas Developments

Most of the oil produced in Greenwood County is from elongated lenses of sand in the lower part of the Cherokee shale at an average depth of about 2,000 feet. The individual lenses are arranged approximately end to end, separated by narrow gaps, so that they form collectively long narrow systems, each 20 to 50 miles long and only a half mile to 1½ miles wide. These elongated sand bodies are commonly referred to as shoestrings. The sand lenses are not at one stratigraphic horizon, but all are confined to restricted stratigraphic zones. Considerable oil is produced in the county from the Mississippian limestone.

In the following discussions individual fields are referred to trends of shoestring oil pools as designated by Bass (1936). The **Sallyards trend** extends from the **Keighley** field in Butler County northwestward across Greenwood County and includes a number of fields from the **Blankenship** (partly in Butler County) to the **Madison** field (Fig. 36). The **Teeter trend** is about 6 miles north-

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west of the Sallyards. It extends from the **Scott** field to the southern part of the **Pixlee** which contains the **Theta** pool (Bass, 1936, pl. 1). The **Quincy** and **Lamont trends** are nearly at right angles to the Teeter and Sallyards. The Quincy crosses the Sallyards in the **Seeley-Wick** field (northwest part of T. 23 S., R. 11 E.) and the **Lamont trend** is about 8 miles northeast of the Quincy.

The Sallyards trend is the **"Golden Lanes."** In it and the other trends, oil pools occur in the "Bartlesville sand" at depths ranging from about 2,000 to 2,500 feet.

The **Atyeo** oil field lies partly in Chase and Lyon Counties, northwest of the **Teeter trend** of shoestring sand bodies. The field was opened in 1925 by a well in T. 22 S., R. 10 E. The reservoir rock is the "Bartlesville sand" at an average depth of about 2,250 feet. Average thickness of the sand is about 25 or 30 feet. A water-flood project is operating in the Greenwood County part of the field.

The **Beaumont** field has produced oil from the "Peru sand" at about 1,830 feet; Mississippian limestone at about 2,445 feet; and from Arbuckle limestone at about 2,470 feet. The field is in T. 27 S., R. 8 E., and lies on the Beaumont anticline. The **Beaumont North** field produces oil from Mississippian limestone at a depth of about 2,475 feet. Gas occurs in the field at about 1,160 feet. The **Beaumont South** field was opened in 1935. Oil occurs in Mississippian limestone at about 2,500 feet.

It is probable that oil was first produced in the **Blackwell** field in 1926, when a Mississippian limestone pool was found in sec. 16, T. 24 S., R. 13 E., at 1,670 feet. The **Blankenship** oil field, T. 26 S., R. 8 E., extends into Butler County. It is a "Bartlesville sand" field in the **Sallyards trend.** The average depth to the producing formation is about 2,450 feet. A water-flooding project is operated in the field. At least one well in the **Brinegar** field has produced from Mississippian limestone at a depth of about 1,850 feet. Other production is from the Rock Lake shale member of the Stanton limestone at depths ranging from about 340 to 440 feet and from "Bartlesville sand." Some gas has been produced in the area at a depth of about 880 feet. Production data in the **Brinegar North** field are not available.

The **Browning** oil field was opened in 1924. It lies in the **Teeter trend,** or **"Little Golden Lanes"** in T. 22 S., R. 10 E. The reservoir rock, the "Bartlesville sand," has a maximum thickness of 50 feet. It lies at a depth of about 2,300 feet. A water-flooding project is

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operating in the field. The discovery well in the **Burkett** field, T. 23 S., R. 10 E., was drilled in 1922. This is a "Bartlesville sand" field in the long **Sallyards "Golden Lanes."** The depth to the oil reservoir is about 2,100 feet. A water-flood project is operating in the field.

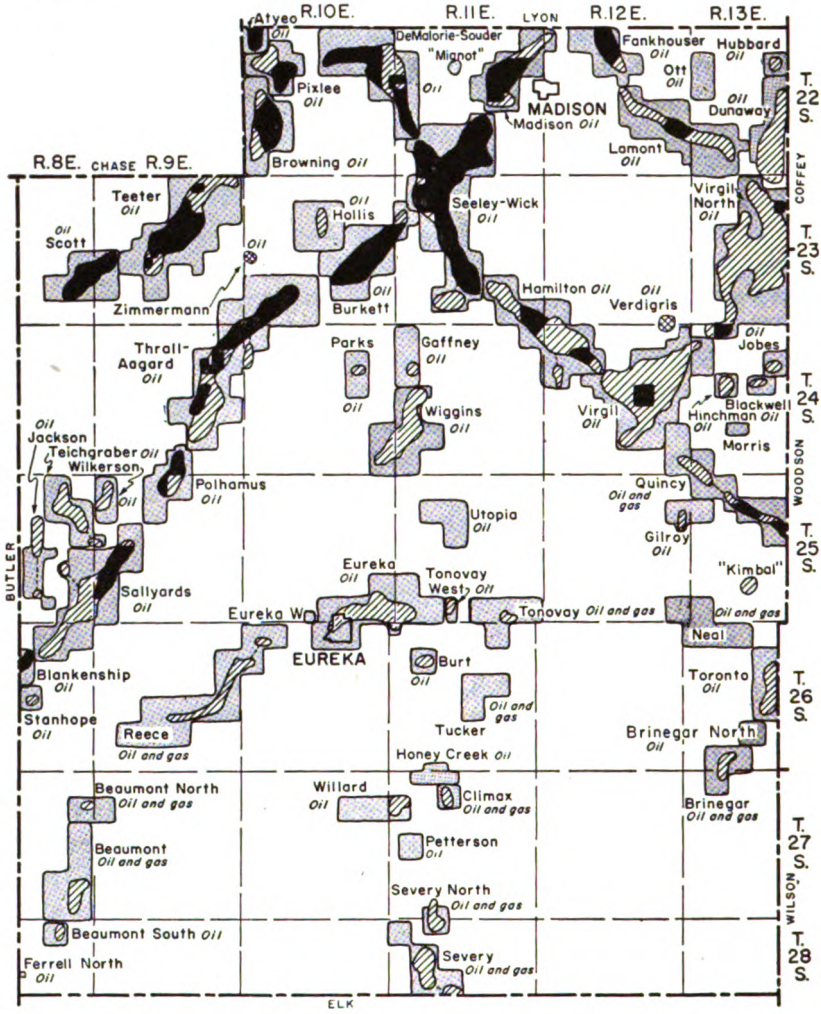

FIG. 36.—Map of Greenwood County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black; crossed lines show 1953 pool discoveries.

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The **Burt,** a Mississippian limestone pool, was discovered in 1949 by a well in sec. 8, T. 26 S., R. 11 E. Oil was found in a zone between 1,865 and 1,878 feet. Initial production of 30 barrels of oil per day was reported. Gas has been produced in the **Climax** field. T. 27 S., R. 11 E., from a Marmaton sandstone at a depth of about 950 feet. Oil is produced in the field from "Bartlesville sand" at a depth of about 1,820 feet.

The **DeMalorie-Souder** oil field, T. 22 S., Rs. 10 and 11 E., was opened in 1924. At least one of the early wells had an initial daily production of 1,000 barrels of oil. Bass (1936, pl. 12) showed that the field lies above at least four disconnected sand bodies, all in the **Quincy trend.** The sand thickness in some parts of the field is 100 feet or more. The depth to the producing zone is about 2,050 feet. There are now six secondary recovery projects operating in the field. It should be noted that although the first **DeMalorie-Souder** producing well was drilled in 1924, one or more producing wells had been drilled in 1923 in the **Harris** field, secs. 18 and 19, T. 22 S., R. 11 E., an area that is now a part of the **DeMalorie-Souder** field.

The **Dunaway** oil field, T. 22 S., R. 13 E., extends into Coffey County. The average depth to the producing "Bartlesville sand" body is about 1,800 feet. Probably the first producing oil wells in the **Eureka** field, T. 25 S., R. 10 E., were drilled in 1927. The oil pool is in the upper part of the Mississippian limestone section at an average depth of about 1,975 feet. The **Eureka West,** a Mississippian limestone pool, was discovered in 1949 by a well in sec. 33, T. 25 S., R. 10 E. Oil was encountered in a zone between 1,979 and 1,995 feet. Initial potential of 15 barrels of oil per day was assigned. No production has been reported, however.

The **Fankhauser** oil field extends from T. 22 S., R. 12 E., northward into Lyon County. The field was drilled extensively in 1926. At least one of the early wells had an initial daily production of 400 barrels of oil. The depth to the producing "Bartlesville sand" averages about 1,850 feet. There are three water-flood projects operating in the field. The **Ferrell North** field was opened in 1944. It is a Mississippian limestone or "chat" field in sec. 15, T. 28 S., R. 8 E. The pay zone is at a depth of 2,742 feet.

The "Bartlesville sand" **Gaffney** oil pool, T. 24 S., R. 11 E., was discovered in 1926. The reservoir rock is at an average depth of about 1,850 feet. The **Gilroy** field, T. 25 S., Rs. 12 and 13 E., was

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discovered in 1928. Present production is from Mississippian rocks at a depth of about 1,600 feet. The **Hamilton** oil field, formerly called **Patterson,** was developed in 1928. The field is in the long **Quincy trend** of "Bartlesville sand" fields and extends to the northwest and southeast from the southwest corner of T. 23 S., R. 11 E. The average depth to the reservoir rock is about 1,750 feet. Two water-flooding projects are operating in the field.

It is probable that oil was first produced in the **Hinchman** field in 1927, when a well in T. 24 S., R. 13 E., found oil in the upper part of the Mississippian limestone at 1,593 feet. The **Hollis** oil pool was discovered in 1925 by a well in T. 23 S., R. 10 E. The depth to the "Bartlesville sand," which is the reservoir rock, is about 2,160 feet. The **Honey Creek** field was opened in 1950 by a well in sec. 32, T. 26 S., R. 11 E. Oil was found in Mississippian limestone at a depth of 1,871 feet. Small production was reported during 1950 and 1951. Initial potential assigned was 30 barrels of oil per day.

The **Hubbard** oil pool, T. 22 S., R. 13 E., is in sandstone in the upper part of the Cherokee section, at an average depth of about 1,500 feet. No production had been reported from the field for several years previous to 1952, when production was resumed. Oil is produced in the **Jackson** field, T. 25 S., R. 8 E., from the "Bartlesville" at an average depth of about 2,450 feet. The **Jobes** field, T. 24 S., R. 13 E., is a Mississippian limestone field, with production from about 1,700 feet.

Logs of producing wells in the **"Kimbal"** field (Kimbal lease, sec. 28, T. 25 S., R. 13 E.) are not available. The **Lamont** oil field, in T. 22 S., Rs. 12 and 13 E., opened in 1927, lies in a shoestring trend with the **Fankhauser** field. The average depth to the producing "Bartlesville sand" zone is about 1,650 feet. One water-flood project is operating in the field.

The **Madison** oil pool, T. 22 S., R. 11 E., at the northeast end of the **Sallyards trend,** probably was discovered in 1921. The "Bartlesville" sandstone there lies at an average depth of about 1,800 feet. Two water-flood projects are operating in the field. The **Morris** pool was named in 1950 from a well in sec. 28, T. 24 S., R. 13 E. Initial production of 12 barrels of oil per day from Mississippian rocks between 1,671 and 1,676 feet was assigned. The Geological Survey has record of another well in the same section completed in 1925 showing initial potential of 75 barrels of oil per day from

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"Bartlesville sand" at a depth of 1,641 feet. No production has been reported for either well.

The **Neil** oil and gas field, Ts. 25 and 26, R. 13 E., has produced gas from the upper part of the Mississippian limestone at a depth of about 1,525 feet. At least one oil well, with production of 25 barrels per day, was drilled in 1939, in sec. 31, T. 25 S., R. 13 E. Oil was found in the upper part of the Mississippian limestone at 1,576 feet. Oil was found in the now abandoned **Ott** field in 1922, when a 200 barrel per day well was completed in sec. 7, T. 22 S., R. 13 E., in Simpson sandstone, at a depth of 2,236 feet. Several other wells with daily production of as much as 450 barrels of oil were drilled soon after the discovery. Although the oil pool may be partly controlled by structure it may be regarded at least in part as being in a stratigraphic trap on the flank of the Chautauqua arch.

Oil production was revived in the **Parks** oil field in 1950. The field is in T. 24 S., R. 10 E. Production is from Mississippian limestone at a depth of about 2,675 feet. The **Petterson** field, which now is abandoned, produced oil from Ordovician limestone at 2,360 feet. Probably the field, which is in T. 27 S., R. 11 E., was opened in 1945. The **Pixlee** field was opened in 1927 by a well in T. 22 S., R. 10 E. The reservoir rock is the "Bartlesville sand" at a depth of about 2,300 feet. The sandstone is as much as 45 feet thick in some parts of the field. Bass (1936) differentiated the **Theta** pool from the **Pixlee** in the southern part of the larger area that is now included in the **Pixlee** field. He pointed out that the **Theta** lies in the **Teeter trend** but that the **Pixlee** is northwest of it. A water-flood project is operating in the field. Oil occurs in the **Polhamus** field, Ts. 24 and 25 S., R. 9 E., in "Bartlesville sand" at an average depth of about 2,250 feet. A water-flood project is now operating in the field, opened in 1925. The **Quincy** oil field was opened in 1927. The average depth to the "Bartlesville" producing sandstone is about 1,500 feet. A water-flooding project operating in the field in T. 28 S., R. 13 E. extends into Woodson County.

The **Reece** oil field, T. 26 S., Rs. 9 and 10 E., produces from Kansas City rocks at about 1,380 feet and from Mississippian limestone at about 2,100 feet. The **Sallyards** oil field was opened in 1917 in T. 26 S., R. 8 E. Oil production in the elongated field, which is a part of the **"Golden Lanes,"** is from "Bartlesville" sandstone at an average depth of about 2,400 feet. There are three water-flooding projects in the field. The **Scott** oil field was opened in 1925 in T.

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23 S., R. 8 E. The field is in the **Teeter trend,** with the "Bartlesville sand" reservoir at an average depth of about 2,575 feet. The average thickness of the sand body exceeds 50 feet; as much as 130 feet has been reported. A water-flooding project is operating in the field.

The **Seeley-Wick** is a large oil field in Ts. 22 and 23 S., R. 11 E. Oil production is from sandstones in both the **Sallyards** and **Quincy trends,** which cross one another in sec. 5, T. 23 S., R. 11 E. The **Wick** reservoir, in the **Sallyards trend,** is slightly higher stratigraphically and hence younger than the **Seeley** reservoir in the **Quincy trend.** The average depth to the pay zones is about 1,950 feet. There are eight water-flood projects operating in the field, which was opened in 1922. The **Severy** field formerly produced gas from the "Burgess sand" at a depth of about 1,910 feet. Oil is produced in the field, T. 28 S., R. 11 E., from Lansing rocks at about 1,125 feet. The **Severy North** field produces oil from Lansing-Kansas City rocks at depths ranging from 830 to about 1,250 feet. The **Stanhope** oil field, T. 26 S., R. 8 E., produces from Mississippian limestone at an average depth of about 2,450 feet.

The **Teeter** oil field was opened in 1921. Four secondary recovery projects are operating in the "Bartlesville sand" field. The depth to the producing formation is about 2,500 feet. The field extends from T. 23 S., R. 9 E., into Lyon County. Four water-flooding projects are operating in the Greenwood County part of the field. The **Teichgraber** field, T. 25 S., R. 8 E., produces oil from the "Bartlesville" at an average depth of about 2,300 feet. The **Thrall-Aagard** field is a part of the long **Sallyards trend**—the **"Golden Lanes."** The **Aagard** pool was found in 1923 by a well in sec. 14, T. 24 S., R. 9 E. In 1924 the discovery well was reported to be producing 400 barrels of oil per day from a zone between 2,134 and 2,169 feet. Probably the **Thrall** pool was opened in 1925 by a well on the Thrall lease in sec. 27, T. 23 S., R. 10 E. The fields were joined many years ago. There are now eight water-flooding projects operating in the field. In 1930 it was noted that a gradual increase in oil production caused by water infiltration from abandoned wells was taking place in the **Aagard** field. This accidental flood is said to have caused an increase from a daily average of 17 barrels of oil per well to 61 barrels. The first controlled flood in the field was initiated in 1937.

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Oil is produced in the **Tonovay** field, T. 25 S., R. 11 E., from the upper part of the Mississippian limestone at an average depth of about 1,830 feet. Gas has been produced in the field from Douglas sandstone at a depth of about 540 feet. The **Tonovay West,** a Mississippian limestone pool, was discovered in 1950 in T. 26 S., R. 11 E. The reservoir rock was reached at 1,948 feet. Initial production was listed as 60 barrels of oil per day. The **Toronto** oil field, T. 26 S., R. 13 E., partly in Woodson County, was discovered in 1913. The producing zone is called "Bartlesville sand"; however, it is believed to be slightly younger than most of the "Bartlesville" in Greenwood County. The **Tucker** field, T. 26 S., R. 11 E., has produced gas from sandstone in the basal part of the Douglas group or in the Pedee group at about 645 feet. Oil has been found in the area in the top of the Mississippian limestone section at 1,892 feet.

The first producing oil well of record in the **Utopia** field, T. 25 S., R. 11 E., was drilled in 1918. Oil was found in a 25-foot sandstone in the upper-middle part of the Cherokee section at a depth of 1,685 feet. The well produced 100 barrels of oil per day when first completed. After 30 days the production had declined to 50 barrels daily and in 6 months an average production of 40 barrels per day was established. The well was abandoned in 1925. The **Verdigris,** a Mississippian pool at 1,760 feet, was opened in T. 24 S., R. 12 E. in 1952. Initial potential of the discovery well was 7 barrels of oil per day.

The **Virgil** field was one of the first to produce oil from the Mississippian limestone in Kansas. The discovery well in this field, the Cosden Oil and Gas Company No. 1 Wyaham in the SE¼ sec. 14, T. 24 S., R. 12 E., was completed on October 12, 1916. The initial production was about 15 barrels. By 1929, 193 oil wells and 10 gas wells were producing in this field. The average initial production of the oil wells was about 28 barrels per day. Some production is from the "Bartlesville sand" but the important production is from a porous zone at or near the top of the Mississippian limestone at a depth of about 1,700 feet. The **Virgil** field is located on a surface structure having a closure of more than 60 feet. The **Virgil North** oil field, in T. 23 S., R. 13 E., was opened in 1920. Oil production is from the "Bartlesville sand" at an average depth of about 1,585 feet, and from Mississippian limestone at about 1,840 feet. Two water-flooding projects are operating in the field.

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The **Wiggins** oil field, T. 24 S., Rs. 10 and 11 E., produces from one or more sandstones in the Cherokee section at an average depth of about 1,800 feet. The **Wilkerson** oil field, T. 25 S., R. 9 E., was opened in 1928. Oil occurs there in the "Bartlesville sand" at about 2,450 feet. The **Willard** oil field produces from Mississippian "chat" at a depth of about 1,880 feet. Probably the field, which is in T. 27 S., Rs. 10 and 11 E., was opened in 1927. The **Zimmermann** oil pool, T. 23 S., R. 10 E., was discovered in 1953 in "Bartlesville sand" at a depth of 2,296 feet. Initial production was rated at 25 barrels of oil per day.

Recent activities.—Of seven new pools opened in Greenwood County since January 1, 1949, only the **Zimmermann** is a "Bartlesville sand" pool. The other six found production in Mississippian rocks (Table 1).

Table 73 summarizes pool wells drilled in Greenwood County from 1949 through 1952 and gives production of the various fields. Data on dry wildcat wells drilled in the same period are listed in Table 36. It is expectable that the number of wells drilled in 1953 will greatly exceed those of previous recent years.

TABLE 36.—*Data on dry wildcat wells drilled in Greenwood County, 1949 through 1952*

Company and farm	Location	Depth to Kansas City, feet	Depth to Mississippian, feet	Total depth, feet
	1949 Wells			
L. F. Reed No. 1 Reed	NW SW SE 28-25-12E	980	.....	1,573†
K. T. Wiedemann No. 1 Amerine	NE NE NE 14-27-9E	.....	2,582*	2,630
	1950 Wells			
Jackman and Jackman No. 1 Agnus Hawthorne	SW NW NW 13-23-11E	.....	.....	1,991†
Ward McGinnis No. 1 Houston	N½ SE SE 7-26-9E	1,605 2,240**	2,365	2,405
Giffin No. 1 Moore	N½ SE NE 35-26-10E	1,272	.....	1,404
Giffin No. 2 Moore	NE NE NE 35-26-10E	1,265	2,054	2,123
Southwest Prod. et al. No. 1 Hodson	SW SW SE 23-26-12E	.....	1,724 2,004*	2,043

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W. M. Glasco No. 1 J. E. Glasco	SW NE SW 11-28-10E	1,400	.....	1,452
John Evans et al. No. 1 Ed Brown	NE NW SE 4-28-12E	.....	.....	1,490
	1951 Wells			
Louisa Gary No. 1 French	NE SW NW 1-22-12E	.....	1,825	1,861
Cox & Burns et al. No. 1 Carson	NW SE NW 4-24-11E	.....	1,990	2,449
Assoc. Resources No. 1 Santier	NW SE NW 1-25-11E	.....	1,834	1,898
D. E. Epp No. 1 Epp	NE NE NE 4-25-12E	.....	1,692	1,835
Davis and Ives No. 1 Boyer	SE SE NW 25-26-12E	.....	1,633	1,673
Parker & McDaniels No. 1 Peoples Natl. Bank	NW NW NE 24-27-10E	.....	1,556	1,612
Morris & Lester Stryker No. 1 Ross	SW SE SW 11-27-12E	585	.....	1,093
	1952 Wells			
Derby Drlg. Co. No. 1 Curry	SW SW SW 11-23-11E	.....	1,950	1,975
Derby Drlg. Co. et al. No. 1 Redding	NW NE NW 11-23-11E	.....	2,020	2,049
Saturn Drlg., Inc. No. 1 Zebold	SE SW NE 6-24-9E	1,680	2,439	2,484
Raymond Smith No. 1 Snyder	SE NE NW 16-24-11E	.....	2,055	2,090
Davis & Conkey No. 1 Winters	NE SE NE 32-24-13E	718	1,572	1,618
Ward A. McGinnis No. 1 Olson	NW NW SW 9-25-8E	.....	2,450	2,484
Ward A. McGinnis No. 1 Lewis	SW SE NW 15-25-9E	.....	2,220	2,223
E. E. Souder No. 1 Sallyards	SE SE SE 27-25-9E	.....	2,203	2,378
Mallard Drlg. Co. No. 1 Anderson	N½ NE SW 14-25-10E	1,290	2,046	2,090
Mouser Drlg. Co. No. 1 Anspaugh	SW NW NE 17-27-10E	.....	2,181	2,200
Ben Hermes et al. No. 1 Shinkle	16-27-13E	.....	.....	1,585
White & Ellis et al. No. 1 Kinman	NE SW NW 11-28-10E	.....	2,143	2,543
Dillon, Jefferies & Bumgarner No. 1 Dillon	SW NW NE 28-25-13E	.....	.....	450

* Depth to top of Arbuckle, feet.
** Depth to top of "Bartlesville," feet.
† Stopped in Cherokee Shale.

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JACKSON COUNTY

Neither oil nor gas in commercial quantities has been produced in Jackson County. Eleven wells have been drilled. Porosity in Mississippian and "Hunton" rocks has been reported, and a show of oil was reported in the "Hunton" limestone in wells in sec. 27, T. 7 S., R. 15 E., and in sec. 14, T. 7 S., R. 13 E.

Geology

SURFACE ROCKS

Glacial deposits, some of which are several feet thick, occur in all parts of Jackson County. Consolidated bedrocks of Permian and Pennsylvanian ages are exposed. The youngest Permian rocks in the county are beds in the lower part of the Chase group and the oldest outcropping Pennsylvanian rock is the White Cloud shale.

Permian rocks.—The Wreford limestone caps hills in the northwestern part of Jackson County. Older Permian rocks (Fig. 3) crop out in most of the western two-thirds of the county. The Cottonwood limestone underlies an extensive dip slope in an area east of the Wreford-capped hills. Permian rocks in this county are similar in thickness and lithology to the same strata in near-by counties.

Pennsylvanian rocks.—Pennsylvanian rocks crop out in the eastern and southern parts of Jackson County. The oldest well-exposed rock is the Burlingame limestone (Fig. 4). The Tarkio and Burlingame limestones are the most prominent limestones among the outcropping Pennsylvanian beds.

SUBSURFACE ROCKS

Jackson County lies in the Forest City basin immediately east of the Nemaha anticline. Depths to some key horizons in five wells in the county are given in Table 37.

Pennsylvanian rocks.—Rocks of Pennsylvanian age in Jackson County have a maximum total thickness of about 2,250 feet. The section is thickest in the northern part of the county which is nearer the deepest part of the Forest City basin. The northward increase in thickness is chiefly in lower Pennsylvanian rocks. In the southwestern part of the county the interval between the base of the Bronson subgroup and the Mississippian rocks is about 800 feet, but the same interval is nearly 1,000 feet thick in the northern part.

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TABLE 37.—*Depths in feet to some key horizons in five wells in Jackson County*

Horizon	Rogers No. 1 Lincoln Liberty Life, NE SE 23-5-16E	Garvin et al. No. 1 Lutz, SW NW SW 27-7-15E	Goens No. 1 Wabense, NE NW 3-8-14E	McLaughlin & Sons No. 1 Kelly, SW NE 24-8-15E	Haverbach et al. No. 1 Ubl, NE NE NE 26-9-14E
Top Shawnee group	.....	490	700	345	.....
Top Douglas group	.....	800	1,060	650	740
Top Lansing group	.....	1,015	1,260	888	1,015
Base Kansas City group	.....	1,365	1,590	1,215?	1,595
Base Fort Scott limestone	.....	1,555	1,800	1,500	1,915?
Top Mississippian rocks	2,080	2,180	2,400	2,115	2,125
Top Chattanooga shale	2,330	2,475	2,592	2,275	2,365
Top "Hunton" limestone	2,533	2,635	2,832	2,480	2,580
Top Maquoketa shale	.....	.....	.....	.....	2,815
Top Viola limestone	.....	.....	.....	.....	2,880
Total depth	2,718	2,774	2,953	2,538	2,905

Mississippian rocks.—The total thickness of the Mississippian limestones ranges from less than 100 feet in the northwestern corner of Jackson County to more than 300 feet in the northeastern corner (Lee and Payne, 1944, fig. 17). The Spergen limestone is the uppermost Mississippian limestone formation that has been identified in the county. It lies next below Pennsylvanian rocks in the northeastern part. Westward the Pennsylvanian sediments overstep the "Warsaw" limestone onto the undifferentiated Burlington-Keokuk formations, the uppermost Mississippian rock in most of the county (Lee and Payne, 1944, figs. 4, 17).

The Chattanooga shale ranges in thickness from slightly more than 150 feet in the southeastern part to more than 250 feet in the western part (Lee, 1940, fig. 14).

Pre-Chattanooga rocks.—The "Hunton" limestone in Jackson County increases in thickness to the northwest toward the deeper part of the North Kansas basin. According to Lee (1943, fig. 12), the thickness range is from about 150 feet in the southeast corner to about 450 feet in the northwest corner. Lee (1943, fig. 13) has shown that Silurian rocks (lower part of the "Hunton" limestone)

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range in thickness from about 100 feet in the southeastern corner to about 300 feet in the northeastern corner.

The interval between the top of the Maquoketa shale (uppermost Ordovician) and the top of the St. Peter sandstone in Jackson County is believed to range from less than 200 feet in the southern and southeastern parts to about 300 feet in the northwestern corner (Lee, 1943, fig. 11). The thickness of rocks between the top of the St. Peter sandstone (upper part of Lower Ordovician) and Pre-Cambrian rocks probably ranges from less than 100 feet in the northwestern part to about 500 feet in the southeastern part (Lee,

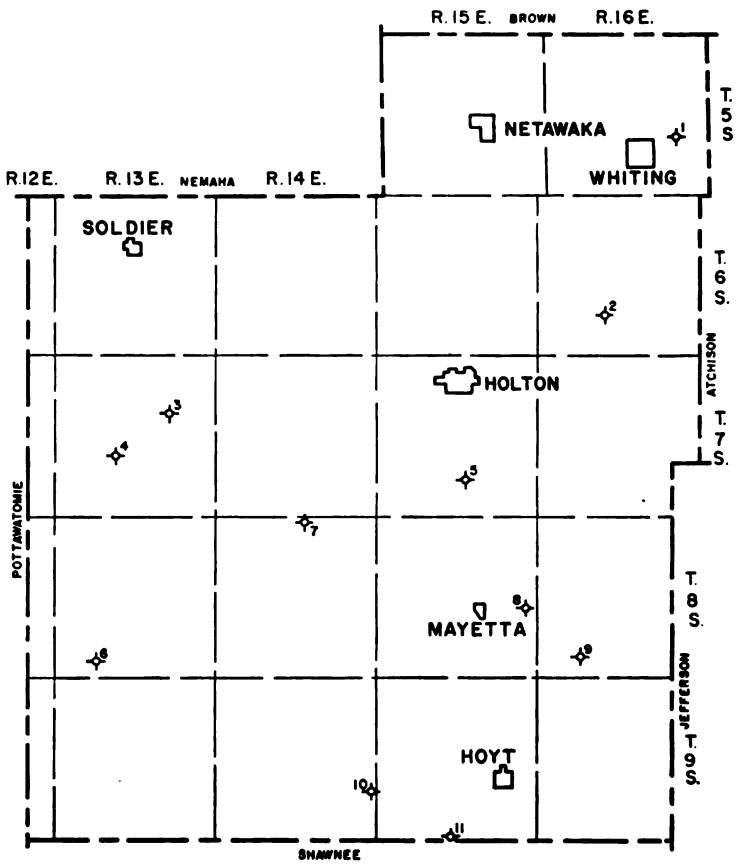

FIG. 37.—Map of Jackson County showing location of wells listed in Table 38.

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1943, fig. 9). The thickness of the St. Peter sandstone is probably much less than 100 feet. In the southern part of the county a few feet of Lamotte sandstone probably lies on the Pre-Cambrian floor.

Oil and Gas Exploration

Figure 37 is a map of Jackson County showing locations of wells drilled for oil or gas. Data on all wells on record in the Geological Survey files are given in Table 38.

The Geological Survey has records of 10 wells that were drilled in Jackson County previous to the end of 1948 (Jewett, 1949, table 44, fig. 31). One well has been drilled more recently. It is the Skelly Oil Company No. 1 Beighley, NE¼ NW¼ SE¼ sec. 14, T. 7 S., R. 13 (well 3, Table 38). It was completed in February 1952.

Table 38.—*Data on wells drilled for oil and gas in Jackson County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	L. B. Rogers No. 1 Lincoln Liberty Life	NE SE SE 23-5-16E	1942	2,718	Stratigraphic data given in Table 37
2	Charles Wheeler	28-6-16E	?	1,200	
3	Skelly Oil Co. No. 1 Beighley	NE NW SE 14-7-13E	1952	3,603	Top Mississippian, 2,415; "Hunton," 2,783; Viola, 3,343; Simpson, 3,438; Arbuckle, 3,567 ft.
4	Stanolind Oil & Gas Co. No. 1 Stratigraphic test	SW cor. 21-7-13E	1943	.....	Log not available
5	Garvin et al. No. 1 John Lutz	SW NW SW 27-7-15E	?	2,774	Stratigraphic data given in Table 37
6	"Well at Adrian"	SW SW NE 32-8-13E	?	1,000	Incomplete log
7	Goens et al. No. 1 Wabense	NE NW 3-8-14E	1928	2,953	Stratigraphic data given in Table 37
8	McLaughlin & Sons Co. No. 1 Kelly	SW NE 24-8-15E	1944	2,538	Stratigraphic data given in Table 37
9	D. W. McLaughlin No. 1 Allen	SW NW NE 32-8-16E	1945	3,068	Top Mississippian, 2,143; "Hunton," 2,515; Viola, 2,730; Simpson, 2,915; Arbuckle, 3,025 ft.
10	Haverbach et al. No. 1 Uhl	NE NE NE 26-9-14E	1938	2,905	Stratigraphic data given in Table 37
11	"Hoyt well"	SE SE SE 33-9-15E	?	1,246½	

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JEFFERSON COUNTY

Only a few test wells had been drilled in Jefferson County before oil was discovered near McLouth in 1940. Gas had been found there the previous year. By midyear 1943, 202 wells had been drilled in the McLouth area, partly in Leavenworth County (Lee and Payne, table 27). The geology and development of the McLouth fields has been discussed thoroughly by Lee (1941) and by Lee and Payne (1944).

Jefferson County produced 1,494 barrels of oil in 1952. Yearly oil production in the county during 1941 to 1952 inclusive is shown in Table 3. Table 73 shows the yearly production in the county's fields for 1949 through 1952. The locations of oil and gas fields and areas of 1952 oil production are shown in Figure 38.

Geology

SURFACE ROCKS

Glacial drift is attenuated in all parts of Jefferson County, but in most of the area consolidated Pennsylvanian bedrocks are well exposed. The youngest Pennsylvanian rock in the county is the Reading limestone (Fig. 4) or a slightly higher bed which is present in the northwestern part of the county; the oldest exposed rocks are the upper beds of the Douglas group which crop out in the southeastern part. The Tarkio and Burlingame limestones cap prominent escarpments east of the Reading limestone exposures. The Shawnee group is well exposed in Jefferson County. Its thickness is about 300 feet. The Ervine Creek and Plattsmouth limestones are the thickest limestones and are the most prominent cliff-making ledges. The upper part of the Lawrence shale, in the Douglas group, is the oldest exposed rock in the county.

SUBSURFACE ROCKS

Jefferson County lies in the Forest City basin and on the northeastern flank of the North Kansas basin. Depths to some stratigraphic horizons in a well in the McLouth area are given in Table 39 and some stratigraphic data are listed in Table 40.

Pennsylvanian rocks.—In the northwestern part of Jefferson County, where the youngest Pennsylvanian rocks are present, the thickness of the Pennsylvanian section is slightly more than 2,000 feet. In the southeastern part of the county Pennsylvanian rocks

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TABLE 39.—*Depths to some stratigraphic horizons in the J. B. Apperson et al. No. 1 Bower well, SE¼ SE¼ NE¼ sec. 5, T. 10 S., R. 20, E., Jefferson County*

Horizon	Depth, feet
Top Mississippian limestone	1,440
Top "Warsaw" limestone	1,450
Top Burlington-Keokuk porous zone	1,580
Top Chattanooga shale	1,781
Top Devonian rocks	1,829
Top Maquoketa	2,002
Top Kimmswick limestone	2,009
Top Decorah shale	2,158
Top St. Peter sandstone	2,165
Top Arbuckle	2,233
Total depth	2,288

are slightly more than 1,000 feet thick. As elsewhere in this part of Kansas, the base of the Oread limestone and the base of the Hertha limestone are convenient subsurface marker beds. Rocks between the base of the Hertha limestone and the Mississippian rocks in Jefferson County range in thickness from about 700 feet in the central-eastern part of the county (the McLouth field) to nearly 900 feet in the northwestern part (Lee, 1943, fig. 17A).

Mississippian rocks.—Limestones of Mississippian age in Jefferson County range in total thickness from about 250 feet in the northwestern part of the county to about 350 feet in the northeastern part (Lee, 1943, fig.16). The St. Louis limestone has been identified as the youngest Mississippian formation in the county (Lee and Payne, 1944, figs. 4, 17). This limestone lies next below Pennsylvanian beds in the northeastern part of the county and occurs as pre-Pennsylvanian outliers in the central part. West of the area in which the St. Louis limestone is next below the Pennsylvanian deposits, the Spergen and Warsaw formations are overlain by Pennsylvanian rocks. In the southwestern part of the county Pennsylvanian rocks lie on the Burlington-Keokuk limestones.

The Chattanooga shale ranges in thickness from about 75 feet in the southeastern part of Jefferson County to more than 150 feet in the northwestern part (Lee, 1943, fig. 14).

Pre-Chattanooga rocks.—Devonian rocks are 173 feet thick in the McLouth field (Lee and Payne, 1944, p. 48). The thickness increases toward the northwest and decreases toward the southeast.

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In the McLouth area Lee and Payne (1944, p. 47, fig. 3) found 15 to 20 feet of sandstone in the basal part of the Devonian section. A few feet of Maquoketa shale was found immediately below Devonian rocks. In a part of the area the Maquoketa shale and about 20 feet of the Kimmswick limestone were removed by erosion. The Kimmswick limestone was found to range in thickness from 125 to 150 feet (Lee and Payne, 1944, pp. 48-49). It lies disconformably on the St. Peter sandstone which is about 70 feet thick in the McLouth area. The Arbuckle rocks (Ordovician and Cam-

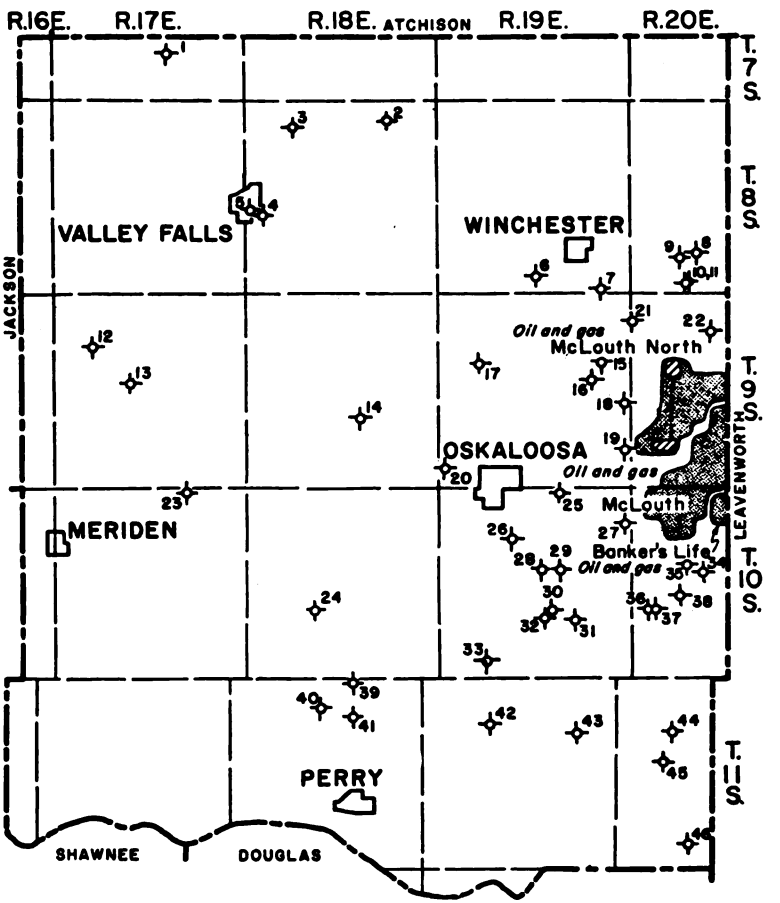

FIG. 38.—Map of Jefferson County showing oil and gas fields and locations of wells listed in Table 40. Diagonal lines show areas of 1952 oil production.

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brian) are about 700 feet thick in the McLouth area. The thickness increases toward the southeast and decreases toward the northwest.

Oil and Gas Developments

The **McLouth** fields have been discussed thoroughly by Lee (1941) and by Lee and Payne (1944). Three stratigraphic zones produced oil or gas: the McLouth sand in the basal part of the Cherokee shale, a zone at the top of Mississippian rocks, and a dolomitic zone in the Burlington-Keokuk limestone about 150 feet below the top of Mississippian rocks. The McLouth area extends into Leavenworth County.

The **McLouth North** gas pool yielded gas from the McLouth sand and oil was found in the same rock on the north and south margins of the area (Lee and Payne, 1944, pl. 3). The **McLouth** gas pool occupies a larger area. The gas was produced from the McLouth sand. Oil was found in Mississippian dolomite in the **McLouth** oil pool in secs. 4 and 5, T. 10 S., R. 20 E., and oil was found in the McLouth sand in sec. 3, T. 10 S., R. 20 E. in the **Bankers Life** pool, Leavenworth County. As commonly divided the McLouth area in Jefferson County includes the **Bankers Life, McLouth,** and **McLouth North** fields (Fig. 38).

One dry wildcat well was reported in Jefferson County in 1948. It is the No. 1 Browning well in the SW¼ SE¼ SW¼ sec. 16, T. 9 S., R. 17 E. Wells outside the McLouth areas, of which the Geological Survey has records, are listed in Table 40.

Recent developments.—One dry wildcat well was drilled in Jefferson County in 1951. It is the Miners Oil Company No. 1 C. A. Long, NE¼ NE¼ NW¼ sec. 27, T. 10 S., R. 19 E. No tests were reported in 1949, 1950, or 1952. A part of the **McLouth** gas area is being made into an underground gas storage reservoir, and hence there has been activity in the area in the past several months.

Table 40.—*Data on dry wildcat wells in Jefferson County (dry holes outside McLouth area)*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	..... No. 1 John Freeland	27-7-17E	1921	1,594	Top Mississippian, 1,590 ft
2	McLaughlin Develop. Co. No. 1 Gillan	SE NW SW 2-8-18E	1942	1,796	Top Mississippian, 1,760 ft.

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TABLE 40.—*Data on dry wildcat wells in Jefferson County (dry holes outside McLouth area), concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
3	McLaughlin Develop. Co. No. 1 Piazzek	SE SW 5-8-18E	1942	1,696	Stopped in Cherokee sh.
4	Myers Milk Co. Town of Valley Falls	19-8-18E	....	509	
5	Valley Falls coal well	SW NW 19-8-18E	1888?	1,191	
6	Bird & Sheedy No. 1 H. T. O'Neil	SE SW NW 34-8-19E	1939	2,685	
7	W. D. Dunn No. 1 Everett	SE SW 36-8-19E	1942	1,800	Top Mississippian, 1,585 ft.
8	McLaughlin & Sons Co. No. 1 O. C. Bodde et al.	NW NW SW 28-8-20E	1942	1,770	Top Mississippian, 1,583 ft.
9	McLaughlin & Sons No. 1 George Miller	SW SE 29-8-20E	1941	1,750	Top Mississippian, 1,544 ft.
10	McLaughlin Develop. Co. No. 1 George Miller	NE SE 32-8-20E	1942	1,536	Top Mississippian, 1,463 ft.
11	McLaughlin & Sons No. 2 George Miller	NE SE 32-8-20E	1942	1,535	Top Mississippian, 1,427 ft.
12	Continental Oil Co. et al. No. 1 Berridge	NW NW SW 8-9-17E	1939	2,981	Top Arbuckle, 2,940 ft.
13	Inland Prod. Co. & E. F. Jackman No. 1 Browning	SW SE SW 16-9-17E	1948	2,445	Top Mississippian, 1,908 ft.
14	J. S. McLaughlin & Sons No. 1 Frazier	SW NE 22-9-18E	1940	1,788	Top Mississippian, 1,675 ft.
15	Northern Oil & Gas Co. No. 1 Winchester	NW NW NW 13-9-19E	1927	3,440?	Top Pre-Cambrian about 3,280 ft.
16	Ed V. Jackson No. 1 J. P. Sheldon	NE SE 14-9-19E	1942	1,749	Top Mississippian, 1,699 ft.
17	D. M. McLaughlin No. 1 Heibsch	NE NW 17-9-19E	1943	1,938	Top Mississippian, 1,712 ft.
18	Bradley & Jackson No. 1 Northwestern Mutual Life Insurance Co.	SE NE 24-9-19E	1942	1,734	Top Mississippian, 1,590 ft.
19	B. O. Slottman et al. No. 1 Bankers Life	SE SE 25-9-19E	1943	1,473	Stopped in Cherokee sh.
20	Sagamore Oil & Gas Co. No. 1 Snyder	SW NW 31-9-19E	1943	1,726	Top Mississippian, 1,555 ft.
21	E. V. Jackson No. 1 Shughart	SW SW 6-9-20E	1942	2,007	Top Mississippian, 1,521 ft.
22	McLaughlin Develop. Co. No. 1 Bodde	NW NW NE 9-9-20E	1942	1,770	Top Mississippian, 1,583 ft.
23	Una Oil Co. No. 1 Griffith	SW NW NW 2-10-17E	1946	2,184	Top Mississippian, 1,692; top "Hunton," 2,160 ft.
24	McLaughlin & Sons No. 1 Vida Moon	SW SW 21-10-18E	1943	1,695	Top Mississippian, 1,648 ft.
25	E. V. Jackson et al. No. 1 M. M. Chavanne	NE NE 3-10-19E	1941	1,658	Top Mississippian, 1,595 ft.

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26	Sifers et al. No. 1 Leonhard	SE SW 9-10-19E	1942	1,709	Top Mississippian, 1,670 ft.
27	Whitten et al. No. 1 Meyer	NE NE 12-10-19E	1941	1,620	Top Mississippian, 1,616 ft.
28	Magnolia Petro. Co. No. 1 C. F. Imus	SE NE SW 15-10-19E	1944	2,256	Top Mississippian, 1,644; top "Hunton," 1,992; top Viola, 2,193 ft.
29	Magnolia Petro. Co. No. 1 National Life Insurance Co.	SE NE SE 15-10-19E	1944	2,149	Top Mississippian, 1,558; top "Hunton," 1,942; top Viola, 2,133 ft.
30	Workman & Sherrod et al. No. 1 Riling	SW SW SE 22-10-19E	1942	1,604	Top Mississippian, 1,589 ft.
31	J. O. Issacs No. 1 Mary Lowe	NE NW 26-10-19E	1943	1,743½	Top Mississippian, 1,616 ft.
32	Miners Oil Co. No. 1 C. A. Long	NE NE NW 27-10-19E	1951	2,270	Top Mississippian, 1,644; top "Hunton," 2,058; top Viola, 2,242 ft.
33	Sherrod & Workman et al. No. 1 Seitz	SW NE 32-10-19E	?	1,643	Top Mississippian, 1,634 ft.
34	Anderson et al. No. 1 Woodhead Estate	NE SW 16-10-20E	1941	2,167	Top Mississippian, 1,543 ft.
35	McLaughlin et al. No. 1 Bank of McLouth	NE SE NE 17-10-20E	1944	1,724	Top Mississippian, 1,580 ft.
36	Luering et al. No. 1 Petrie	NE SE SE 19-10-20E	?	1,738	Top Mississippian, 1,555 ft.
37	Caufield & Sullivan No. 1 Ragan	SW SW SE 19-10-20E	1941	1,708	Top Mississippian, 1,562 ft.
38	Mosbacher et al. No. 1 Stroud	SW NE 20-10-20E	1941	1,531	Top Mississippian, 1,420 ft.
39	Keith et al. No. 1 Mary Smith	NE NE 3-11-18E	1942	1,777	Top Mississippian, 1,637 ft.
40	Anderson Drlg. Co. No. 1 Gramse	SE SE 4-11-18E	1932	2,324	Top Mississippian, 1,536; top "Hunton," 1,945 ft.
41	Anderson Drlg. Co. No. 1 Stines	NE NE NE 10-11-18E	?	1,565	
42	Jack Sherrod No. 1 Green	SW SW NW 9-11-19E	1941	1,685	Top Mississippian, 1,530 ft.
43	Pryor & Lockhart et al. No. 1 Varner	NE SE 11-11-19E	1942	1,527	Top Mississippian, 1,415 ft.
44	McLaughlin & Sons No. 1 White	NE SE 8-11-20E	1942	1,665	Top Mississippian, 1,503 ft.
45	Stewart et al. No. 1 Otto	SE NW SE 17-11-20E	1941	600?	
46	Magnolia Petro. Co. No. 1 Burns	SE NE NW 33-11-20E	1942	2,167	Top Mississippian, 1,442; top Viola, 1,932; top Arbuckle, 2,130 ft.

JOHNSON COUNTY

Small amounts of oil and gas have been produced in several parts of Johnson County. Productive sandstones are found in the Mar-

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maton and Cherokee groups. A report on the geology of Johnson and Miami Counties (Newell, 1935) includes areal geologic maps and describes in detail the outcropping rocks in the two counties. The subsurface geology of Johnson County has been discussed by Ockerman (1935) and Lee (1943) in papers on the subsurface rocks in northeastern Kansas.

A small amount of oil has been produced recently in the "Dennis" field. Locations of oil and gas fields as defined by the Kansas Nomenclature Committee are shown in Figure 39.

Geology

Surface Rocks

Pennsylvanian rocks crop out in all parts of Johnson County except where concealed by glacial drift or other surficial deposits. Pennsylvanian groups present include the Douglas, Pedee, Lansing, and Kansas City (Figs. 4, 5). The youngest Pennsylvanian rock in the county is the Tonganoxie sandstone which crops out on the uplands in the western part of the county; the oldest outcropping rock is the Winterset limestone member of the Dennis formation which crops out in the valley of Indian Creek along the eastern edge of the county and in the bed of Turkey Creek in northeastern Johnson County.

A large part of Johnson County is immediately underlain by the Stanton limestone. The Plattsburg and Wyandotte limestones crop out in many places along the valley walls of streams which have cut into the upland that is floored by the Stanton limestone. There are several useful key beds in the outcropping rocks. Among the more easily identified beds are black platy and fissile shale in the Eudora shale member of the Stanton limestone; the Merriam limestone, basal member of the Plattsburg formation; and the Paola limestone, basal member of the Iola formation.

Subsurface Rocks

Depths to some stratigraphic horizons in four wells in Johnson County are shown in Table 41.

Pennsylvanian rocks.—The average thickness of Pennsylvanian rocks in Johnson County is about 1,000 feet. The thickness of the Pennsylvanian section from the top of the Lansing group, which includes the surface rocks over a large part of the county, to the top of the Mississippian limestones is about 1,050 feet.

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TABLE 41.—*Depths in feet at which some key horizons were reached in four wells in Johnson County* (Data in part from Lee and Payne, 1944, fig. 7)

Horizon	McCain No. 1 Doane, SE NW SW 34-12-22E	G. L. Smith No. 1 Pretz, SW SE NW 1-14-22E	Seminole Petro. Co. No. 1 Harrington, NE NE SW 12-14-22E	Adolf Thurow No. 1 Green, Cen. SW 25-14-22E
Base Hertha limestone	312	345	340	401
Base Fort Scott limestone	568	.....	753	652
Top Mississippian limestone	1,000	1,009	1,025	1,038
Top Chattanooga shale	1,387	1,412	1,395	1,447
Top Devonian limestone	1,429	.....	.....	1,528
Top Kimmswick (Viola) limestone	1,465	1,450	1,435	1,543
Top Decorah and Plattin limestone	1,578	.....	.....	1,567
Top St. Peter sandstone	1,605	1,555	1,535	1,587
Top Arbuckle limestone	.....	.....	1,598	1,654
Top Pre-Cambrian rocks	.....	.....	2,400	.....
Total depth	1,895	1,560	2,421	1,698

Mississippian rocks.—The total thickness of Mississippian limestone formations in Johnson County ranges from about 350 feet in the northwestern part to slightly more than 450 feet (Lee, 1943, Fig. 13). The average thickness of the Chattanooga shale in the county is somewhat less than 50 feet (Lee, 1943, Fig. 14).

Pre-Chattanooga rocks.—A thin section of Devonian rock is believed to underlie all of Johnson County. Lee (1943, fig. 7) identified 36 feet of Cooper and undifferentiated limestones in the McCain No. 1 Doane well in sec. 34, T. 12 S., R. 22 E., and 15 feet of Devonian sandstone in the Adolf Thurow No. 1 Green well in sec. 25, T. 14 S., R. 22 E. Fifteen feet of Devonian sandstone was found in a well in Missouri a few miles east of the southern corner of Johnson County.

Silurian rocks, the Maquoketa shale, and a part of the Kimmswick limestone were removed by erosion from this area before the time of deposition of Devonian sediments. The Kimmswick limestone was found to be 113 feet thick in the Doane well and 24 feet thick in the Green well. Twenty-seven feet of Decorah shale was found in the Doane well and 20 feet was found in the Green well.

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The St. Peter sandstone is believed to underlie all of Johnson County. The thickness everywhere probably is less than 100 feet. The Arbuckle limestone is 802 feet thick in the Seminole Petroleum Company No. 1 Harrington well in sec. 12, T. 14 S., R. 22 E. The Arbuckle rocks increase in thickness to the southeast. Lee (1943, fig. 5) has shown that pre-St. Peter rocks in Johnson County probably include Cotter dolomite, Jefferson City limestone, Roubidoux formation, Gasconade and Van Buren dolomites, Gunter sandstone, Eminence and Bonneterre dolomites, and Lamotte sandstone. There probably is a thin wedge of Potosi dolomite between the Eminence and Bonneterre dolomites in the eastern part of the county.

Pre-Cambrian rocks were reached at 2,400 feet in the Seminole Petroleum Company No. 1 Harrington well.

Oil and Gas Developments

Johnson County has never been an important oil county, and the gas production has not been spectacular. However, most test wells have not reached potential oil reservoirs in rocks below the Mississippian limestone. Structural and stratigraphic conditions cause the area to be interesting and the county should not be written off without more thorough testing.

The **Bonner Springs** gas field is defined as extending into Johnson from Wyandotte County. For many years gas was produced in the **Craig-Monticello** field. Now the field is being used for underground gas storage. Production was from sandstones in the Pleasanton, Marmaton, and Cherokee groups. The principal production came from upper Cherokee rocks. In sec. 15, T. 12 S., R. 23 E., small gas wells were developed in the Knobtown sandstone in the upper part of the Pleasanton shale, a few feet below the Hertha limestone at depths ranging from about 200 to 300 feet. The Reid No. 1 Hodge well, in the SW¼ SW¼ sec. 15, T. 12 S., R. 23 E., yielded gas from the Knobtown sandstone and upper Cherokee sandstone. The Webb No. 1 Fee well, in the NE¼ SE¼ sec. 15, found gas in the same two zones. Gas was found in Pleasanton sandstone and in an upper Cherokee sandstone in T. 12 S., R. 23 E., and smaller amounts of gas were found in the "Peru sand" in some locations. In a part of this field, especially in sec. 25, 26, and 27, a gas-bearing sandstone as much as 60 feet thick was reported in the lower part of the Pleasanton shale.

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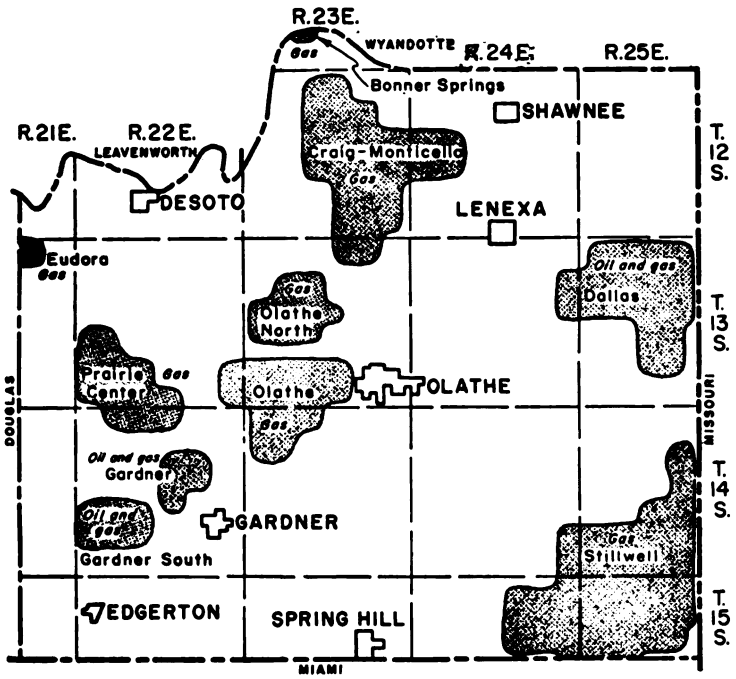

FIG. 39.—Map of Johnson County showing oil and gas fields as designated by the Kansas Nomenclature Committee.

Gas was produced from several zones in an unnamed field in the northeastern part of T. 12 S., R. 25 E. The "Bartlesville sand" at a depth of 692 feet is reported to have yielded an initial flow of 331,000 cubic feet of gas in a well in the NW¼ NE¼ NE¼ sec. 9, T. 12 S., R. 25 E.

The **Dallas** oil and gas area has had several revivals after temporary abandonments through the last several years. Gas was produced from the Knobtown sandstone. Several wells were drilled in about 1938. Depths to the Knobtown sandstone in the area range from about 100 to 200 feet. Oil was produced many years ago in the same area from the "Squirrel sand" at depths ranging from 400 to 500 feet. A few years ago a small amount of oil was produced from the "Squirrel sand" in sec. 13, T. 13 S., R. 24 E., after some "Squirrel sand" gas wells had been drilled near by. In 1952 gas was reported in the "Bartlesville sand" in sec. 13, T. 13 S., R. 24 E. The field had no commercial gas production in 1952, but a very small

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TABLE 42.—*Data on recent wells in Johnson County*

Name of well	Location	Year	Total depth, feet	Remarks
G. L. Smith No. 1 Pretz	SW SE NW 1-14-22E	1948	1,560	Stratigraphic data in Table 41
R. E. Andrews No. 1 Davis	NE SW NW 2-15-24E	1948	903	
Classen No. 1 Fee	SW NW NE 13-13-24E	1950	562	18,000 cu. ft. gas
H. A. Hershfield, Jr. et al. No. 1 Classen	SE NE NW 13-13-24E	1950	548	116,448 cu. ft. gas
H. A. Hershfield, Jr. No. 2 Classen	NW SE NW 13-13-24E	1950	540	Small oil producer; top of oil sand, 518 ft.
Inland Empire Oil & Gas Co. No. 3 Classen	SW SE NW 13-13-24E	1950	542	Oil reported between 511–515 and 529–538 ft.

amount of oil has been produced recently from one well. There was scattered gas production for many years in the southern part of Johnson County. Production was chiefly from the "Squirrel sand."

The former gas field known as the **Eudora** extends into northwestern Johnson County from Douglas County. The **Gardner** and **Gardner South** oil and gas fields are in T. 14 S., R. 22 E. With the exception of a few barrels of oil produced recently in the **Dallas** field, the **Gardner** is the last field in the county to have produced oil. The initial production of the discovery well of the area, drilled in 1928, was reported as 100 barrels of oil daily from a Marmaton sandstone. The following year several oil wells with production ranging from 5 to 100 barrels daily were drilled in sec. 15. Small amounts of gas are still reported from the **Gardner** area, and from the **Olathe** and **Olathe North** fields. The **Prairie Center** gas field (the Sunflower Ordnance Works now includes the site of the old town of Prairie Center) was drilled in 1942. Production was found in Pleasanton, Marmaton, and upper Cherokee rocks. The maximum wells had a daily capacity of about half a million cubic feet of gas. The **Stillwell** gas field no longer produces commercially. Production there was chiefly from the "Squirrel sand."

Data on recent drilling activities in Johnson County are listed in Table 42.

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LABETTE COUNTY

Oil and gas have been produced in Labette County for many years. Oil and gas are produced from the Bandera shale, the Fort Scott limestone, the Cherokee shale, the Mississippian limestone, and the Arbuckle dolomite. An oil and gas exploration map of Labette County was published by the Geological Survey (Abernathy, 1939) 15 years ago. It was remarkably complete in showing the locations of wells and their stratigraphic depths. Many wells, however, have been drilled since the map was prepared.

Labette County produced 7,461 barrels of oil in 1952. Production in the county each year from 1917 to 1952 inclusive is shown in Tables 2 and 3. Table 73 gives the production in the various fields in the county for 1949 through 1952.

One water-flooding project was reported in the county in the Price field in 1952 (Table 4). Natural gas production of 19,614 thousand cubic feet was reported for 1952 in Labette County.

Figure 40 shows the locations of oil and gas fields in Labette County, as defined by the Kansas Nomenclature Committee, and the locations of areas that produced oil in 1952.

Geology

SURFACE ROCKS

All exposed consolidated rocks in Labette County are of Pennsylvanian age. The youngest consolidated rock is the Chanute shale in the Kansas City group (Fig. 5). It is exposed in the northwestern part of the county. The Bronson subgroup and the Pleasanton group crop out in a broad belt across the northwestern part of the county. The eastern boundary of the outcrop of Pleasanton rocks is at a point north of Parsons on the Neosho County line. Because the limestones in the Kansas City group become thin and inconspicuous southward, it is convenient to use the northern Oklahoma classification in the southern half of western Labette County. This classification includes the Chanute shale, Drum limestone, Cherryvale shale, Dennis limestone, Coffeyville shale, and Seminole (Hepler) sandstone.

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The Marmaton group (Fig. 5) crops out in a broad band across the northeastern and southern parts of Labette County. The outcrop in the northern part of the county extends from the vicinity of Parsons to the Crawford County line, and in the southern part of the county it extends from a point south of Chetopa to the southwestern corner of the county on the Oklahoma line. The shale formations of this group underlie broad plains, whereas the limestone formations make more or less prominent escarpments across the regional dip slope of the beds. The Fort Scott limestone (locally called "Oswego") crops out in a narrow band across the southeastern corner of the county from the vicinity of Oswego to Bartlett. The outcrop makes a prominent escarpment in most places. The escarpment of the Pawnee limestone is relatively inconspicuous, although it is prominent farther south in Nowata County, Oklahoma. The Altamont limestone makes a prominent escarpment and the Lenapah makes a weak bench; these cross the county a little to the west of the Pawnee outcrop.

The Cherokee shale (Fig. 6) is the surface rock in the southeastern corner of Labette County. The western limit of its outcrop is a line running northeast and southwest through Oswego. Shale is predominant in the Cherokee. The area of Cherokee outcrop in Labette County is, therefore, a lowland plain floored with residual soil in which there are few rock exposures.

SUBSURFACE ROCKS

Depths to some key horizons in two Labette County wells are given in Table 43.

Pennsylvanian rocks.—The Lenapah limestone is about 30 feet thick in the subsurface in the western part of Labette County. The Nowata shale consists of about 40 feet of clay and sandy shale. The Altamont limestone consists of two beds of light-gray limestone, each about 10 feet thick, separated by about 4 feet of black fissile shale. The Bandera shale is about 122 feet thick. It includes sandy shale and sandstones. The Pawnee limestone, locally known as the "pink lime," ranges in thickness from about 22 to 34 feet. The Labette shale ranges in thickness from 55 feet in the northwestern part of the county to 90 feet in the southwestern part. A thin bed

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TABLE 43.—*Depths in feet to some stratigraphic horizons in two Labette County wells*

Horizon	G. F. Glore No. 1 L. Wert, Cen. NE SE 17-31-21E	David H. Morgan & J. A. Jensen No. 1 Mary Thomas et al., SW NW NW 36-34-18E
Top Fort Scott limestone	...	250
Top Mississippian limestone	496	842
Top Chattanooga shale	817	1,180
Top Arbuckle limestone	830	1,201
Top Pre-Cambrian rocks	1,886	.....
Total depth	1,893	1,209

of coal occurs in the upper part of the Labette shale and a thin limestone lies near the base of the shale. In the northeastern part of Labette County the Fort Scott limestone consists of two limestones separated by black shale. The upper limestone is about 20 feet thick and the lower limestone is about 8 feet thick. The black shale is about 5 feet thick. In the southwestern part of the county three or more limestones seemingly constitute the Fort Scott limestone. These limestones and separating shales have a maximum thickness of about 100 feet. The upper limestone has a maximum thickness of 41 feet, the middle limestone has a maximum thickness of 34 feet, and the lower limestone has a thickness of 15 feet. The upper black shale is about 4 feet thick and the lower black shale is about 8 feet thick.

The Cherokee shale ranges in thickness from about 395 to 560 feet. The shale in Labette County thickens regularly toward the southwest, but local variations in thickness are common. Sandstone commonly occurs in thin lenticular beds, and it is present in the lower part of the Cherokee in thick and massive beds. These beds include the "Bartlesville," Bluejacket ("Columbus"), and Little Cabin ("Burgess") sandstones. The most persistent limestone in the Cherokee shale is the Verdigris (Ardmore), which occurs about 80 feet below the base of the Fort Scott limestone in the eastern part of the county and about 40 feet below the Fort Scott in the western part. The Verdigris is a single bed of fossiliferous limestone about 3 feet thick.

Mississippian rocks.—About 350 feet of Mississippian rocks overlie the Chattanooga shale in Labette County. As pointed out by

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Lee (1939), these rocks were deposited on the nearly flat surface of the Chattanooga shale and later were gently folded and elevated. Subsequent erosion removed part of the Mississippian rocks from the elevated areas. The Mississippian formations in Labette County include the Spergen, "Warsaw," Keokuk-Burlington, Reeds Spring, and St. Joe limestones, the Northview shale, and the Compton limestone. The Chattanooga shale has an average thickness of about 20 feet; locally it ranges from 2 to 50 feet. The top of the Chattanooga is about 800 feet below the surface in the southeastern part of the county, and the depth increases to 1,340 feet in the northwestern part. The Chattanooga shale lies unconformably on Ordovician rocks.

Ordovician and Cambrian rocks.—Ordovician rocks in Labette County include the Cotter and Jefferson City dolomites, the Roubidoux formation, the Gasconade dolomite, and the Van Buren formation. Cambrian rocks include the Eminence and Bonneterre dolomites and the Lamotte sandstone.

Inferred geologic conditions in pre-Chattanooga rocks in Labette County are shown by Keroher and Kirby (1948, figs. 3, 4, 5, 6, 8, 9, and 11).

Oil and Gas Developments

In 1952 Labette County produced 7,461 barrels of oil from seven fields shown in Figure 40, which shows also locations of oil and gas fields as defined by the Kansas Nomenclature Committee. Producing fields, especially gas, formerly covered much of the county. Divisions have been drawn rather arbitrarily. Also in part, oil and gas production of importance has been somewhat more localized than the field map may indicate. Hence local names have been applied to some smaller areas in which producing wells have been more or less concentrated. Oil production in various areas in Labette County in the years 1949 through 1952 is listed in Table 73.

The **Altamont** oil and gas field, Ts. 32 and 33 S., R. 19 E., is a large area including many former gas wells but the principal production was centered in the **"Lush"** area, secs. 4 and 5, T. 33 S., R. 19 E., where gas was found in shale in the Fort Scott limestone formation at about 270 feet, the "Bartlesville sand" at about 540 feet, and in the upper part of Mississippian limestone at about 775 feet. The **Angola** gas field produced from the Fort Scott formation and several sandstones in the Cherokee shale. The **Banzet** field,

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T. 35 S., R. 19 E., produced gas from the "Bartlesville sand." Some oil was produced in the area in 1950 (Table 73). The **Bartlett** field, T. 34 S., R. 20 E., has had a few gas wells, producing chiefly from the "Bartlesville."

The **Chetopa** oil pool, sec. 36, T. 34 S., R. 20 E., was discovered in 1936. It is an Arbuckle limestone pool at a depth of about 850 feet. The reservoir is about 3 feet thick and lies below a thin caprock of hard brown limestone. Daily production of wells ranged from 30 to 120 barrels of oil. Gas was produced from Mississippian limestone in the eastern part of the section. The pool seemingly is in a closed structure. The **Chetopa Townsite** gas field, opened in 1935, is in Mississippian limestone at a depth of about 500 feet.

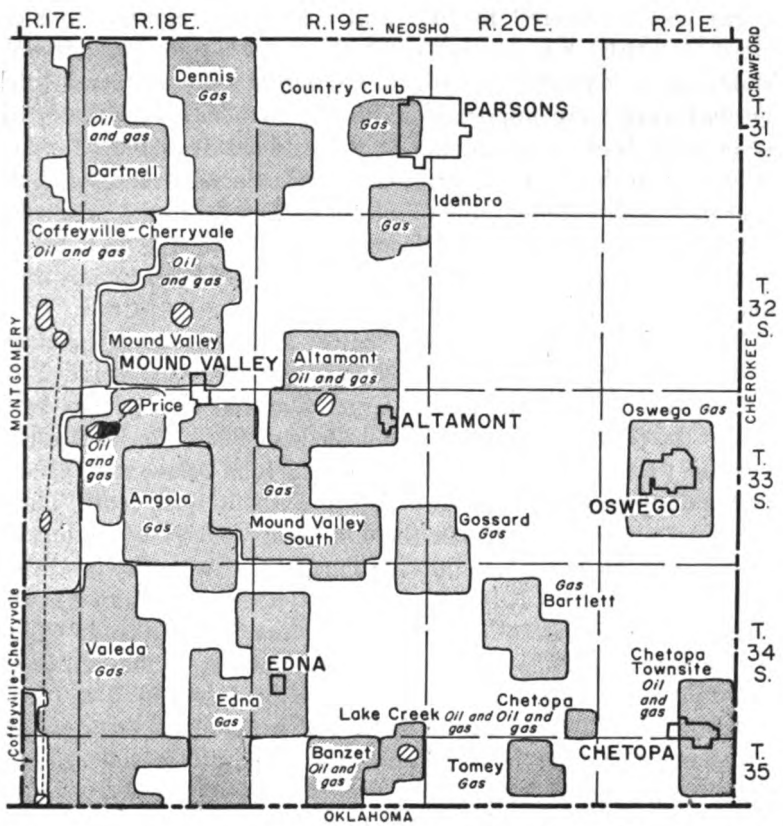

FIG. 40.—Map of Labette County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

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The **Coffeyville-Cherryvale** oil and gas field is a large area in eastern Montgomery County and western Labette County. Its large size is due to many former gas wells between and beyond the oil-producing parts and the areas of more important gas production. The **"Kincaid"** area in secs. 23, 24, and 25, T. 32 S., R. 17 E., is a part of the **Coffeyville-Cherryvale** field. Oil production is from the "Bartlesville sand." The **"Mortimer"** area, secs. 2, 11, and 12, T. 31 S., R. 17 E., was quite active from about 1913 until 1927. Gas was produced from the Fort Scott limestone formation at about 600 feet, the "Bartlesville sand" at about 840 feet, and from the upper part of the Mississippian limestone at about 1,020 feet. In the **"Timber Hills"** area, a formerly important gas field in secs. 2, 11, 12, 13, and 14, T. 32 S., R. 17 E., and secs. 7 and 8, T. 32 S., R. 18 E., gas was discovered in 1905 and activity is reported to have started in 1910. For several years the field supplied Cherryvale (Montgomery County) with gas. Smelting zinc ore and brick manufacturing were important industries in Cherryvale that used gas; no records of gas production in the field are available. Production was from the Fort Scott formation, "Bartlesville sand," and the upper part of the Mississippian limestone. Depths to the producing zone in the Fort Scott range from about 575 to 675 feet, to the "Bartlesville" from 705 to 860 feet, and to the Mississippian limestone from 880 to 890 feet.

The **Country Club** gas field, T. 31 S., R. 19 E., has been abandoned for many years. The **"Dack"** gas area, in secs. 4 and 5, T. 31 S., R. 18 E., is a part of the larger **Dartnell** oil and gas field. Most of the former gas wells were drilled in 1927. Production was from the Fort Scott formation, about 935 feet below the surface, and Mississippian limestone at a depth of about 1,080 feet. There have been a few oil wells in the **Dartnell** area. Oil production probably was from the "Bartlesville sand." Gas was first produced in the **Dennis** field in 1914. The reservoir rock is sandstone in the Bandera shale formation locally known as the "Dennis sand." Bandera Quarry sandstone is the proper designation. The thickness of the gas sand ranges from about 12 to 50 feet and it lies at a depth of about 340 feet. Initial daily production of the wells ranged from about 100 to 500 thousand cubic feet of gas. There were more than 100 wells in the field.

The **Edna** oil and gas field, Ts. 34 and 35 S., Rs. 18 and 19 E., supplied the town of Edna with gas for several years. Most of the

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production was from the "Bartlesville sand" at a depth of about 580 feet, but shale in the Fort Scott limestone at about 300 feet and a porous zone in the upper part of the Mississippian limestone at about 800 feet were productive also. The **Gossard** gas pool, discovered in 1906, is a "Bartlesville sand" pool. Thickness of the producing zone, which lies at about 450 feet, was reported as ranging from 17 to 61 feet. Initial production of wells was as much as a million cubic feet of gas daily. Gas production in the **Idenbro** field, Ts. 31 and 32 S., R. 19 E., was from the upper part of Mississippian limestone or from "chat" at a depth of about 745 feet.

The **Lake Creek** gas field, in Ts. 34 and 35 S., R. 19 E., sometimes is called the **Wilmoth** field. Gas production probably was chiefly from "chat" at about 700 feet. Oil production was reported in the field during 1952.

Production of gas started in the large **Mound Valley** field in 1905. Some gas and oil are still being produced from "Bartlesville sand." The field is in T. 32 S., R. 18 E. The thickness of the productive rock ranges from 6 to 60 feet. Some well logs show two sandstones separated by about 30 feet of shale. Both of these sandstones, known as the "Upper Bartlesville" and the "Lower Bartlesville," were productive in some wells. Some gas and oil have been produced in the field from the upper part of the Mississippian limestone. The **Mound Valley South** field is nearly continuous with the **Mound Valley, Altamont, Gossard, Angola,** and **Rice** fields. It includes a large number of former gas wells, most of which produced from the "Bartlesville."

The **Oswego** gas field, T. 33 S., R. 21 E., includes the more local area known as the **Oswego City Park** gas field. Several gas wells were drilled there in 1920. Gas was produced from the upper part of the Mississippian limestone at about 580 feet below the land surface. Initial daily production of the wells ranged from 100 to 500 thousand cubic feet of gas.

The **Price** oil field produces from the "Bartlesville" at a depth of about 600 feet. Oil production has been continuous since the discovery of the pool in 1917. Initial production ranged from 10 to 50 barrels of oil daily. The **Tomey** gas field is in T. 35 S., R 20 E. The Geological Survey has records of small gas wells in secs. 3 and 11. The **Valeda** gas field covers a large area in southwestern Labette County. A part of the area has the local name **"Traxon"** field. Gas was produced from the Fort Scott formation at about

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360 feet, "Bartlesville sand" at about 600 feet, and from Mississippian limestone at about 825 feet. According to Abernathy (1939) five Arbuckle test wells have been drilled in sec. 30, T. 34 S., R. 18 E. which is in the **"Traxon"** area. One gas well in the **Valeda** area is producing for local consumption.

Recent advances in well completions by rock-fracturing methods are arousing new interests in Labette as in other eastern Kansas counties. Considerable drilling is being done at the present time.

LEAVENWORTH COUNTY

When oil and gas were discovered in the McLouth area several years ago, Leavenworth and Jefferson Counties became rather important as oil and gas producing counties. In 1951 the reported oil production in Leavenworth County was 11,220 barrels; no production of oil was reported in 1952. However, it is reported that the Ackerland field was active. Gas production now has become of little importance; 6,608 thousand cubic feet was reported in 1952.

The geology and development of the McLouth oil and gas field have been described in detail by Lee (1941) and by Lee and Payne (1944).

Oil production in the county during the years 1941 to 1951 inclusive (except 1943 when the production is not separated from that of Jefferson County) is shown in Table 3.

Geology

SURFACE ROCKS

Outcropping consolidated rocks in Leavenworth County are of Pennsylvanian age. The youngest of these formations is the Deer Creek limestone or possibly the lower part of the Tecumseh shale, and the oldest is the Wyandotte limestone. Much of the county is mantled with glacial drift.

Pennsylvanian rocks.—The soil on the surface of more than half the area of Leavenworth County is immediately underlain by rocks of the Douglas group (Fig. 4). This area of rolling topography is east and south of the sinuous escarpment capped by the Oread limestone. The outcrop line of the Oread extends from the northeastern corner of the county along Missouri River to the vicinity of Leavenworth and northwestward to the southwest corner of the county.

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West of the Oread escarpment is a less conspicuous line of hills capped by the Lecompton limestone. Hills capped by Deer Creek limestone are in the northwestern part of the county. Rocks older than those of the Douglas group are exposed in the county along Kansas and Missouri Rivers. The oldest exposed bedrock in the county crops out along Kansas River near Lenape and Loring. The Shawnee group in the county is about 350 feet thick, and the Douglas group ranges from about 180 to 280 feet.

Rocks of the Pedee group (Fig. 5) are well exposed in the vicinity of Leavenworth where the Weston shale and the thin overlying Iatan limestone have a combined thickness of about 45 feet. Locally the entire Pedee section and in some places older rocks have been removed by erosion that preceded Douglas deposition. In those places the Tonganoxie sandstone or possibly the higher Ireland sandstone lies on some part of the Stanton limestone. The Lansing group in the county is about 80 feet thick. Strata in the upper part of the Kansas City group show unusual development along Kansas River in the vicinity of Lenape and Loring. Shale units several feet thick become only a few inches thick in short lateral distances, and limestones, particularly the Farley limestone, change abruptly in thickness and lithology.

SUBSURFACE ROCKS

Leavenworth County is in the Forest City basin and on the southeastern margin of the North Kansas basin. The Chattanooga shale oversteps beveled Devonian rocks from the northwest (Lee, 1943, fig. 7). The Maquoketa shale is believed to be absent except in the northwestern part of the county (Lee, 1943, figs. 11, 12). Depths to some key horizons in two Leavenworth County wells are given in Table 44.

Pennsylvanian rocks.—The average thickness of the Pennsylvanian section in Leavenworth County is about 1,000 feet. The thickness of rocks between the Hertha limestone and the top of Mississippian rocks ranges from a little less than 700 feet to slightly more than 800 feet.

Mississippian rocks.—According to Lee and Payne (1944, fig. 17), the Mississippian limestone formations in Leavenworth County have an average total thickness of about 400 feet. The thickness of the Chattanooga shale in the county ranges from about 50 to 75 feet (Lee, 1943, fig. 7).

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TABLE 44.—*Depths in feet to some horizons in two Leavenworth County wells*

Horizon	McLaughlin & Sons No. 1 Thorpe, NE NE 27-10-20E	Workman et al. No. 1 Hoffine, NE NW SE 11-12-22E
Top Lansing group	320	.....
Top Mississippian limestone	1,398	1,045
Top Chattanooga shale	1,734	1,453
Top "Hunton" limestone	1,794	1,473
Top Viola limestone	1,953	.....
Top St. Peter sandstone	2,088	.....
Top Arbuckle rocks	2,164	.....
Total depth	2,209	1,550

Pre-Chattanooga rocks.—According to Lee (1943, fig. 12), the interval between the base of the Chattanooga shale and the top of the Maquoketa shale in Leavenworth County ranges from about 100 to 225 feet. The Maquoketa shale is present only in the northwestern part of the county. Lee's studies (1943, fig. 11) indicate that the average thickness of the rocks between the top of the Maquoketa shale and the top of the St. Peter sandstone in northwestern Leavenworth County is about 200 feet, and the thickness of rocks between the top of the St. Peter sandstone and the Pre-Cambrian ranges from about 650 feet in the northwestern part of the county to about 800 feet in the southeastern part.

OIL AND GAS PRODUCTION

The Geological Survey has records of 207 wells that have been drilled for oil and gas in Leavenworth County (Table 45). These wells are rather closely concentrated in the areas in which oil or gas has been found, leaving large parts of the county untested (Fig. 41). Rocks lower than the upper part of the Mississippian limestone are almost entirely untested.

The discovery of gas in October 1941, in the NE¼ sec. 12, T. 10 S., R. 20 E., opened the **Ackerland** gas field; gas was found in the McLouth sand at a depth of 1,330 feet. Oil was found in the **Ackerland** field in the SW¼ sec. 6 and sec. 7, T. 10 S., R. 21 E. The oil pool is in the McLouth sand at about 1,390 feet. The **Bankers Life** oil pool, in Leavenworth and Jefferson Counties, T. 9 S., R. 20 E.,

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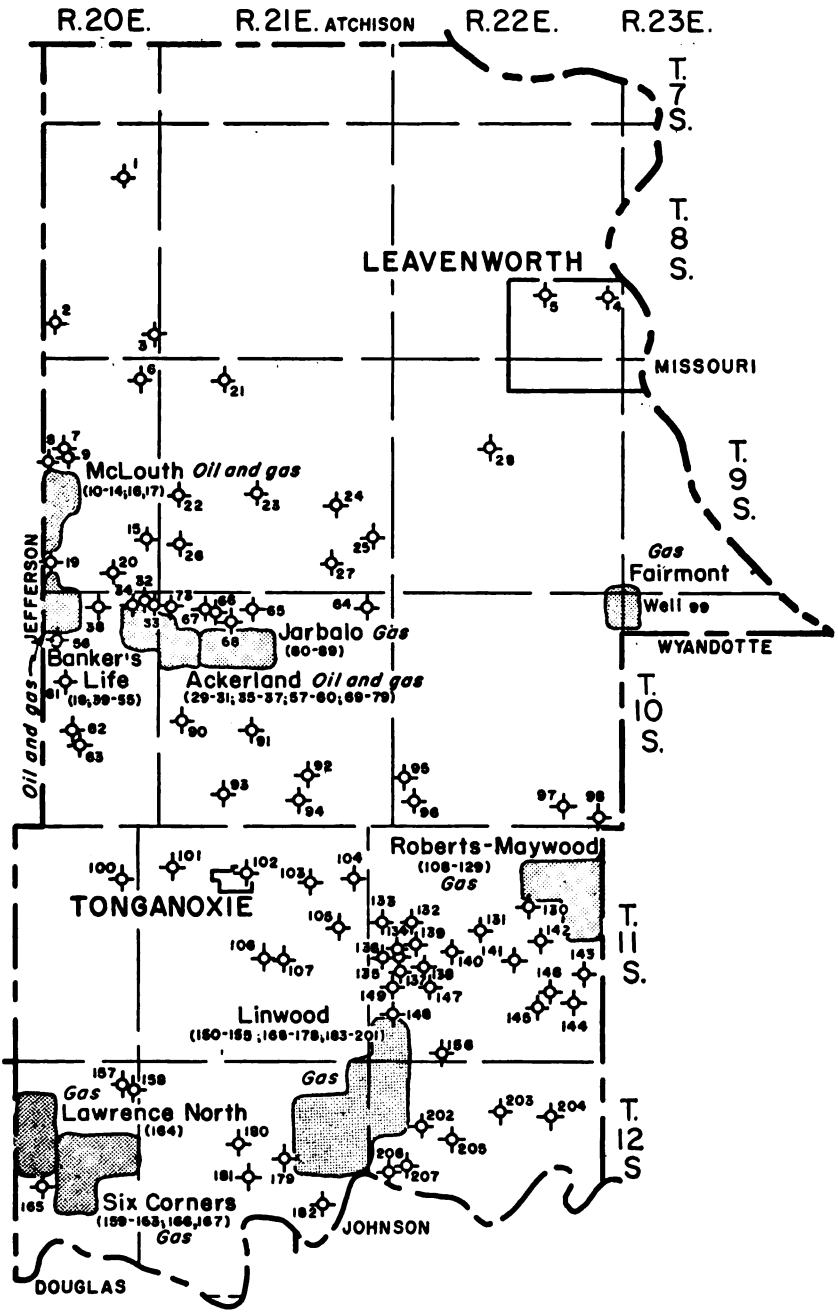

FIG. 41.—Map of Leavenworth County showing oil and gas fields and locations of wells listed in Table 45.

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was discovered in 1941. It is in the McLouth sand (lower part of the Cherokee shale) at a depth of about 1,400 feet.

In 1945 a small gas well in T. 10 S., R. 23 E. opened the **Fairmont** gas field. Gas occurs there in the lower part of the Cherokee shale at a depth of about 1,086 feet. The **Jarbalo** gas field, T. 10 S., R. 21 E., is adjacent to the part of the **Ackerland** field that contains the oil pool. Gas was found in the **Jarbalo** field at a depth of about 1,270 feet in the McLouth sand.

The **Lawrence North** gas field was opened by a well in T. 12 S., R. 20 E. which was drilled in 1944, but the field may be regarded as an extension of the **Six Corners** field which was drilled many years earlier. Very little gas has been produced from the **Lawrence North** field. Here gas was found in the "Squirrel sand" at about 700 feet. An area of shallow gas production in T. 11 S. and 12 S., Rs. 21 and 22 E. is designated as the **Linwood** gas field. Gas occurs in the "Squirrel sand" at an average depth of about 600 feet. Most of the wells were drilled in the early 1920's. The Leavenworth County part of the **McLouth** oil field, which extends into the county from Jefferson county (T. 9 S., R. 20 E.) produced from the McLouth sand at a depth of about 1,390 feet.

The Leavenworth County part of the **Roberts-Maywood** gas field, which extends into the county from Wyandotte County, is in T. 11 S., R. 22 E. This is the only area in Leavenworth County from which commercial gas production was reported recently. Gas occurs there in the Knobtown sandstone at an average depth of about 400 feet. There have been at least two wells in this field as far south as the north part of sec. 13. Gas from the field is piped to the town of Basehor.

As early as 1927, gas was stored in the **Six Corners** field which formerly produced from the "Squirrel sand" at a depth of about 250 feet. The reservoir has a thickness of about 20 feet and the average wells produced about half a million cubic feet of gas daily when the field was opened. The practicability of natural gas storage in rock formations demonstrated in the **Six Corners** field is said to have been inducive to the common practice of storing gas in porous rocks in suitable structures.

Oil production as recorded in Geological Survey files for the years 1949 through 1951 is listed in Table 73.

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TABLE 45.—*Data on wells drilled for oil and gas in Leavenworth County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Mat Cohen No. 1 M. L. Decker	NW SW NW 12-8-20E	1941	1,925	Top Mississippian, 1,418 ft.
2	McLaughlin et al. No. 1 Dietrich Estate	NE NW 34-8-20E	1943	1,586	Stopped in Cherokee sh.
3	Lebsack & Wamhoff No. 1 Maduska	SE NE 36-8-20E	1940	1,505	Top Mississippian, 1,497 ft.
4	.....	SW SW NE 25-8-22E	....	1,170	Stopped in Cherokee sh.; gas 1,170 ft.
5	Leavenworth * City well	NE NE SE 27-8-22E	....	2,116	Show of gas, 950 ft; gas 1,147 ft.
6	E. V. Jackson et al. No. 1 N. Fevurly	SW SE 1-9-20E	1941	1,501	Top Mississippian, 1,365 ft.
7	Frank Whitten et al. No. 1 Courtney	SW NE 15-9-20E	1942	1,392	
8	McLaughlin & Sons No. 1 Tabor Edmonds	SW SW 15-9-20E	1942	1,531	Top Mississippian, 1,516 ft.
9	E. V. Jackson et al. No. 1 Francis Houston	NW SE 15-9-20E	1942	1,453	Top Mississippian, 1,434 ft.
10	Wilson et al. No. 1 Martz	SW NW 22-9-20E	1943	1,473	Top Mississippian, 1,461 ft.
11	McLaughlin & Sons No. 1 Chas. Miller	SW SW 22-9-20E	1942	1,420	Gas well, McLouth field
12	Chas. Miller No. 1 Chas. Miller	NW SW 22-9-20E	1942	1,447	Discovery well, McLouth gas pool
13	Chas. Miller No. 2 Chas. Miller	NE SW 22-9-20E	1942	1,445	Dry hole; top Mississippian, 1,429 ft.
14	Chas. Miller No. 1 Tullis	SW SW SE 22-9-20E	1943	1,422	Dry hole; top Mississippian, 1,382 ft.
15	Chas. Miller No. 1 Moses	SE SE 25-9-20E	1943	1,492	Top Mississippian, 1,300 ft.
16	E. W. Mosbacher No. 1 M. A. Dolman	NW NW SE 27-9-20E	1941	1,615	Top Mississippian, 1,411 ft.
17	W. O. Smythe et al. No. 1 Jacobson	SW NW 27-9-20E	1942	1,482	Gas well, McLouth field
18	Aladdin Oil Co. No. 1 M. D. Edmonds	SW SW 34-9-20E	1941	1,447½	Gas well, Bankers Life field
19	Byram et al. No. 1 Kell	NW NW 34-9-20E	1943	1,441	Top Mississippian, 1,437 ft.
20	McLaughlin-Steinel No. 1 Lee	NE SE 35-9-20E	1944	1,550	Top Mississippian, 1,388 ft.
21	J. B. Apperson et al. No. 1 Geisen	NW SE 5-9-21E	1942	1,549	Top Mississippian, 1,380 ft.
22	Mosbacher & Miller No. 1 J. R. Locke	NE SW 19-9-21E	1941	1,505	Top Mississippian, 1,367 ft.
23	Chas. Miller et al. No. 1 Schwartzer	N½ NW SE 21-9-21E	1944	1,431	Top Mississippian, 1,314 ft.
24	Chas. Miller No. 1 Corlett	S½ SW SE 23-9-21E	1944	1,555	Top Mississippian, 1,395 ft.

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TABLE 45.—*Data on wells drilled for oil and gas in Leavenworth County, continued*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
25	Chas. Miller No. 1 Mary S. Barnhardt	NE NE SW 25-9-21E	1943	1,410	Top Mississippian, 1,277 ft.
26	Miller et al. No. 1 Fasenmyer	SW SW SE 30-9-21E	1943	1,424	Top Mississippian, 1,259 ft.
27	Chas. Miller No. 1 S. Stillings	SE SE NW 35-9-21E	1943	1,518	Top Mississippian, 1,366; gas 1,220–1,338 ft.
28	Mosbacher et al. No. 1 Sloan	SW SW NE 16-9-22E	1944	1,468	Top Mississippian, 1,325 ft.
29	Miller, Cross et al. No. 1 Bell	NW SE 1-10-20E	1942	1,368	Discovery well Ackerland gas pool
30	Miller, Cross et al. No. 2 Bell	SW SE 1-10-20E	1942	1,405	Gas well; top Mississippian, 1,400 ft.
31	Miller, Cross et al. No. 3 Bell	E½ SE 1-10-20E	1942	1,398	Gas well
32	George O'Dea et al. No. 1 W. F. Borst	SW NE 1-10-20E	1942	1,502	Top Mississippian, 1,472 ft.
33	McLaughlin & Sons No. 1 Borst	SE NE 1-10-20E	1943	1,474	Top Mississippian, 1,471 ft.
34	Magnolia Petro. Co. No. 1 Kessinger	SE NW 1-10-20E	1942	1,470	Top Mississippian, 1,460 ft.
35	McKnabe et al. No. 1 Kessinger	NW SW 1-10-20E	1942	1,420	Top Mississippian, 1,420 ft.
36	Ward Schooler et al. No. 1 Schmidt	NE SW 1-10-20E	1942	1,409	Gas well; show of oil 1,407–1,409 ft.
	Deepened by McLaughlin		1946	1,611	Top Mississippian, 1,426 ft.
37	McLaughlin & McNerny No. 1 Schmidt	SE SW 1-10-20E	1942	1,452	Top Mississippian, 1,425 ft.
38	McNerny No. 1 Fidler	NE NW 2-10-20E	1942	1,454	Show of gas 1,364 ft; top Mississippian, 1,392 ft.
39	Longwell et al. No. 1 Bankers Life (McLeod)	NW SW 3-10-20E	1941	1,475	Oil well; Bankers Life field
40	Longwell et al. No. 2 Bankers Life (McLeod)	NE NE SW 3-10-20E	1941	1,420	Oil well
41	Longwell et al. No. 3 Bankers Life (McLeod)	NW NW SW 3-10-20E	1941	1,461	Oil well
42	Longwell et al. No. 4 Bankers Life (McLeod)	SW NE SW 3-10-20E	1941	1,456	Oil well
43	Ward Schooler et al. No. 1 Bankers Life (McLeod)	SW SW 3-10-20E	1942	1,491	Oil well
44	Chas. Miller No. 5 Bankers Life	E½ NW SW 3-10-20E	1945	1,501	Oil well
45	Chas. Miller No. 6 Bankers Life	NE NW SW 3-10-20E	1945	1,470	Oil well
46	Chas. Miller No. 7 Bankers Life	NW NE SW 3-10-20E	1946	1,483	Oil well
47	Chas. Miller No. 8 Bankers Life	NW SW 3-10-20E	1946	1,493	Dry hole
48	Chas. Miller No. 9 Bankers Life	NW NW SW 3-10-20E	1946	1,470	Dry hole

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49	Chas. Miller No. 9 "A" Bankers Life	NW NW SW 3-10-20E	1946	1,489	Dry hole
50	R. L. Cambell No. 1 Figgs	NW SE SE 3-10-20E	1944	1,632	Top Mississippian, 1,511 ft.
51	J. W. Longwell No. 1 W. F. Moore	NW NE 3-10-20E	1941	1,632	Top Mississippian, 1,490 ft.
52	McLaughlin Sons No. 1 Ragan	NW NW 3-10-20E	1940	1,456	Gas well
53	Apperson, Pundt et al. No. 1 Steenstry	SW SE NW 3-10-20E	1941	1,473	Oil well
54	J. W. Longwell et al. No. 1 Steenstry	NE NW 3-10-20E	1941	1,429	Gas well
55	Longwell et al. No. 2 Steenstry	SW NW 3-10-20E	1941	1,393	Gas well
56	Jackson et al. No. 1 Black (Lobb)	NE NW NW 10-10-20E	1944	1,616	Dry hole; top Mississippian, 1,473 ft.
57	E. W. Mosbacher No. 1 Bell Estate	NW NE NE 12-10-20E	1941	1,487	Discovery well, Ackerland gas field
58	W. T. McNerny No. 1 Chapman	E½ NW NW 12-10-20E	1942	1,428	Dry hole; top Mississippian, 1,421 ft.
59	W. T. McNerny et al. No. 1 Federal Land Bank (Watson)	NE NW 12-10-20E	1942	1,385	Gas well
60	W. T. McNerny et al. No. 1 Williams	SW NW 12-10-20E	1942	1,495	Gas well
61	J. W. Billingsley et al. No. 1 D. Wilkins	SW NE 15-10-20E	1941	1,575	Dry hole; top Mississippian, 1,425 ft.
62	W. O. Smythe et al. No. 1 Chas. Miller	NE SE 22-10-20E	1942	1,947	Top Mississippian, 1,476 ft.
63	McLaughlin & Sons No. 1 Thorpe	NE NE 27-10-20E	1941	2,209	Stratigraphic data in Table 44 Oil shows 2,129–2,137 and 2,177–2,187 ft.
64	Chas. Miller No. 1 Stillings "A"	NW SE NW 1-10-21E	1943	1,377	Top Mississippian, 1,220 ft.
65	Chas. E. Miller No. 1 Mason	SW SW NW 4-10-21E	1943	1,377	Top Mississippian, 1,323 ft.
66	Trawver et al. No. 1 Farrar	NE SW 5-10-21E	1944	1,488	Top Mississippian, 1,294 ft.
67	John McGuire No. 1 Harrison	SW NW 5-10-21E	1944	1,365	Top Mississippian, 1,343 (?) ft.
68	McLaughlin et al. No. 1 Meyers	SE SE 5-10-21E	1943	1,446	Top Mississippian, 1,353 ft.
69	Miller-Magnolia et al. No. 3 Bell	SE SW 6-10-21E	1943	1,433	Oil well, Ackerland field
70	Chas. Miller No. 3 Jim Bell	SE SE SW 6-10-21E	1943	1,433	Oil well
71	Chas. Miller No. 3 Bell Estate	S½ SW SW 6-10-21E	1943	1,402	Oil well
72	Chas. Miller No. 1 Bell Estate	S½ NW SW 6-10-21E	1942	1,438	Dry hole; top Mississippian, 1,430 ft.
73	Miller et al. No. 1 Kansas City Life Insurance Co.	SW SE NW 6-10-21E	1943	1,480	Top Mississippian, 1,425 ft.
74	Chas. Miller No. 1 Jim Bell	NW NW 7-10-21E	1943 (1945)	1,384 (1,432)	Gas well, Ackerland field; deepened

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TABLE 45.—*Data on wells drilled for oil and gas in Leavenworth County, continued*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
75	Chas. Miller No. 2 Jim Bell	SW NW 7-10-21E	1943	1,342	Dry hole; top Mississippian, 1,335 ft.
76	Chas. Miller et al. No. 4 Jim Bell	NE NW NW 7-10-21E	1943 (1945)	1,352 (1,372)	Gas well, Ackerland field; deepened
77	Chas. Miller No. 5 Bell	SE NW NW 7-10-21E	1944	1,408	Dry hole; top Mississippian, 1,378 ft.
78	Miller, Magnolia et al. No. 1 Jeannin	NE NW 7-10-21E	1943	1,414	Top Mississippian, 1,412 ft; show of oil, 1,412 ft.
79	Schafges-Anderson No. 1 Jeannin	NE NE 7-10-21E	1943	1,454	Top Mississippian, 1,450; show of oil, 1,450 ft.
80	Apperson-Sherrod No. 1 P. W. Farrar	SE NE NW 8-10-21E	1943	1,545	Top Mississippian, 1,384 ft.
81	Dave Wilson et al. No. 1 Farrar	SW NW NE 8-10-21E	1943	1,376	Top Mississippian, 1,325 ft.
82	McLaughlin & Associates No. 1 Union Central Life Insurance Co.	NE NE 8-10-21E	1943	1,274	Stopped in Cherokee sh.
82a	John McGuire No. 1 Summers	NE SW 8-10-21E	1944	1,419	
83	McLaughlin et al. No. 1 W. F. Bank	NW NW 9-10-21E	1943	1,460	Top Mississippian, 1,343 ft.
84	John McGuire No. 1 Banks	SW NW 9-10-21E	1943	1,287	Stopped in Cherokee sh.
85	Jack Sherrod No. 1 Lollar	NW SW SE 9-10-21E	1944	1,415	Top Mississippian, 1,267 ft.
86	Sherrod-Apperson et al. No. 1 Metropolitan Life Insurance Co.	W½ NW SW 9-10-21E	1943	1,286	Gas well, Jarbalo field
87	Sherrod-McLaughlin No. 2 Metropolitan Life Insurance Co.	SE SW 9-10-21E	1944	1,315	Dry hole; top Mississippian, 1,313 ft.
88	McGuire et al. No. 1 Murphy	W½ NE SW 9-10-21E	1944	1,255	Gas well, Jarbalo field
89	Dave Wilson No. 1 Murphy	SW NE 9-10-21E	1944	1,283	Dry hole; top Mississippian, 1,275 ft.
90	Aladdin Oil Co. No. 1 Corlett	SW NE 19-10-21E	1941	1,430	Top Mississippian, 1,417 ft.
91	Dunn et al. No. 1 R. R. Oglivie	NE NW SW 21-10-21E	1942	1,510	Top Mississippian, 1,465 ft.
92	Huisman-Newland No. 1 Bachelor	E½ SE SE 27-10-21E	1943	1,216	
93	Frazier et al. No. 1 Fred Korb	NW NE 32-10-21E	1932	1,287	Stopped in Cherokee sh.
94	Huisman et al. No. 1 John Meritt	SW NE 34-10-21E	1943	1,400	Top Mississippian, 1,264 ft.
95	Hardaway et al. No. 1 Scheller	SW SE SW 30-10-22E	1939	345	
96	A. P. Laughlin No. 1 Lewis Seufert	SW SW NE 31-10-22E	1944	1,276	Top Mississippian, 1,140 ft.

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97	..... No. 1 Myers	SE SE SW 36-10-22E	....	597	
98	John Kelley No. 1 Khrone	SW NW 6-10-23E	1945	1,750	Discovery well, Fairmont gas pool
99	Miller et al. No. 1 Blimm	NW NW SE 12-11-20E	1943	1,558	Top Mississippian, 1,330 ft.
100	S. R. McKinney et al. No. 1 Roberts	N½ NE NE 7-11-21E	1941	1,441	
101	Franklin Ice Cream Co. No. 1 Tonganoxie Plant	Cen. NE 9-11-21E	1934	1,075	Top Mississippian, 1,065 ft.
102	"Tonganoxie well"	Cen. 11-11-21E	....	854	Stopped in Cherokee sh.
103	.....	SW SW NE 12-11-21E	....	1,052	Top Mississippian, 1,047 ft.
104	Schlottman & Heuisman No. 1 Bracey	NW SW 13-11-21E	1942	1,116	Top Mississippian, 1,115 ft.
105	Ryan Consolidated Petro. Corp. No. 1 Laming	SW NW 22-11-21E	1942	2,033	Top Mississippian, 1,226 ft. (?)
106	B. O. Schlottman No. 1 Perkins	SE NE 22-11-21E	1942	1,431	Top Mississippian, 1,227 ft.
107	W. H. Schwartz No. 1 Lester Hall	SW SW 1-11-22E	1944	544	
108	Garden et al. No. 1 Staatz	SW SE SE 1-11-22E	1931	580	
109	..... No. 2 Rutherford	SE NE 11-11-22E	....	492	Gas well, Roberts-Maywood field
110	S. R. McKinney No. 1 Rutherford	NE NE 11-11-22E	1944	675	Dry hole
111	S. R. McKinney No. 2 Rutherford	SE NW 11-11-22E	1944	515	Gas well
112	..... No. 1 Harry Simpson	NE NE 11-11-22E	....	394	Gas well
113	Breuer-Lane No. 1 Allen	NW SW 12-11-22E	1944	368	Gas well
114	Breuer-Lane No. 2 Allen	NW NE SW 12-11-22E	1944	354½	Gas well
115	S & S Drlg. Co. No. 1 Allen	NE NE SW 12-11-22E	1931	497	Dry hole
116	Schwartz et al. No. 1 Kampfer	SW SW 12-11-22E	1944	336	Gas well
117	Schwartz & McKinney No. 1 Reardon	SE SE NW 12-11-22E	1944	289	Gas well
118	Schwartz & McKinney No. 2 Reardon	SW NW 12-11-22E	1944	395	Gas well
119	S & S Drlg. Co. No. 1 Roberts	SE NW NE 12-11-22E	....	497	Discovery well, Roberts gas pool
120	..... No. 2 Roberts	SE NE NE 12-11-22E	....	488	Gas well
121	..... No. 3 Roberts	SW NE 12-11-22E	....	342	Gas well
122	A. Goldman No. 4 Roberts	NE NE 12-11-22E	....	532	Dry hole
123	..... No. 3 Schmitt	N½ NW 12-11-22E	....	466	Gas well

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TABLE 45.—*Data on wells drilled for oil and gas in Leavenworth County, continued*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
124	Schwartz & McKinney No. 1 Schmitt	NE NW 12-11-22E	1944	405	Gas well
125	..... No. 1 Rachel Fudge	NW NW 13-11-22E	....	401	Gas well
126	..... No. 2 Rachel Fudge	NW NE 13-11-22E	....	368	Gas well
127	..... No. 3 Rachel Fudge	NW NE (?) 13-11-22E	....	375	Dry hole
128	..... No. 1 Schubert	SW NE SE 13-11-22E	....	345	Dry hole
129	Joe Cooper No. 1 Lynch	NW NW NW 14-11-22E	1931	1,023	Stopped in Cherokee sh.
130	Smith et al. No. 1 Herman	NE SE SE 16-11-22E	1946?	624	Gas well
131	Stewart No. 1 Otto	NW SW 17-11-22E	....	417	Stopped at about base of Kansas City gr.
132	Forrester et al. No. 1 Yazel	18-11-22E	....	1,045	No log available, no definite location in section
133	Roxana Oil Co. No. 1 Fisher	SE NE 19-11-22E	1942	1,630	Dry hole
134	Roxana Oil Co. No. 2 Fisher	SE NE 19-11-22E	1942?	645	Gas well
135	Roxana et al. No. 3 Fisher	SW NE (?) 19-11-22E	1943	665	Dry hole
136	Roxana et al. No. 1 O'Keefe	NE SE 19-11-22E	1942	662	Gas well
137	Roxana Oil Co. No. 2 O'Keefe	NW SW 20-11-22E	1942	850	Gas well
138	McKinney et al. No. 1 Mary H. Roberts	SW NW 20-11-22E	1942	707	Dry hole
139	McLaughlin & Enochs No. 1 Schubert	SW NW 21-11-22E	1942	1,051	Stopped in Cherokee sh.
140	Smith et al. No. 1 Herman	SE NE SE 22-11-22E	1946	425	Gas well
141	Cooper et al. No. 1 Towsen	NE NE NW 23-11-22E	1931	851	
142	Breuer & Kelley No. 1 Thomas	SW SW SE 24-11-22E	1945	705	
143	Hart et al. No. 1 Spillman	SW SW 25-11-22E	1943	830	
144	..... No. 1 Ney	NE SW 26-11-22E	1917	874	
145	Perkins et al. No. 1 Holmes	SW NE NE 26-11-22E	1947	635	
146	Roxana Drlg. Co. No. 1 Mary J. Reiger	NW NE 29-11-22E	1943	805	Gas well (small)
147	McKinney & Miller No. 1 Mills	SW SE 30-11-22E	1942	675	

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148	W. H. Schwartz et al. No. 1 Skinner	NW NE 30-11-22E	1942	655	
149	Kaw Pipe Line Co. No. 1 Haulbert	SW SW NE 31-11-22E	1923	610	Gas well, Linwood field
150	Clevenger No. 1 Fee (?)	SW SW SE 31-11-22E	1923	660	Dry hole (?)
151	Kaw Pipe Line Co. No. 1 Oelschlager	SW SW SE 31-11-22E	1922	677	Gas well
152	Kaw Pipe Line Co. No. 2 Oelschlager	S½ SE 31-11-22E	1924	653	Gas well
153	Kaw Pipe Line Co. No. 1 Pierce	SE SE SW 31-11-22E	1921	673	Dry hole (?)
154	Kaw Pipe Line Co. No. 2 Pierce	NE SW 31-11-22E	1924	642	Gas well.
155	T. A. Goff No. 1 Harbaugh	SE SE 32-11-22E	1940	719	Dry hole
156	..... No. 1 Musset	35-11-22E	....	624	Dry hole
157	O. J. Connell No. 1 Hopkins	NW SE 1-12-20E	1942	1,260	Top Mississippian, 1,222 ft.
158	..... No. 1 Nine Mile Ranch	SE SE (?) 1-12-20E	1924	775	Probably same as Riling and Johnson No. 1 Nine Mile log of which has questionable location
159	..... No. 1 Charlton	NE SE NW 14-12-20E	1922	750	
160	Small & Magee No. 1 Charlton	SE NW NE 14-12-20E	1922	783	
161	..... No. 2 Charlton	SW SW NW 14-12-20E	1922	763	
162	O. J. Connell No. 1 Hemphill	NW SE 14-12-20E	1942	1,252	Top Mississippian, 1,217 ft.
163	Wise No. 1 Hemphill	SE NW SE 14-12-20E	1922	766	
164	Sloan & Zook No. 1 Hill	NW NW NW 15-12-20E	1945	1,214	Top Mississippian, 1,207 ft.
165	J. M. Huber Corp. No. 1 Mohler	NW NE 22-12-20E	1944	718	Gas well, Lawrence North field
166	Kerlyn Oil Co. No. 1 Hemphill	NE NE NW 23-12-20E	1940	1,046	Dry hole; old well deepened, probably produced gas
167	..... No. 1 Charles Ward	N½ NE 23-12-20E	1922	732	
168	..... No..... P. I. Dent	NE SE 1-12-21E	1921	797	Dry hole (?) Linwood gas field
169	Bonner Springs Oil & Gas Co. No. 1 Shoenlaber	SE SE 11-12-21E	....	655	Gas well
170	Bonner Springs Gas Co. No. 3 Shoenlaber	SE SE 11-12-21E	....	641	Gas well
171	Lucky Ten Oil & Gas Co. No. 1 Oliver	SW NW NW 13-12-21E	1928	654	Gas well
172	Lucky Ten Oil & Gas Co. No. 1 Baird	NW NW 14-12-21E	....	595	Gas well
173	Lucky Ten Oil & Gas Co. No. 1 Browning	NE NE 14-12-21E	....	332	Gas well

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TABLE 45.—*Data on wells drilled for oil and gas in Leavenworth County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
174	Goff No. 1 Joe Coleman	NE cor. 14-12-21E	1943	659	Gas well
175	Jones et al. No. 2 Harry Smith	SW NE SE 14-12-21E	1939	1,085	Gas well; top Mississippian, 1,000 ft.
176	Jones et al. No. 3 Harry Smith	NW NW SE 14-12-21E	1939	592	Gas well
177	Smith et al. No. 4 Fee	SW SE 14-12-21E	1943	625	Dry hole
178	Smith et al. No. 5 Fee	NE NE SE 14-12-21E	1943	611	Dry hole
179	Johnson et al. No. 1 Collins	NE SE 15-12-21E	1939	1,040	Top Mississippian, 1,037 ft.
180	..... No. 1 Martin Coyne	SW SE NE 16-12-21E	....	725	
181	Cooper et al. No. 1 Chas. Curtis	NW NE NE 21-12-21E	1930	945	
182	..... No. 1 Flora Burnett	SE 23-12-21E	1939	826	
183	..... No..... Aschell	SW NW NE 6-12-22E	1921	705	
184	Linwood Oil, Gas & Develop. Co. No. 11 Harbaugh	SW SE 6-12-22E	1922	685	
185	Linwood Oil, Gas & Develop. Co. No. 1 Havens	NE SW 6-12-22E	1922	692	Gas well, Linwood field
186	Linwood Oil, Gas & Develop. Co. No. 2 Havens	NE SW 6-12-22E	1922(?)	725	
187	..... No. 1 Hones	NW SE NE 6-12-22E	1921	693	Gas well (?)
188	Kaw Pipe Line Co. No. 2 Hones	NW SE NW 6-12-22E	1921	670	Gas well (?)
189	Kaw Pipe & Gas Co. No. 3 Harry Homis	SE SE NW 6-12-22E	1923	660	Gas well
190	Kaw Pipe Line Co. No. 1 Schee	NW SW NE 6-12-22E	1921	705	Gas well
191	Kaw Pipe Line Co. No. 2 Skee	SW NW SE 6-12-22E	1923	745	Dry hole
192	Linwood Oil, Gas & Develop. Co. No. 1 Whittaker	SE SE SW 6-12-22E	1922	691	Gas well (?)
193	Linwood Oil, Gas & Develop. Co. No. 2 Whittaker	NE NE SW 6-12-22E	1922	699	Gas well (?)
194	Linwood Oil, Gas & Develop. Co. No. 3 Whittaker	E½ SW 6-12-22E	1922	672	Gas well (?)
195	..... No. 1 Wilkins	NE NW 6-12-22E	....	713	Gas well

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196	..... No. 1 Harbaugh	SW NW SE 7-12-22E	....	698	
197	..... No. 2 Harbaugh	SE NE NW 7-12-22E	....	687	Gas well
198	Linwood Oil, Gas & Develop. Co. No. 1 Krametis	NE SW NW 7-12-22E	1922	682	Gas well (?)
199	Linwood Oil, Gas & Develop. Co. No. 2 Krametis	NW NE NW 7-12-22E	1922	704	Gas well (?)
200	Forrester et al. No. 2 Oelschlager	SW NE 7-12-22E	1930	771	Dry hole
201	Forrester et al. No. 2 Oelschlager	SE NE NE 7-12-22E	1930	1,002	Dry hole
202	Tom Galf No. 1 Timmerman	SW SE 8-12-22E	1937	739	Dry hole
203	Fielder et al. No. 1 Lange	SE SE NW 10-12-22E	....	822	
204	Workman et al. No. 1 Hoffine	NE NW SE 11-12-22E	1945	1,550	Stratigraphic data in Table 44
205	T. A. Goff No. 1 Cone	NW NW NW 16-12-22E	1939	703	
206	Forrester et al. No. 1 Yazel	SW SW SE 18-12-22E	....	1,045	Top Mississippian, 988 ft.
207	Forrester et al. No. 2 Yazel	SE SE 18-12-22E	1930	1,546	Top Mississippian, 1,408 ft.

* This well probably was drilled to 2,116 feet and is the well reported by Haworth (1908, pl. 42).

LINN COUNTY

Three wells were drilled in Miami County in 1860, and a short time later several wells were drilled north of Mound City in Linn County. Small amounts of oil and gas were produced from these wells. Important amounts of oil and gas have been produced in Linn County for many years. The oil production in 1926 was 89,208 barrels. Production has declined from this maximum, but many wells have been especially long-lived. Because of the increased importance of water flooding, the production of oil in 1943 was more than 50 percent greater than in 1942 and now production is nearly 100 percent above that of 1943 (Table 3). Gas is widespread in the county but production has become of little importance. A small amount of oil has been produced from near the top of the Mississippian limestone. All other production is from Pennsylvanian rocks. A few deep tests in the county have been unsuccessful.

The oil and gas resources of Linn County have been described by Jewett (1940a) in a report which contains a map showing locations

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of known wells as of 1940 and gives the stratigraphic depths of many wells.

Linn County produced 62,136 barrels of oil during 1952. Production in the county during the years 1912 to 1952 inclusive is given in Tables 2 and 3. Table 73 shows oil production in the various fields in Linn County for 1949 through 1952. The 1952 gas production was 1,600 thousand cubic feet. Four water-flooding projects were reported in Linn County in 1952. It is estimated that 58,375 barrels of oil was produced by water flooding during 1952.

Figure 42 shows the oil and gas producing areas and areas of 1952 oil production in Linn County.

Geology

Surface Rocks

With the exception of a few feet of unconsolidated deposits of Pleistocene and Tertiary (?) age, the surface rocks of Linn County are of Pennsylvanian age. The youngest consolidated rock is the Plattsburg limestone, basal formation in the Lansing group (Fig. 5), which underlies a small area in the extreme northwestern part of the county. The oldest exposed rock is the upper part of the Labette shale.

The upper part of the Kansas City group in Linn County includes shales and comparatively thin limestones. The total thickness of the Zarah and Linn subgroups is about 210 feet. These rocks crop out in the western part of the county, and are characterized by thick, more or less sandy, gray and yellow shales. There is a persistent sandstone in the Chanute shale, and a bed of coal occurs below the sandstone. The average thickness of the Bronson subgroup in the county is slightly more than 200 feet. Limestone constitutes more than half the thickness. The rocks of this subgroup form the boldest escarpments in the county, and the upper formation (Dennis limestone) lies immediately below the soil in a large area. These rocks are characterized by flinty and oölitic limestones in the Dennis and Swope formations and by black platy shale in the lower parts of the same formations. There are several key horizons which are useful in mapping surface structures.

The Pleasanton group ("big shale" of drillers) in Linn County ranges in thickness from about 80 to 200 feet. Massive sandstone occurs locally in the upper part of the Pleasanton, and locally there

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are several feet of alternating thin beds of shale and dark limestone. This upper part constitutes the Knobtown sandstone in the central part of the county. The Hepler sandstone, lying at the base of the Pleasanton group, ranges from about 2 to 25 feet in thickness.

The Marmaton group of limestone and shale is about 200 feet thick at outcrops in Linn County. Locally the upper three formations have been partly or entirely removed by erosion before deposition of the overlying Pleasanton shale. The lower part of the Labette shale and the Fort Scott limestone do not crop out in the county. The other formations of this group (Fig. 5) are present at the surface in the eastern and southeastern parts of the county. The Bandera and Labette formations contain lenses of sandstone.

SUBSURFACE ROCKS

Hundreds of wells, most of which did not reach the oldest Pennsylvanian rocks of the region, have been drilled in Linn County. However, several wells have penetrated older rocks and eight wells are known to have reached rocks older than those of Mississippian age. Depths to some key horizons in the Holeman and Edwards No. 9 Pollman well are given in Table 46. Linn County lies in the northern part of the area of the Chautauqua arch.

Pennsylvanian rocks.—Subsurface Marmaton rocks are about 250 feet thick and consist of limestone, shale, and sandstone. Gas is produced from the Bandera and Labette formations and oil from the Bandera formation. The Cherokee shale includes five or more gas and oil producing zones which are chiefly lenticular

TABLE 46.—*Depths to some key stratigraphic horizons in the Holeman and Edwards No. 9 Pollman well, SE¼ sec. 35, T. 19 S., R. 24 E., Linn County* (Data in part from Keroher and Kirby, 1948, pp. 87-92)

Horizon	Depth, feet
Top Mississippian limestone	460
Top Chattanooga shale	812
Base Chattanooga shale and top Arbuckle rocks (Cotter-Jefferson City dolomites)	882
Top Roubidoux formation	1,055
Top Gasconade and Van Buren dolomites	1,190
Top Eminence dolomite	1,370
Top Bonneterre dolomite	1,510
Total depth	1,601

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sandstones that are known as the "Squirrel," "Upper Bartlesville," "Lower Bartlesville," and "Burgess" ("Tucker") sandstones. "Shale gas" is produced from black platy shale in the upper few feet of the Cherokee section in several parts of Linn County.

Mississippian rocks.—Mississippian rocks in Linn County were discussed by Lee (in Jewett, 1940a, pp. 14-17). Depths to Mississippian rocks range from less than 450 feet below valleys in the eastern part of the county to about 1,000 feet on the uplands in the western part. The average thickness of Mississippian rocks is slightly more than 350 feet in the northwestern part and 390 feet in the southeastern part. The Mississippian rocks are slightly less than 300 feet thick in some areas in the central part of the county. The Mississippian section includes Meramecian rocks comprising the St. Louis limestone, the Spergen or "upper Warsaw" limestone, and the "Warsaw" limestone, having a total thickness of about 155 feet; Osagian rocks, including the undifferentiated Keokuk and Burlington limestones and the Sedalia (?) limestone, having a total thickness of about 150 feet; and Kinderhookian rocks, including the Chouteau limestone, about 100 feet thick. The Chattanooga shale, also probably of Kinderhookian age, has an average thickness of about 20 feet.

In Linn County the Chattanooga shale lies on rocks of Early Ordovician age. It is probable that younger Ordovician, Silurian, and Devonian rocks were deposited and later eroded from this part of the Chautauqua arch area.

Ordovician rocks.—According to Keroher (in Jewett, 1940a, pp. 12-14), who studied cuttings from the Holeman and Edwards No. 9 Pollman well in the SE¼ sec. 35, T. 19 S., R. 24 E., Ordovician rocks in Linn County include 168 feet of undifferentiated Cotter and Jefferson City dolomites; 145 feet of Roubidoux formation; and 135 feet of undifferentiated Gasconade and Van Buren dolomites and Gunter sandstone.

Cambrian rocks.—We have no record of wells in Linn County that have penetrated the full thickness of Cambrian rocks. The Holeman and Edwards No. 9 Pollman well was drilled through 150 feet of undifferentiated Proctor and Eminence dolomites and 90 feet into the Bonneterre dolomite (Jewett, 1940a, pl. 2). From studies of cuttings from wells in near-by areas, it is believed that the Bonneterre dolomite in Linn County is about 125 feet thick and that the Lamotte sandstone is probably about 40 feet thick.

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Oil and Gas Developments

The shallower rocks in Linn County have been explored extensively for oil and gas, but deeper rocks, especially those of Ordovician age, have been tested inadequately. Several years ago a small amount of oil was found in the weathered upper part of the Mississippian limestone in the southwestern part of the county near Blue Mound, but elsewhere production has come from Pennsylvanian rocks. Oil or gas or both have been found in the Bandera formation, the upper few feet of the Cherokee shale, the "Squirrel sand," the "Bartlesville sand," the "Tucker sand" (in the basal part of the Cherokee shale), and the upper part of the Mississippian limestone. Oil discoveries have been restricted generally to the northern and western parts of the county. There are gas wells in many parts of the county; therefore, it is difficult to divide the county into definite fields or producing areas. Areas of greater concentration are discernible, however (Fig. 42).

The **Beagle** oil field extends into Linn County from Miami County. The area has been abandoned for several years. The **Blue Mound** oil field extends westward into Anderson County. A small amount of oil was produced about 10 years ago from the top of the Mississippian limestone at a depth of about 800 feet in sec. 19, T. 22 S., R. 22 E. Most of the production has come from Pennsylvanian rocks at shallower depths. The field has had no reported production for several years.

The **Centerville** field produces oil chiefly from the "Squirrel sand." In 1935 The Texas Company started a water-flooding project in T. 21 S., R. 22 E. in the **Centerville** area. The entire property was yielding 8 barrels of oil per day when water flooding was begun. A notable increase in production took place 12 months later. Between December 6, 1935, and November 1, 1942, 84,189 barrels of oil had been produced as the result of injecting 739,913 barrels of water (Grandone, 1944, pp. 91-92). There were 59 oil wells at that time. Oil is produced now in four areas in the **Centerville** field; one water-flooding project is operating.

The **Critzer** gas field is a large elongated area. Now the wells have been abandoned except for possible noncommercial use. Gas was produced chiefly from sandstone in the basal part of the Cherokee section, called "Tucker sand." The **Fontana South** gas field extends into Linn County from Miami County. Gas occurs in the

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uppermost part of the Cherokee section in black shale that lies a few feet below the base of the Fort Scott limestone. Gas from these rocks is commonly called "shale gas."

The **Goodrich-Parker** oil-producing area is a shoestring about 7 miles long and one-half to 1 mile wide. Oil production is from the "Squirrel sand." In 1952 oil was produced in two areas in the field. Two water-flood projects were active in the field. The **LaCygne-Cadmus** area produces oil chiefly from sandstone in the Bandera formation. During 1952 two water-flood projects were active in the field. The only commercial gas production in Linn County at present is in the **LaCygne** area.

Gas in the **Mound City** field was found in sandstone in the Bandera shale and in the Labette shale ("Weiser" and "Peru sands" of several eastern Kansas fields); in dark shale in the upper part of

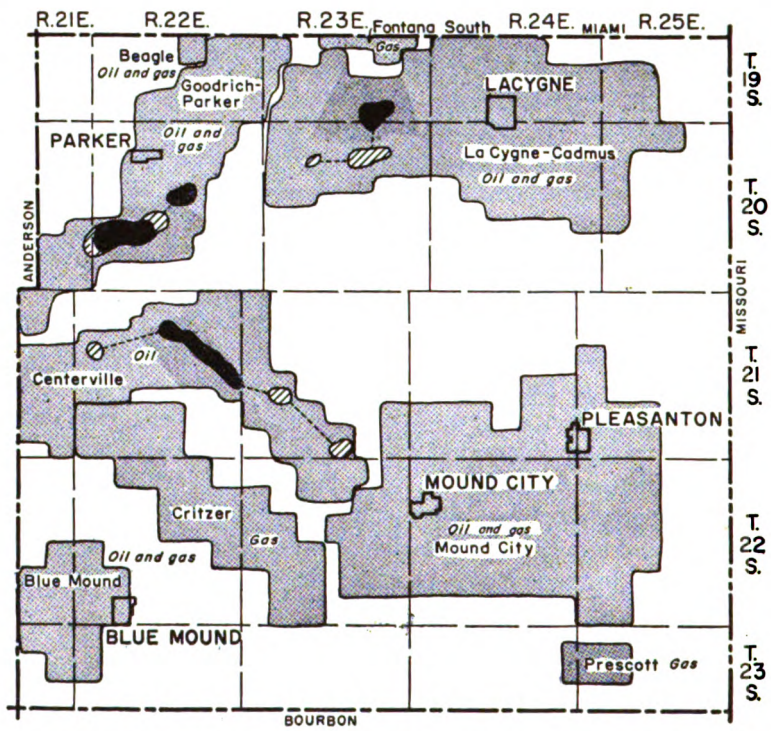

FIG. 42.—Map of Linn County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

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the Cherokee section; in the "Squirrel sand"; in the "Upper" and "Lower Bartlesville sands"; and in the "Tucker sand." Oil has also been produced from the "Upper Bartlesville." The smaller **Mound City** oil pool, in the "Squirrel sand," is on a structural dome that is rather large in comparison to most eastern Kansas structures. Seemingly the apex of the dome, which caused the accumulation of large quantities of oil and gas in Pennsylvanian rocks, lies a short distance north and east of Mound City. This was one of the first oil pools discovered in Kansas. The wells were pumped intermittently for many years, but the field is now inactive. The Evans et al. No. 1 Charles Cook well, in the SE¼ SE¼ NW¼ sec. 4, T. 22 S., R. 24 E., was drilled on the Mound City structure in 1938. The total depth of the well is 800 feet. The top of Mississippian limestone was encountered at 455 feet; the top of Kinderhookian (?) rocks at 700 feet; and the top of the Arbuckle at 745 feet. A strong show of oil was found in the top of the Mississippian limestone. The **Prescott** gas field is in the southeastern part of Linn County. Gas was found there in the "Upper" and "Lower Bartlesville sands."

Pennsylvanian rocks in Linn County have been tested relatively thoroughly for oil and gas but older rocks mostly are untested. In 1948 several new gas wells were drilled northwest of Pleasanton. It is expectable that new methods of well completions will revive or extend former oil producing areas.

LYON COUNTY

According to Landes (1937, p. 57) oil was discovered in Lyon County in 1922 when the Ordovician Bradfield pool was found. Later "Bartlesville sand" oil production was extended from Greenwood County into the southern part of Lyon County. Following the discovery of the Viola limestone Davis Ranch pool in Wabaunsee County in 1949, northeastern Lyon County became an area in which there was considerable exploration for deep oil pools and in 1950 the Bushong, a "Hunton" limestone oil pool, was discovered.

The geology, mineral resources, and ground-water resources of Lyon County have been described recently by O'Connor, Goebel, and Plummer (1953).

In 1952 Lyon County produced 264,969 barrels of oil from six fields. Oil production in the county for 1922 through 1952 is given in Tables 2 and 3. Production for 1949 through 1952 is given in

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Table 73. Locations of oil fields and areas of oil production in 1952 are shown in Figure 43.

Geology

Surface Rocks

Surficial deposits in Lyon County include several feet of flint gravel, principally on the uplands, and finer alluvium in the stream valleys. The flint gravel beds, which are especially abundant in the southern part of the county, are probably of Tertiary age.

Permian rocks.—Permian rocks (Fig. 3) of Wolfcampian age crop out in the western part of Lyon County. About 600 feet of lower Permian strata are exposed. The Florence limestone or a few feet of overlying sediments is the uppermost Permian rock in the county. In several exposures in Lyon County basal Permian rocks are seemingly conformable with the underlying Brownville limestone.

About 100 feet of rocks of the Chase group is exposed in western Lyon County. These rocks are characterized by bright-colored shales and massive limestones. The Florence and Wreford limestones contain abundant nodules of flint. In Lyon County, as in several other eastern Kansas counties, rocks assigned to the Council Grove group have a total thickness of about 300 feet. The percentage of limestone in this division is much larger than in the underlying Admire group. Highly colored shales similar to those in the overlying Chase group are characteristic of the Council Grove group, especially in its upper part. The Cottonwood and Neva limestones are the most easily recognized limestones. The thickness of the Admire group in Lyon County is about 150 feet. These rocks are chiefly gray and yellow shale but the Towle shale is partly red. They contain limestones commonly less than 2 feet thick and minor amounts of sandstone.

Pennsylvanian rocks.—Upper Pennsylvanian sediments, including rocks of the Wabaunsee group and the upper part of the Shawnee group, crop out in the eastern part of Lyon County. The thickness of exposed Pennsylvanian rocks in the county is approximately 500 feet. Most of the named units of the Wabaunsee group (Fig. 4), especially the limestones, are fairly easily recognized at their outcrops. Fairly light-colored limestones only a few feet thick and clayey and sandy shales are characteristic of Wabaunsee rocks in this part of the State. Fusulinids are abundant in Wabaunsee rocks.

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The Topeka limestone and the upper part of the Calhoun shale are exposed in a small area in T. 20 S., R. 13 E. along a tributary to Neosho River. Elsewhere in Lyon County these rocks are buried beneath younger bedrock.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons in 34 recently drilled wildcat wells in Lyon County are listed in Table 47.

Pennsylvanian rocks.—The thickness of Pennsylvanian rocks in Lyon County varies from place to place because of slight lateral changes in thicknesses of rock units and because Pennsylvanian rocks that are present in the western part of the county have been removed from the eastern part by erosion. The westward-dipping surface rocks have been beveled by erosion. The average thickness of rocks from the top of the Topeka limestone to the base of the Pennsylvanian section is about 1,650 feet. Pennsylvanian rock groups in Lyon County are not greatly different in thickness and lithology from those of neighboring counties. Oil is produced in the southern part of the county from the "Bartlesville sand," in the lower part of the Cherokee shale.

Mississippian rocks.—The total thickness of Mississippian limestone formations in Lyon County ranges from about 300 feet in the northwestern corner to slightly more than 450 feet in the central-eastern part (Lee, 1943, fig. 6). The Chattanooga shale has an average thickness of about 100 feet (Lee, 1940, pl. 3).

Pre-Chattanooga rocks.—In most of Lyon County the Chattanooga shale is believed to lie on the Viola limestone (Ockerman, 1935, fig. 2). In the northern part of the county the "Hunton" limestone underlies the Chattanooga shale and the pre-Chattanooga outcrops of the "Hunton" and Viola limestones were separated by a narrow band of Maquoketa shale. In the northern part of the county the interval between the base of the Chattanooga shale and the top of the Maquoketa shale is about 100 feet (Lee, 1943, fig. 12). The total thickness of rocks between the top of the Maquoketa shale and the top of the St. Peter sandstone is probably less than 100 feet everywhere in the county (Lee, 1943, fig. 12) and the interval from the top of the St. Peter sandstone to the Pre-Cambrian floor ranges from about 300 to 800 feet.

Keroher and Kirby (1948, figs. 4, 6, 8, and 9) estimated that the thickness of the Jefferson City-Cotter sequence in Lyon County

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TABLE 47.—*Data on dry wildcat wells drilled in Lyon County, 1949 through 1952*

Company and farm	Location	Depth to Lansing, feet	Depth to Mississippian, feet	Depth to Viola, feet	Depth to Arbuckle, feet	Total depth, feet
		1949 Wells				
Elk Petro. Corp. No. 1 Zink	NE NE NW 27-15-10E	1,759*	2,620 3,133**	3,278	3,438	3,487
Geo. F. Johnson et al. No. 1 Casey	NE NE SW 31-15-10E	1,590*	2,465 2,927**	3,071	3,247	3,293
Ohio Oil Co. No. 1 Kizler	NE NE NW 21-16-10E	1,606*	2,501 2,993**	3,093	3,251	3,317
Geo. F. Johnson et al. No. 1 Wheat	NE NE SW 6-16-12E	1,340*	2,230 2,733**	2,819	2,974	3,025
Inland Oil Co. No. 1 Diggs	NW SW NW 18-18-10E	1,455 1,570*	2,475 2,910**	2,989	3,134	3,204
J. M. Huber Corp. et al. No. 1 Ball	NW SW NW 23-18-10E	.....	2,289 2,765**	2,840	2,943	2,985
Mendenhall Drlg. Co. et al. No. 1 Davis	SE SE SE 4-19-12E	1,238*	2,010	.....	.....	2,056
A. R. Jones & Lotus Oil Co. No. 1 Watts	NE NW NE 16-20-11E	1,329*	2,047	2,509	2,644	2,666
Mendenhall Drlg. Co. et al. No. 1 Neil	NE NW NE 9-21-12E	1,282*	2,010 2,476**	.....	2,564	2,578
		1950 Wells				
Stanolind Oil & Gas Co. & Winkler & Koch No. 1 Cornwell	NE NE NE 26-16-10E	1,440	2,471 2,948**	.....	.....	2,967
Ben F. Brack Oil Co. Inc. No. 1 Davidson	NW NE NW 33-17-11E	990	2,156	2,745 2,865†	2,916	2,935
Mendenhall Drlg. Co. No. 1 Roberts	SE SE SE 15-18-10E	1,280	.....	.....	.....	1,682
Ray Anderson et al. No. 1 Grimmet	SW SE NE 22-18-10E	1,265	.....	.....	.....	1,652
Ray Anderson et al. No. 1 Ball	SW SW NW 23-18-10E	1,265	.....	.....	.....	1,615
Willingham et al. No. 1 Brockhouse	SE SE NE 28-19-10E	1,220	2,184 2,617**	2,627 2,711†	2,763	2,794
Susima Oil Co. No. 1 Warren	SE SE SW 19-20-10E	.....	.....	.....	.....	2,303
Susima Oil Co. No. 1 Owen	SW NW NE 30-20-10E	1,382	2,448	.....	.....	2,451
J. C. Scanlon & Reece No. 1 Farmer-Bell	NE NW SW 31-20-10E	1,480	2,490	.....	.....	2,539
A. R. Jones No. 1 Kuhlman	SW NE SW 28-20-11E	1,060	2,110	2,564 2,637†	2,699	2,760
Bennett & Roberts Drlg. Co., Inc. No. 1 Blair	SW SW SW 8-20-12E	900	1,948	.....	.....	1,980
Lance Hill et al. No. 1 Dickinson	SW NW NW 16-20-12E	.....	.....	.....	.....	1,295
Lance Hill et al. No. 1 Redecker	NE NE NE 17-20-12E	910	1,947	2,440 2,497†	2,547	2,565

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1951 Wells						
Carter Oil Co. No. 1 Davidson	NE NE SE 29-15-11E	1,553	2,584 3,096**	.....	3,384	3,470
Merton M. Bulla No. 1 Richards	NE NE SE 6-16-10E	1,495	2,500 2,976**	3,087	.....	3,234
Woods Oil & Gas Co. No. 1 Weller	SW SW NE 11-17-10E	1,388	2,395 2,928**	.....	3,155	3,205
Woods Oil & Gas Co. No. 1 Proehl	SE NE NW 16-17-10E	1,378	2,414 2,930**	.....	3,143	3,190
Lance Hill et al. No. 2 Redecker	NE NE NE 17-20-12E	1,274	.....	.....	.....	1,275
Armstrong Drlg. Co. No. 1 Klumpy	NE NE NE 26-21-11E	.....	2,015	.....	.....	2,055
1952 Wells						
White & Ellis Drlg. Co. et al. No. 1 Day	NE NE SE 16-16-11E	1,392	2,351 2,907**	.....	.....	3,134
Stanolind Oil & Gas Co. No. 1 N. Christensen	SW SW NW 9-17-11E	1,236	2,260 2,780**	.....	2,988	3,015
Ben F. Brack Oil Co. Inc. No. 1 Miller	NE NE SW 24-19-11E	.....	2,012	2,461	2,614	2,630
J. P. Gaty No. 1 Van Sickle	SE NW NW 16-20-12E	1,255	2,020	.....	.....	2,030
Ben F. Brack Oil Co. Inc. No. 1 Rachel Williams	NW NW NW 18-21-10E	1,528*	2,348	2,799 2,845†	.....	2,885
Emery Const. Co. No. 1 Rossillian	Cen. W½ W½ E½ 2-21-11E	.....	2,064	2,579†	2,645	2,675

* Depth to top of Kansas City, feet.
** Depth to top of "Hunton," feet.
† Depth to top of Simpson, feet.

ranges from about 100 feet in the northwest part of the county to about 375 feet in the southeast part; the Roubidoux dolomite less than 100 feet in the southeast part to slightly more than 150 feet in the northwest part; the Van Buren-Gasconade sequence—believed to be absent in the western half of the county—ranges from a featheredge to a thickness less than 50 feet in the eastern part; the Bonneterre dolomite from a featheredge in the southeast corner to a maximum of more than 100 feet in the northeast part.

Oil and Gas Developments

The **Atyeo** oil field is in Lyon, Chase, and Greenwood Counties. The field was extended into Lyon County in 1926. Production is from the "Bartlesville sand," the top of which lies at a depth of about 2,200 feet. Two water-flood projects are active in the field.

The **Bradfield** oil pool, T. 21 S., R. 10 E., was discovered in 1922. Oil occurs in the Kimmswick (Viola) limestone at a depth of about

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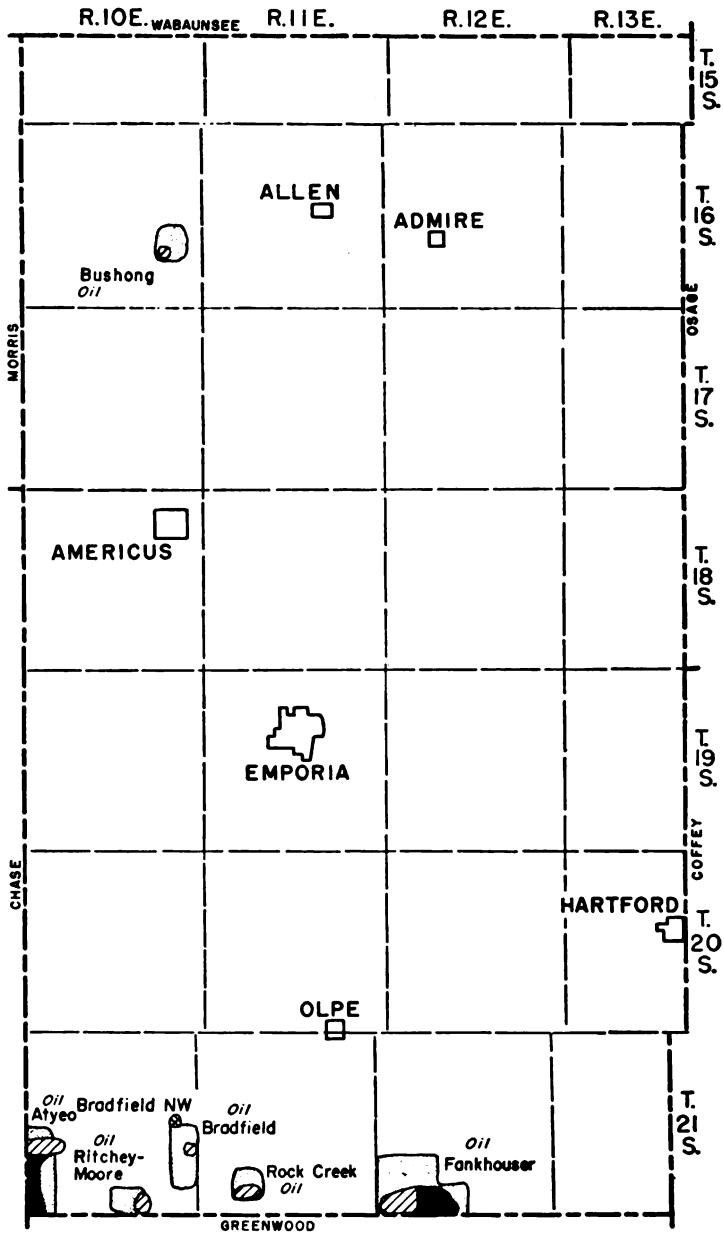

FIG. 43.—Map of Lyon County showing oil fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black; crossed lines show 1953 pool discovery.

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2,600 feet. The Viola is believed to lie next below the Chattanooga shale in that area. Production records are very incomplete but it is reported that the field yielded 27,516 barrels of oil in 1925. Several additional wells were drilled in 1926 and 1927. A dry hole was drilled in the edge pool area, sec. 23, in 1950. In 1952 a small well, in sec. 24, revived production in the field, and early in 1953 another small producer was put down in the same section. In 1953, the **Bradfield Northwest** field was opened in sec. 13, T. 21 S., R. 10 E. Production amounting to 25 barrels of oil per day was reported from the Viola limestone at a depth of 2,527 feet.

The **Bushong,** a "Hunton" limestone pool, was discovered in 1950 by a well in sec. 26, T. 16 S., R. 10 E. The discovery well was rated at 257 barrels of oil per day. The pay zone lies between 2,950 and 2,967 feet in depth. The **Bushong** pool is about 18 miles southeast of the axis of the Nemaha anticline, seemingly in about the deepest part of the trough that lies east of the anticline. It is about 15 miles south of the similarly geologically situated **Davis Ranch** pool in Wabaunsee County. The **Fankhauser** oil field extends into Greenwood County. The field was extended into Lyon County in 1926. Oil production is from the "Bartlesville sand." One water-flood project is operating in the field. The extension of the **Atyeo** and **Fankhauser** fields into Lyon County resulted in an increase of oil production in the county from 27,515 barrels in 1925 to 625,931 barrels in 1926 (Landes, 1937, p. 57).

The **Ritchey-Moore** field formerly produced oil from the upper part of the Mississippian limestone between 2,170 and 2,194 feet. Several dry holes have been drilled in the field. Production in the field was revived in 1952, when 21,168 barrels of oil was reported. The **Rock Creek,** a "Bartlesville sand" pool, was discovered in 1947 in sec. 32, T. 32 S., R. 11 E. Initial production from the "Bartlesville sand" was reported to be 35 barrels daily.

Recent developments.—Table 73 summarizes recent drilling activities in Lyon County. Dry wildcat wells drilled in 1949 to 1952, inclusive, are listed in Table 47, along with depths to important stratigraphic horizons reached in the wells.

The revival of the **Bradfield** field in 1952 and the discovery of the **Bradfield Northwest** pool in 1953 are regarded as important developments in eastern Kansas.

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MARION COUNTY

The recent discoveries of oil pools in Marion County are rather remarkable. In 1952 two Mississippian limestone pools were discovered, and in the early part of 1953 one Viola limestone and 23 Mississippian pools were found. A Mississippian gas pool also was found in 1953.

Oil and gas have been produced in Marion County in widely scattered areas; oil fields chiefly are confined to the eastern half of the county in the northwestern part of the Sedgwick basin or on the west flank of the Nemaha anticline. Chief oil production is in Mississippian and Ordovician rocks from traps that partly are stratigraphic and partly structural. The geology of the southern part of the county was discussed several years ago by Thomas (1927, 1929). More recently Lukert (1949) has interpreted subsurface conditions in southern Marion County.

Soon after the discovery of oil in the Elbing pool in Butler County, the Elbing field was extended into Marion County and the Peabody, Covert-Sellers, and Florence pools were found. These fields lie above rather low surface anticlines in which oil occurs in Ordovician rocks at an average depth of about 2,400 feet. Inasmuch as oil occurs in eroded dolomites that are overstepped by Pennsylvanian and Mississippian rocks, it is proper to say that the oil is in stratigraphic traps as well as in anticlines. Important production has been found also in Mississippian limestone or more definitely in "chat" (local accumulations of cherty debris from eroded Mississippian formations). One Marion County field, the Wenger, produces from "Hunton" limestone.

During 1952 Marion County produced 567,290 barrels of oil and 69,180 thousand cubic feet of gas. Oil production each year from 1922 to 1952 inclusive is shown in Tables 2 and 3. Production from the various fields in the county during the years 1949 to 1952 is listed in Table 73.

Figure 44 is a map of Marion County showing locations of oil and gas fields and of areas that produced oil in 1952.

Geology

SURFACE ROCKS

Cretaceous sandstone and shale (Dakota and Kiowa) occupy small areas at the surface in western Marion County. Permian rocks

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crop out in the remaining part of the county. Exposed Permian rocks include those between the lower part of the Wellington shale and the strata a few feet below the base of the Barneston limestone (Fig. 3). The Carlton limestone, in the lower part of the Wellington shale, crops out in a narrow band a few miles east of the eastern border of Cretaceous rocks. Limestones in the upper part of the Chase group crop out in steep escarpments in the eastern part of the county.

SUBSURFACE ROCKS

Marion County is on the west flank of the Nemaha anticline and on the margins of the Salina and Sedgwick basins. The northern part of the county is on the southern margin of the North Kansas basin (Figs. 11, 12).

Permian and Pennsylvanian rocks.—The average thickness of Permian and Pennsylvanian rocks in Marion County is about 2,500 feet. This section is thicker in the western part of the county and thinner in the eastern part.

Mississippian rocks.—Mississippian limestone formations seemingly are absent in the eastern part of T. 18 S., R. 5 E. and the east half of T. 19 S., R. 5 E. in extreme northeastern Marion County (Lee, 1939, pl. 1). The thickness of Mississippian limestone in the county, as shown by Lee's studies, ranges from a featheredge to slightly more than 300 feet in the extreme southwestern part.

The Chattanooga shale is believed to be absent in approximately the same area in Marion County in which Mississippian limestones are absent. The Chattanooga shale ranges in thickness from a fraction of a foot to about 250 feet. The greatest thickness is in the west-central part of the county (Lee, 1940, pl. 3).

Pre-Chattanooga rocks.—In Marion County the Chattanooga shale, where present, is in contact with the "Hunton" limestone, Maquoketa shale, and Viola limestone (McClellan, 1930; Ockerman, 1935, fig. 2). The "Hunton" is represented by Silurian rocks. In the northeastern part of the county where the Chattanooga shale is absent, Pennsylvanian rocks are believed to truncate underlying rocks as old as the upper part of the Arbuckle limestone. The thickness of the Silurian limestone ranges from a featheredge to about 100 feet. It is believed to underlie only the northern part of the county. The maximum thickness of the Maquoketa shale in the county is believed to be about 100 feet and the greatest thick-

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ness of the Viola limestone is about the same. The maximum thickness of the St. Peter sandstone is perhaps less than 50 feet, and the average thickness of Arbuckle rocks is believed to be about 400 feet.

Ranges of thicknesses of pre-St. Peter rocks in Marion County as inferred by Keroher and Kirby (1948, figs. 4, 8, and 9) are Jefferson City-Cotter sequence, about 150 to 350 feet, increasing southwestward; Roubidoux dolomite, mostly less than 200 feet; and Bonneterre dolomite, a featheredge to 150 feet in the northwest part.

Oil and Gas Developments

The **Antelope** oil pool was discovered early in 1947. The discovery well, in T. 18 S., R. 4 E., was rated at 22 barrels of oil per day from Mississippian "chat" at about 2,380 feet. The **Antelope North** pool was discovered early in 1948. The discovery well was rated at 35 barrels of oil per day. Production is from the Kansas City limestone at about 1,840 feet. The **Biscuit Hill,** a small Mississippian oil pool, was found in 1952 in T. 21 S., R. 4 E. Initial daily production of 3 barrels of oil was reported. The producing zone is between depths of 2,269 and 2,275 feet. No commercial production was reported from the field in 1952. The **Cedar Creek** field, opened in 1950 in T. 20 S., R. 5 E., produces oil in the Viola limestone at a depth of 2,563 feet.

The **Covert-Sellers** oil pool was discovered in 1920 in T. 21 S., R. 4 E., by a well which encountered oil in the Viola limestone. The **Doles Park** gas field extends into Marion County from McPherson County. The pool was discovered early in 1947 in T. 19 S., R. 1 W. The initial daily production from Mississippian limestone was established at 283,600 cubic feet of gas. A well in T. 18 S., R. 2 E. found a Viola limestone pool, the **Durham,** at a depth of 2,899 feet during 1953. Initial potential was 202 barrels of oil per day. The **Edmonds** is a Mississippian limestone pool, discovered at a depth of 2,471 feet in T. 22 S., R. 4 E. in 1953. Initial daily production of 25 barrels of oil was reported.

The **Elbing** oil field is chiefly in Butler County, but was extended into T. 22 S., R. 4 E. in southern Marion County in 1920. The discovery well of the **Elbing North** pool, drilled in 1947, found production in Mississippian "chat" at 2,439 feet. The well was rated at 100 barrels of oil per day. The **Fanska** oil pool, T. 17 S., R. 1 E., was discovered in 1943. Production is from lower Pennsylvanian

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rocks at a depth of about 2,680 feet. The **Florence** oil pool was discovered in 1920 in T. 21 S., R. 5 E. Oil was found in the Viola limestone. The **Hillsboro** oil pool was discovered in 1928. The discovery well, in T. 19 S., R. 3 E., produces oil from the Viola limestone; it is reported that this well produced 332 barrels of oil from the "Mississippi lime" before it was deepened to the Viola. The average depth to the top of the producing zone in the Viola in this area is about 2,820 feet. Initial production of some wells was as high as 400 barrels of oil per day.

The **Lehigh** oil and gas field was opened in 1946. The discovery well, in T. 19 S., R. 1 E., had initial daily production of 28 barrels of oil, 75 barrels of water, and 3 million cubic feet of gas. Initial production of four other wells that have been drilled in the field include 340 barrels of oil and 1 percent water; 206 barrels of oil and 9 percent water; 2 million cubic feet of gas; and 3½ million cubic feet of gas and 5 barrels of oil. **The Lehigh North,** a Mississippian limestone gas pool, was discovered in 1953 in T. 19 S., R. 1 E. The well had a daily potential of 2,500,000 cubic feet of gas.

The **Lost Springs** oil pool, discovered in 1926, extends from northeastern Marion County into Dickinson County. Production is from the Mississippian limestone, the top of which is encountered at an average depth of about 2,365 feet. Average initial production was about 135 barrels of oil per day and the maximum initial production was about 1,000 barrels. In the **Lost Springs East** pool, production is from the top of Mississippian rocks or "chat." The **Lost Springs South** pool was discovered in 1947. The discovery well was rated at 35 barrels of oil per day from the top of the Mississippian limestone. The amount of produced water was about equal to the oil. The last production reported in the field was for 1949. The **Lost Springs Southeast** field was opened in 1948. Initial production of 12 barrels of oil per day from Mississippian at 2,345 feet was reported.

The **Peabody** oil pool was discovered in 1920 in T. 22 S., R. 4 E. The Viola limestone is the producing rock. The **Propp** gas pool was discovered in T. 19 S., R. 4 E. in 1926. Initial production of the discovery well was 4 million cubic feet of gas per day. Production is from the "chat," in the upper part of the Mississippian limestone. Oil production has been reported in the **Propp** field since 1950 (Table 73). Four gas wells in 1952 produced 69,180 thousand cubic feet of gas. **The Quarry Siding,** a 1953 Mississippian

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oil discovery, was found in T. 19 S., R. 4 E. Production, reached at a depth of 2,302 feet, was rated at 22 barrels of oil per day.

The **Robinson** gas pool, in T. 20 S., R. 5 E., was discovered in 1930. Initial daily production was estimated as 1½ million cubic feet of gas. Production is from Cherokee rocks at a depth of 2,095 feet. In 1941, the Dexter et al. No. 1 Robinson was rated as having an initial daily production of 1 million cubic feet of gas from a depth of 2,073 feet. The **Shank**, a Mississippian limestone pool be-

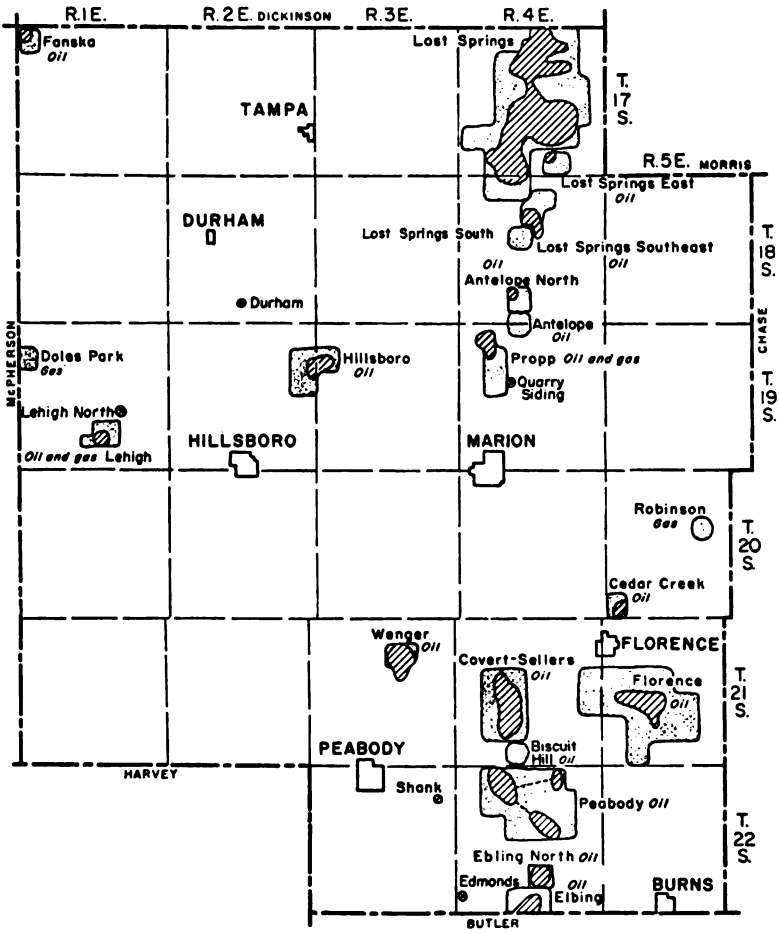

FIG. 44.—Map of Marion County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; crossed lines show 1953 pool discoveries.

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tween 2,474 and 2,501 feet, was discovered in 1952 in T. 22 S., R. 3 E. The discovery well was rated as having an initial daily potential of 75 barrels of oil. The **Wenger** oil pool was discovered in 1947. The discovery well, in T. 21 S., R. 3 E., found oil in the "Hunton" limestone at 2,771 feet. Initial rating of the well was 50 barrels of oil per day.

Recent discoveries.—Three oil pools and one gas pool were discovered in Marion County during the first part of 1953. Three are in Mississippian rocks and one in Viola (Table 1). Two Mississippian oil pools were opened in 1952 and one in 1950.

It is expectable that the number of wells drilled in Marion County in 1953 will exceed the number drilled in any previous recent year. Data on pool wells drilled in the county from 1949 through 1952 are listed in Table 73. Table 48 summarizes data on wildcat wells drilled in the same period.

TABLE 48.—*Data on wildcat wells drilled in Marion County, 1949 through 1952*

Company and farm	Location	Depth to Lansing, feet	Depth to Mississippian, feet	Depth to Viola, feet	Depth to Simpson, feet	Total depth, feet
		1949 Wells				
Anderson-Prichard Oil Corp. No. 1 Scully	SE SE NE 34-18-2E	.....	2,512	2,923	3,000	3,017
Hutchinson Oil & Gas Co. No. 1 Ptacek	SE SE SW 20-19-4E	.....	2,335	2,612	.....	2,655
Stromfeltz et al. No. 1 Hoffman	SE SE SW 24-19-5E	1,600*	2,131	2,355	.....	2,377
Stromfeltz et al. No. 1 Graham	NW SW NW 35-19-5E	.....	.....	2,372	.....	2,390
Crumpacker & Veeder No. 1 Flaming	SE SW NE 11-20-2E	.....	2,571	2,950	3,022	3,036
Dieter et al. No. 1 Weins	SW SE SE 27-20-2E	.....	2,573	2,909	2,986 3,055**	3,115
Uhl & Gould No. 1 Carpenter	NW NW NW 6-20-4E	.....	2,273	2,552	2,611	2,624
Slack & Scanlan No. 1 Good	SW SW SE 20-20-4E	.....	2,247	2,504	2,585 2,647**	2,670
Kelly et al. No. 1 Wheeler	SE SW SW 27-20-4E	.....	2,185	2,487	.....	2,511
Adair No. 1 Fisher	NE SE NE 6-21-4E	.....	2,295	2,526	2,598 2,630**	2,667
Thrifty Drlg. Co. No. 1 Hawk	SW SE SW 14-22-5E	1,971*	2,406	2,536	2,684 2,767**	2,799
H. & M. Drlg. Co. & Seibel No. 1 Genzen	SW SW SW 19-22-5E	.....	2,432	2,660	.....	2,660

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TABLE 48.—*Data on wildcat wells drilled in Marion County, 1949 through 1952, concluded*

Company and farm	Location	Depth to Lansing, feet	Depth to Mississippian, feet	Depth to Viola, feet	Depth to Simpson, feet	Total depth, feet
		1950 Wells				
Crest Petro., Inc. et al. No. 1 Schweitzer	NE NW NW 27-19-3E	2,014*	2,368	2,720	2,793	2,834
C. T. Shelton & Veeder Supply & Develop. Co. No. 1 Thies	SE SE SW 14-19-4E	.....	2,337	.....	.....	2,386
Aladdin Petro. Corp. No. 1 Wallace	SE SE SW 34-21-2E	2,098*	2,715	3,135	3,190 3,257**	3,309
A. D. Allison & Co. & Max Steinbuchel No. 1 Goering	NW NW NE 27-21-3E	1,925*	2,515	2,895	.....	2,905
Russell Drlg. Co. No. 1 Spangler	S½ SE NE 35-22-3E	.....	2,611	2,865	2,980	3,110
		1951 Wells				
Crest Petro., Inc. No. 1 Turner	SW SW NW 34-19-3E	1,814	2,365	2,680	2,732 2,815**	2,833
Derby Oil Co. No. 1 Boettchen	NE NW SW 11-19-4E	1,753	2,296	.....	.....	2,370
Donald T. Ingling et al. No. 1 Heerey	NW NW NW 29-20-3E	1,943	2,494	2,846	2,894	2,935
J. H. Wagner et al. No. 1 Johnsmeyer	SE SE NE 17-20-4E	.....	2,225	2,516	.....	2,524
Donald T. Ingling et al. No. 1 Klassen	SW NW SW 18-21-1E	2,330	2,966	3,484	3,506	3,524
Donald T. Ingling et al. No. 1 Potter	SW SW SE 3-22-3E	1,953	2,445	2,895	2,925	2,990
Aladdin Petro. Corp. No. 1 Reigle	NW NE SW 12-22-3E	1,917	2,459	2,791	2,835 2,906**	2,950
Aladdin Petro. Corp. No. 1 Fern	NW NE NW 36-22-3E	1,944	2,551	2,885	2,958 3,030**	3,058
		1952 Wells				
Western Central Petro. Co. No. 1 Knaak	S½ S½ SW 24-19-2E	1,970	2,550	2,945	.....	2,975
Geo. Martin No. 1 Boettcher	SW SW SE 11-19-4E	1,753	2,285	2,634	.....	2,666
Aladdin Petro. Corp. No. 1 Stenzel	SW SE NW 18-19-5E	.....	2,302	.....	2,453†	2,532
Slusser Drlg. Co. No. 1 Meireroff	SE NE SW 27-19-5E	1,726	2,208	2,419	.....	2,439
K. T. Wiedemann No. 1 Hawk	SW SW NE 31-22-4E	2,047*	2,448	.....	.....	2,501
Donald T. Ingling et al. No. 1 Logan	SE NE NW 29-22-5E	1,803	2,412	2,604	.....	2,810

* Depth to top of Kansas City, feet.
** Depth to top of Arbuckle, feet.
† Depth to top of "Hunton," feet.

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MARSHALL COUNTY

Neither oil nor gas in commercial quantities has been found in Marshall County. The county lies in an area where regional structural conditions are such that one might expect to find stratigraphic oil traps in the more deeply buried rocks. The Geological Survey has records of 21 wells that have been drilled for oil or gas in the county.

Geology

SURFACE ROCKS

In most of Marshall County the exposed rocks are of Permian age. A small area in the western part of the county is occupied by outcrops of Cretaceous sediments and a few feet of late Pennsylvanian rocks crop out in the eastern part of the county.

Cretaceous rocks.—A small upland area in T. 2 S., R. 6 E. and in the extreme northwest corner of T. 3 S., R. 6 E. in western Marshall County is underlain by Dakota sandstone and shale.

Permian rocks.—In most of Marshall County the soil is immediately underlain by Permian rocks that embrace the section between the lower part of the Wellington shale and lowermost Permian (Fig. 3). Several limestones of lower Permian age are useful key beds for surface structural mapping. Outcropping Permian rocks in the county are similar to the same strata in Riley County and are more completely discussed in the part of this paper in which Riley County is discussed.

Pennsylvanian rocks.—The Dover limestone (Fig. 4) and a few feet of other upper Pennsylvanian rocks crop out in eastern and southeastern Marshall County (Moore and Landes, 1937).

SUBSURFACE ROCKS

Studies by Lee, Leatherock, and Botinelly (1948) on the stratigraphy and structural development of the Salina basin should be of interest in exploration for oil and gas in Marshall County. Depths to some key horizons in a well in sec. 10, T. 4 S., R. 7 E. are given in Table 49.

Permian and Pennsylvanian rocks.—The combined thickness of Permian and Pennsylvanian rocks in Marshall County ranges from less than 1,000 feet to more than 2,000 feet. The thinner section is in the eastern part of the county where Permian rocks have been

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TABLE 49.—*Depths to some stratigraphic horizons in the B. B. Blair No. 1 Cox well, Cen. SW¼ SW¼ sec. 10, T. 4 S., R. 7 E., Marshall County*
(Data in part from Lee, Leatherock, and Botinelly, 1948)

Horizon	Depth, feet
Top Topeka limestone	810
Top Devonian limestone (Base of Pennsylvanian)	1,445
Top Silurian limestone	1,478
Top Maquoketa shale	1,757
Top Kimmswick limestone	1,814
Top Platteville limestone	2,047
Top St. Peter sandstone	2,117
Top Pre-Cambrian rocks	2,157
Total depth	2,175

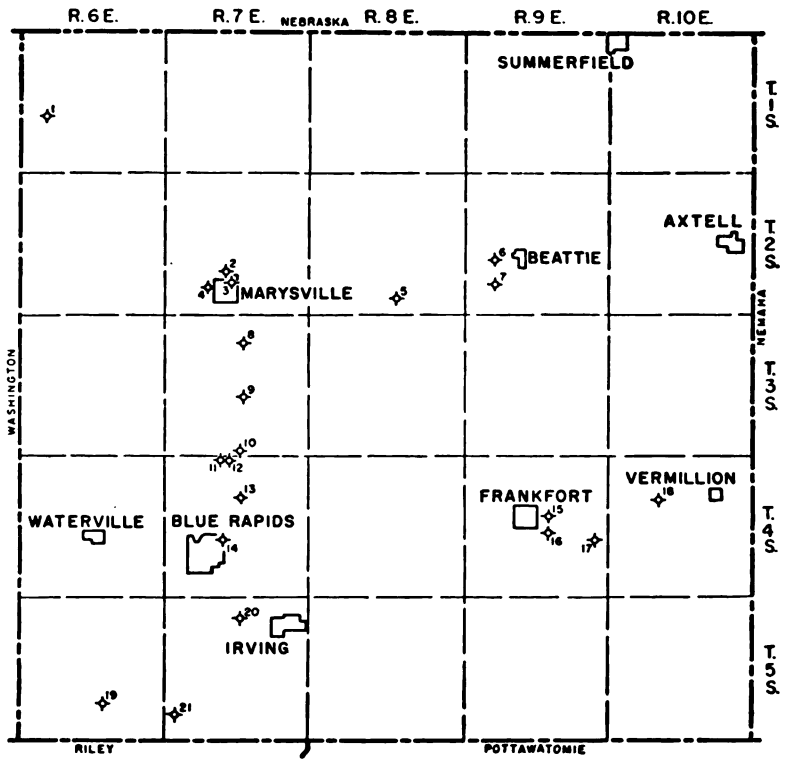

FIG. 45.—Map of Marshall County showing location of wells listed in Table 50.

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TABLE 50.—*Data on wells drilled for oil and gas in Marshall County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Davon Oil Co. No. 1 Schaefer	NW NW SW 20-1-6E	1950	2,715	Top Pre-Cambrian, 2,698 ft.
2	"Well near Marysville"	SE NW NE 28-2-7E	?	1,644	Stopped in Cherokee shale
3	Carter No..... Marysville	NE SE SE 28-2-7E	?	1,700	Stopped in Cherokee shale
4	Schnell & Mildeen No. 1 Marysville	NE NE SE 29-2-7E	1908	1,700	Top "Hunton," 1,692 ft.
5	Herbert Droge et al. No. 1 Suggett	NW SW NW 34-2-8E	1951	2,373	
6	Vermillion Oil Co. No. 1 Fitzgerald	SW¼ 20-2-9E	1922	1,271	Top Pre-Cambrian, 1,265 ft.
7	..... No. 1 Beatty	SW¼ 29-2-9E	?	3,000	Oil and gas shows at 1,182; Pre-Cambrian, 1,420 ft.
8	Blazier et al. No. 1 Cooper	NE NE NW 10-3-7E	1929	2,325	Stopped in St. Peter ss.
9	Falcon Seaboard Drlg. Co. No. 1 Randel	NW NE SW 22-3-7E	1951	2,322	Top Lansing, 1,150; top "Hunton," 1,516; top Viola, 1,872 ft.
10	Aladdin, Thrifty & Leiker et al. No. 1 Rombeck	NW SW SW 34-3-7E	1948	1,915	Top "Hunton," 1,632 ft.
11	H. J. Uhl et al. No. 1 Marvin	NE NE NW 4-4-7E	1948	1,875	Stopped in "Hunton" ls.
12	Marshall County Synd. No. 1 Catherine Finn	NW NE NE 4-4-7E	1929	3,935	Top "Hunton," 1,520; top St. Peter, 2,148 ; Pre-Cambrian, 2,220 ft.
13	B. B. Blair No. 1 Cox	SW SW 10-4-7E	1944	2,175	Some stratigraphic data listed in Table 48
14	George F. Johnson No. 1 Floyd Brown	NE SE SW 21-4-7E	1950	2,063	Pre-Cambrian, 1,999 ft.
15	..... No. 1 Sharer	15-4-9E	?	850	Oil show 750-755 ft.; 100 M cu. ft. gas, 790 ft.; stopped in Kansas City gr.
16	Swicker & Simcox No. 1 Dowrimple	N½ NW 22-4-9E	1929	1,245	St. Peter ss. on Pre-Cambrian rocks, 1,225 ft.
17	Dalton J. Woods No. 1 George Sharer	24-4-9E	1947	1,365	Pre-Cambrian, 1,340 ft.
18	Kansas Oil Co. No. 1 A. Fisher	NE SW SW 9-4-10E	1953	1,116	Pre-Cambrian, 1,104 ft.
19	Ohio Oil Co. No. 1 Osterkamp	SW SW NE 27-5-6E	1951	2,565	Top Lansing, 1,212; top "Hunton," 1,674; top Viola, 2,235 ft.
20	Falcon Seaboard Drlg. Co. No. 1 Blaney	NE SW SW 3-5-7E	1951	2,571	
21	Ohio Oil Co. No. 1 W. J. Krapochuil	SE SE SW 30-5-7E	1951	2,526	

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eroded. Marshall County lies on the west flank of the Nemaha anticline where the Pennsylvanian section is much thinner than it is east of the anticline. West of the anticline the older Pennsylvanian section is reduced in thickness, but Pennsylvanian rocks above the base of the Kansas City group have about the same thickness on both sides of the uplift. Redbeds are characteristic of the lowermost Pennsylvanian rocks.

Mississippian limestones and the Chattanooga shale are probably absent in all parts of Marshall County.

Pre-Chattanooga rocks.—In Marshall County Pennsylvanian rocks overstep from the west the "Hunton" limestone, the Maquoketa shale, the Viola limestone, and the Simpson formation (St. Peter-Decorah). Arbuckle rocks are probably absent from all parts of the county. The Marshall County Syndicate No. 1 Catherine Finn well, NW¼ NE¼ NE¼ sec. 4, T. 4 S., R. 7 E., was drilled 1,720 feet into Pre-Cambrian rocks, all of which probably comprise metamorphosed sediments. Wells in Marshall County have reached Pre-Cambrian rocks at depths ranging from 1,225 to 2,698 feet.

Exploration for Oil and Gas

Previous to 1949, 13 wells had been drilled for oil or gas in Marshall County (Jewett, 1949, p. 231). According to Geological Survey records no wells were put down in the county in 1949, 2 were drilled in 1950, and 5 in 1951. No wells were recorded in 1952, but 1 dry hole was abandoned early in 1953. It is obvious that the county is inadequately tested.

Data on wells of which the Geological Survey has records are listed in Table 50. Their locations are shown on Figure 45.

MIAMI COUNTY

Miami County was one of the first counties in Kansas to produce oil and gas and it was in Miami County that oil was first found in a well in Kansas. Three wells were drilled by Dr. G. W. Brown near Paola in 1860; these were the first test wells drilled in the State. The first two wells were abandoned as dry holes at depths of about 100 feet (Haworth, 1908, p. 22). The third well was drilled deeper and the discovery of oil was reported. Natural gas was piped to

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Paola from a field 7 miles to the east as early as 1884. This was the first city in Kansas to be supplied with natural gas.

The early exploration for and the discovery of oil and natural gas in Miami County near Paola have been described in several publications (Haworth, 1908, p. 22; Forbes, 1942, pp. 9-10; Moore and Jewett, 1942; Jewett and Abernathy, 1945, pp. 179, 181-192).

During 1952, 18 secondary recovery projects operated in Miami County, with an estimated production of 527,059 barrels of oil. All the oil and gas that has been found in Miami County occurs in Pennsylvanian rocks. In the eastern part of the county depths to oil- and gas-bearing formations range from about 325 or less to 400 feet; depths in the western part of the county are as much as 700 feet.

The reported oil production in Miami County in 1952 (591,153 barrels) was nearly three times as much as that of 1944 (197,510 barrels). This amazing increase is due almost entirely to extension and improved methods of secondary recovery operations. Gas production has become relatively unimportant; the county's total reported production in 1952 was 47 million cubic feet. Oil production in the various fields in the county, 1949 through 1952, is listed in Table 73.

Geology

SURFACE ROCKS

The surface geology of Miami County has been described by Newell (1935). His report contains an areal geologic map of the county and detailed descriptions of outcropping rocks.

With the exception of a few feet of unconsolidated deposits of Recent, Pleistocene, and Tertiary (?) age, the surface rocks of Miami County are of Pennsylvanian age. They include most of the Lansing group, all the Kansas City group, and most of the Pleasanton shale (Fig. 5). The upper part of the Stanton limestone of the Lansing group has not been identified in the county, although the entire formation is probably present under soil cover in the northwestern part of the county. The thickness of the exposed part of the Stanton limestone ranges from about 26 to 36 feet, the thickness of the Vilas shale from about 6 to 20 feet, and the thickness of the Plattsburg limestone from about 10 to 22 feet. These rocks are exposed in the northwestern part of the county.

Rocks of the Kansas City group, whose total thickness is about 255 feet, crop out in areas characterized by the prominent Wyan-

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dotte limestone escarpment and by the thick Lane shale section in the western part of the county. The Iola limestone escarpment is less conspicuous. The Wyandotte limestone is the formation next below the soil on the uplands in nearly all the county except the southeastern and northwestern parts. The Westerville limestone seemingly is absent in Miami County. The total thickness of rocks of the Bronson subgroup in the county is about 80 feet. Limestone is the dominant rock of this assemblage, which is characterized by oölitic cross-bedded flinty limestones and thinner black platy shales. These rocks crop out in the southern and southeastern parts of the county.

The thickness of the Pleasanton shale in Miami County is approximately 140 feet, but only about the upper 90 feet is exposed. The exposures of these rocks are along Hushpuckney Creek, Marais des Cygnes River, Middle Creek, and Sugar Creek in the southern and southeastern parts of the county.

SUBSURFACE ROCKS

Table 51 gives depths to some stratigraphic horizons in five wells in Miami County.

Pennsylvanian rocks.—The thickness of Pennsylvanian rocks in Miami County ranges from slightly more than 1,000 feet in the northwestern part to about 600 feet in the southeastern part. All oil and gas production in the county is from Pennsylvanian rocks, and numerous producing zones ranging from the Pleasanton shale to the lower part of the Cherokee shale are known. The Pleasanton rocks are easily recognized in well logs, and comprise strata that are referred to as the "big shale." In the subsurface, the Hepler sandstone is locally in contact with the "Big Lake" sandstone in the Bandera shale. Because of this relationship, the "Big Lake" sandstone in some places comprises two sandstones, the Hepler sandstone at the base of the Pleasanton shale and the Bandera Quarry sandstone in the upper part of the Marmaton group. A part of the oil and gas produced in the Big Lake area is from the Hepler sandstone. The common thickness of Pleasanton rocks in the county is about 200 feet. The Marmaton group is about 150 feet thick and the Cherokee shale ranges in thickness from about 350 feet to 450 feet.

Mississippian rocks.—The total thickness of Mississippian limestone formations in Miami County ranges from about 350 feet to

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TABLE 51.—*Depth in feet to some stratigraphic horizons encountered in five wells in Miami County*

Horizon	No. 1 Lee, SW SW 16-16-23E	Breisch No. 1 Ringer et al. 3-17-23E	Breise et al. No. 1 Brown, NE SW 12-17-21E	Clark No. 1 Vaughn, SE SW 28-17-22E	"Osawatomie" deep well, NE NW 12-18-22E
Base Hertha limestone	195	195	380	315	95
Base Fort Scott limestone	445	475	?	615	419
Top Mississippian limestone	852	888	1,055	981	770
Top Chattanooga shale	1,278	1,272	1,410	1,385	1,195
Top Viola limestone	1,312?	1,312?	1,465	1,428	1,255
Top St. Peter sandstone	1,350	1,493	1,510	1,460	1,535
Top Arbuckle limestone	1,393	1,533	1,538	.....	1,634
Top Pre-Cambrian rocks	2,883	.....	.....	.....	.....
Total depth	2,707	1,700	1,801	1,704	2,568

slightly more than 450 feet. The Chattanooga shale is believed to be less than 50 feet thick in all parts of the county.

Pre-Chattanooga rocks.—Miami County lies on the northern flank of the Chautauqua arch. Ordovician rocks, including Viola dolomite, St. Peter sandstone, and Arbuckle dolomite, are overstepped by the Chattanooga shale. The Viola and St. Peter are believed to be present only in the approximate northwestern half of the county. Elsewhere the Chattanooga shale is in contact with Arbuckle dolomite. The thickness of the Viola dolomite ranges from a featheredge to about 200 feet. The maximum thickness of the St. Peter sandstone is probably not much greater than 100 feet. Arbuckle rocks in the county have an average thickness of perhaps 850 feet. The Lamotte sandstone, having a maximum thickness of about 100 feet, probably underlies most or all the county.

Keroher and Kirby (1948) estimated that the Jefferson City-Cotter sequence in Miami County ranges from less than 100 feet in the northeastern part to something more than 200 feet in the southwestern part; the Roubidoux dolomite from about 100 feet in the southwest corner to a lesser amount in the northeastern part; the Van Buren-Gasconade sequence from 150 feet in the southwest corner to less than 200 feet in the northeastern part; the Eminence

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dolomite from an amount slightly greater than 100 feet in the southwest corner to more than 150 feet in the northeastern part; the Bonneterre dolomite from about 100 feet in the northwest corner to a somewhat greater amount in the southeastern part of the county.

Oil and Gas Developments

In 1884 gas was piped into Paola from wells about 7 miles east of town, and then, and earlier, oil was sold locally as lubricating oil. In about 1886 a small refinery was erected in Paola, and refinery products were shipped from there to Omaha and Kansas City. In 1889 the **Paola** field is reported to have yielded 500 barrels of oil which was the total oil production of Kansas. Early in the present century important oil production moved westward in Miami County and the western half, where the **Paola, "Osawatomie,"** and **Rantoul**

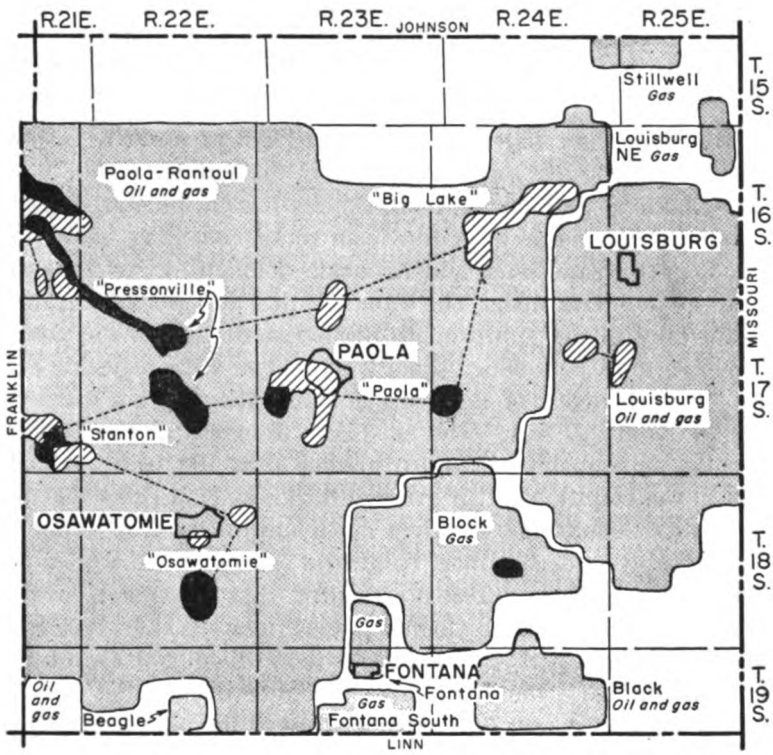

FIG. 46.—Map of Miami County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

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fields are situated, was the leading district. Wells in these fields generally had initial production of less than 100 barrels of oil per day, and their productions soon declined to a few barrels. In the autumn of 1926 the **"Big Lake"** pool was discovered. The discovery well in this field was drilled in sec. 20, T. 16 S., R. 24 E. This discovery resulted in an increase in the county's production from 13,153 barrels of oil in 1925 to 752,102 barrels in 1927. Much prospecting in the eastern half of the county followed. The **"Big Lake"** field was extended and several smaller fields were opened. In this part of the county producing wells range in depth from about 325 to 400 feet. In the western part, wells are as deep as 750 feet.

Oil and gas wells are distributed so widely in Miami County that it is not deemed practicable to divide the county into small fields. Gas has been produced in nearly all parts of the county and wells have been drilled wherever locations are convenient to pipe lines or for domestic use. Many farmers have their own gas wells or one or more wells serve a few farms. The amount of natural gas that enters commercial pipe lines has now become very small.

Most of Miami County lies within the area designated as the **Paola-Rantoul** oil and gas field (Fig. 46). The **Louisburg** oil and gas field is a smaller area covering much of the eastern part of the county.

Inasmuch as at present oil is produced in isolated areas and from pools that have well-established names, such as **"Big Lake," "Pressonville,"** and **"Stanton,"** it seems advisable to segregate oil production as is shown in Table 73 and Figure 46. The discovery well of the **"Big Lake"** oil-producing area was drilled on the Big Lake lease in sec. 20, T. 16 S., R. 24 E. in November 1926. The producing formation is a shoestring sandstone having a northeast-southwest trend. The wells range in depth from about 325 to 400 feet. Initial daily productions ranged from about 20 barrels to more than 250 barrels of oil. The producing sandstone is known as the "Big Lake sand"; it is correlated in part with the Bandera Quarry sandstone that lies between the Altamont and Pawnee limestones. In most of the area, however, the Altamont limestone is absent and the Hepler sandstone is seemingly locally in contact with the lower sandstone, the Bandera Quarry. Until more detailed studies are made, it is not deemed possible to determine whether production is chiefly from the Hepler sandstone or from the Bandera Quarry sandstone. The maximum known thickness of the "Big Lake sand" in the area

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is slightly more than 55 feet. Repressuring by air was practiced for many years before water flooding was initiated.

The **"Pressonville"** shoestring oil-producing area extends into Franklin County. This area in Miami County is about 12 miles long and ranges from about a quarter of a mile to 2 miles or more in width. Oil production is chiefly from the "Squirrel sand" at depths ranging from about 500 feet in the eastern part to about 750 feet in the western part of the area. The thickness of the "Squirrel sand" ranges from a few feet to about 50 feet.

The **"Paola"** oil-producing area includes pools that lie north, south, and southwest of Paola. Oil production in this part of the county is chiefly from the "Wayside sand" (in the Nowata shale), but some production seemingly is from the Hepler sandstone. Disconformable relations at the base of the Hepler cause it to be in contact with various upper Marmaton rocks. The Lenapah limestone is thin and locally absent, and it is difficult to differentiate the Hepler and "Wayside sand" in many logs. Some oil and frequent oil shows have been reported in the Knobtown sandstone in the area. Gas is produced in the Paola area from the Hepler sandstone, "Wayside sand," sandstone in the Bandera shale, "Peru sand," black shale in the upper few feet of the Cherokee shale, and "Bartlesville sand." Gas production is not as completely confined to definite areas as is oil production, and there was almost an unbroken gas field extending from Paola northwestward about 14 miles, eastward about 10 miles, southeastward, southward, and westward to the county boundaries and beyond.

Scattered wells in all directions make exact delineation of the **"Stanton"** oil pool boundary uncertain. Production seemingly is chiefly from the Hepler sandstone, which is about 15 feet thick and occurs between 350 and 450 feet below the surface. The "Squirrel sand" also is productive in a part of the area, and gas is produced from several zones. Water flooding was initiated in this area many years ago.

Oil production in the **"Osawatomie"** area is principally from a sandstone locally called "Wayside sand," but seemingly the reservoir rock is the Bandera Quarry sandstone which occurs in the Bandera shale. Water flooding has been practiced in the Osawatomie area for several years.

Former oil production in the **Black** field was from sandstone, probably the "Wayside," at an average depth of about 230 feet.

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Some early production may have been from the Hepler sandstone. Production data are not available but there are numerous drillers logs of the wells in the Geological Survey's files. In 1943 and 1944 an oil mining venture was initiated in the field in sec. 9, T. 19 S., R. 24 E. A shaft was put down and several nearly horizontal holes were drilled into the reservoir rock. Little or no commercial oil was produced. The field was developed mostly in 1924, and has been inactive for many years. A water-flood project is being operated in the **Block** field, in T. 18 S., R. 24 E. Production of oil is reported to be from the "Squirrel sand" at a depth of about 500 feet.

Gas has been produced in the **Fontana** field principally from the "Squirrel sand" at depths of about 500 feet. Gas has been produced in the **Fontana South** field from Pennsylvanian sandstones ranging in depth from about 300 to 500 feet. Probably most of the gas comes from the Bandera Quarry sandstone but the Hepler (?) sandstone or "Wayside" and the "Squirrel" have been productive in the area. Gas in the **Louisburg Northeast** field has been produced from the "Squirrel sand" at depths of about 500 feet.

MONTGOMERY COUNTY

Gas was discovered in Montgomery County in 1881 and oil was discovered in 1903 in the Bolton pool. The geology and oil and gas resources of Montgomery County were described by Moore and Boughton (1921) and by Abernathy (1940). Abernathy's report includes a map showing locations of most of the wells that had been drilled before the time of the report's publication and the stratigraphic depths of many of the wells are indicated.

Repressuring oil sands by water injection has become a very important phase of the petroleum industry in Montgomery County. Sixteen water-flooding projects, with an estimated production of 543,736 barrels of oil, operated in Montgomery County in 1952.

During 1952 Montgomery County produced 677,863 barrels of oil. The yield of natural gas was 554,298 thousand cubic feet. Oil production in the county for 1893 through 1948 is given in Tables 2 and 3. Table 73 gives the production in the county's various fields for 1949 through 1952. Figure 47 shows the locations of oil and gas fields and the areas of oil production in 1952.

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Geology

SURFACE ROCKS

Pennsylvanian rocks including those of the Douglas, Pedee, Lansing, Kansas City, Pleasanton, and Marmaton groups (Fig. 4) crop out in Montgomery County. Beds in the lower part of the Douglas group are exposed in the western and northwestern parts of the county. The oldest exposed rock in the county is the Altamont limestone of the Marmaton group which crops out in the southeastern corner.

The Tonganoxie sandstone is the caprock of prominent hills in the area of Douglas outcrops, and the Weston shale in the Pedee group underlies a broad area south of Elk River in the western part of Montgomery County. The outcrop belt of these rocks north of the river is much narrower. Most of the limestones in the Lansing and Kansas City groups are thin and inconspicuous in this part of the State and several of them pinch out before reaching the Kansas-Oklahoma line. Marmaton limestones, however, are thicker than farther north.

Because of lateral changes in rocks of the Missourian Series, it is convenient to apply the classification commonly applied to equivalent rocks in northeastern Oklahoma to these rocks south of T. 33 S. In this classification the Ochelata group includes rocks between the base of the disconformity at the base of the Tonganoxie sandstone (Virgilian-Missourian boundary) and the disconformity at the base of the Noxie sandstone. The Ochelata group is about 200 feet thick in Montgomery County. It consists chiefly of shale and sandstone. These rocks crop out in the county in the west-central and north-central parts. The Skiatook group includes rocks between the disconformity below the Noxie sandstone and the disconformity at the base of the Missourian Series, which is overlain by the Hepler (Seminole) sandstone. These rocks are slightly more than 200 feet thick in Montgomery County. The Drum limestone (Kansas City group) is 50 feet or more thick in the vicinity of Independence, but it is not present in the southern part of the county where it is seemingly cut out by the disconformity below the Ochelata rocks. The Dennis (Hogshooter) limestone is persistent across the county. The Swope limestone pinches out in the vicinity of Liberty, or is present southward as a thin zone of limy shale. The Hertha limestone becomes very thin before reaching the State line. The

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Checkerboard limestone, in the lower part of the Skiatook group, crops out in Coffeyville and vicinity. Upper Marmaton rocks are exposed in the southeastern part of Montgomery County. The oldest rock exposed in the county is the Altamont limestone or a few feet of the Bandera shale.

SUBSURFACE ROCKS

Montgomery County is in the area of the Chautauqua arch, where the Chattanooga shale lies on lower Ordovician rocks. Depths to some stratigraphic horizons in three Montgomery County wells are listed in Table 52.

Pennsylvanian rocks.—The average total thickness of Marmaton rocks in Montgomery County is about 390 feet. A bed of sandstone 20 to 50 feet thick, known as the "Weiser sand," occurs locally in the upper part of the Bandera shale. The thickness of the Bandera ranges from about 60 to 150 feet. The Pawnee limestone ranges in thickness from about 22 to 50 feet. It is chiefly dense, hard, light-gray, fossiliferous limestone, locally consisting of two beds of limestone separated by a few feet of black shale. It is locally designated by drillers as the "pink lime" or "40-foot limestone." The thickness of the Labette shale ranges from about 40 to 100 feet, and the average is about 70 feet. There is a thin bed of coal in the upper part of the Labette shale in southeastern Montgomery County, and a

TABLE 52.—*Depths in feet to some stratigraphic horizons in three Montgomery County wells*

Horizon	Cowles et al. No. 1 Clem, SE SE SE 6-32-16E	Hydraulic Oil Co. No. 1 Beal, SW SW NW 12-33-14E	——— No.— J. B. Miller, 33-33-17E
Base Kansas City group	285	668	...
Top Lenapah limestone	335	715	(No log above 850 feet)
Top Pawnee limestone	523	865	...
Top Fort Scott limestone	615	960	...
Base Fort Scott limestone	700	1,045	...
Top "Bartlesville sand"	900	1,180	...
Top Mississippian limestone	1,068	1,424	850
Top Chattanooga shale	1,385	1,638	1,155
Top Ordovician rocks	1,418	1,672	1,205
Top Pre-Cambrian rocks	.....	2,536	2,155
Total depth	1,456	2,541	2,160

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bed of sandstone, called the "Peru sand," occurs locally. The total thickness of the Fort Scott limestone (including the Breezy Hill? limestone) ranges from about 75 to 100 feet in the county. Three limestone members (locally four or five) are included. The upper limestone, which is very hard and dense, is called "Oswego," "brown lime," or "first lime" by some drillers and operators. The middle and lower limestones, called the "second lime" and "third lime," commonly are not as hard as the upper limestone and are impure in most places. The black shale beds separating the limestones range in thickness from 2 to 20 feet.

The Cherokee shale in Montgomery ranges in thickness from about 304 to 495 feet. It consists of gray and black shale, a few lenses of sandstone, several thin beds of coal, and a few thin beds of limestone. A sandstone in the upper part of the Cherokee is known as the "Squirrel sand." The Verdigris limestone is massive, fossiliferous, and dark gray, and ranges from 3 to 5 feet in thickness. It is persistent and commonly lies about 30 to 70 feet below the Fort Scott limestone. A similar bed about 40 feet below the Verdigris occurs locally. Sandstone lenses about 140 to 200 feet above the base of the Cherokee are called "Bartlesville sand." Some of these sandstone bodies are more than 100 feet thick. A conglomerate composed principally of chert and smaller amounts of limestone and pyrite occurs in the basal part of the Cherokee. In some places the "Burgess sand" directly overlies the conglomerate. Black shale, 40 to 90 feet in thickness, commonly lies on the "Burgess sand" in Montgomery County. If the sandstone and conglomerate are not present, the black shale lies on the Mississippian limestone.

Mississippian rocks.—The Mississippian rocks in Montgomery County have an average thickness of about 300 feet. Anticlines are generally marked by thin sections of Mississippian rocks (Lee, 1939, p. 12, pl. 1). The minimum thickness recorded is about 225 feet. The upper part of the Mississippian rocks was weathered and made porous before deposition of the overlying Pennsylvanian rocks, and most of the oil produced from Mississippian rocks is from this porous zone. The Mississippian rocks include the "Warsaw" limestone, Cowley formation, Keokuk limestone, Burlington limestone, Reeds Spring limestone, St. Joe limestone, Northview shale, and Compton limestone. The Chattanooga shale, which is black or gray and fissile, has an average thickness of about 40 feet in Montgomery County. It lies on Ordovician rocks.

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Ordovician rocks.—Ordovician rocks in Montgomery County include the Cotter and Jefferson City dolomites, the Roubidoux formation, and the undifferentiated Gasconade dolomite and Van Buren formation. The total thickness of these rocks in the county is about 725 feet.

Cambrian rocks.—The Cambrian rocks in Montgomery County are the Eminence and Bonneterre dolomites and the Lamotte sandstone. The total thickness of Cambrian rocks in the county is about 350 feet.

Pre-Cambrian rocks.—Well logs indicate that red granite was reached at a depth of 2,155 feet in the J. B. Miller well in sec. 33, T. 33 S., R. 17 E., and at 2,536 feet in the Hydraulic Oil Company No. 1 Beal well in sec. 12, T. 33 S., R. 14 E. (Table 52).

Oil and Gas Developments

Montgomery was one of the first counties in Kansas to produce large quantities of oil and gas. Gas was found in small quantities at several places in the county as early as 1881. Larger supplies of gas were found near Cherryvale in 1889 and near Coffeyville about a year later. Gas was piped to Coffeyville in 1892; that city was one of the first towns in southeastern Kansas to use natural gas. The largest gas field in the county, the **Independence** field, reached its peak of production in 1904. At that time it had an open-flow capacity exceeding 700 million cubic feet. Gas wells having initial daily productions of 10 to 20 million cubic feet were common; the largest well was reported to have had an initial production of 93 million cubic feet per day. During the early history of the gas industry, gas was produced from well-defined areas, such as the **Elk City, Independence, Jefferson, Cherryvale,** and **Coffeyville** areas. Later gas was produced from widely distributed wells in the county, and development has been so widespread that any one field is almost continuous with other fields. Gas is produced chiefly from the "Bartlesville sand"; the lowest gas-producing rock is the Arbuckle limestone.

Oil was first produced in Montgomery County in 1903, the year in which the **Bolton** pool southwest of Independence was discovered. Initial productions of wells in that pool ranged from 10 to 1,000 barrels per day. Subsequently oil pools were found in nearly all parts of the county. Oil production in Montgomery County reached its peak in 1925 when 1,136,654 barrels was produced.

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Water flooding of partly depleted oil-bearing formations was practiced in the county as early as 1920, and modern systematic water flooding started in 1939.

Oil and gas have been produced in Montgomery County from the Lane-Vilas, Bandera, Labette, and Cherokee shales, and the Fort Scott, Mississippian, and Arbuckle limestones. Gas was found in the northwestern part of the county from at least three sandstones in the Lane-Vilas shale. The upper sandstone is locally called "Bush-Denton" or "Ferguson"; the middle sandstone is called "Longton," "Webb," or "Heck"; and the lower sandstone is called "Encill." Oil is produced from the "Wayside sand" in the Nowata shale; this

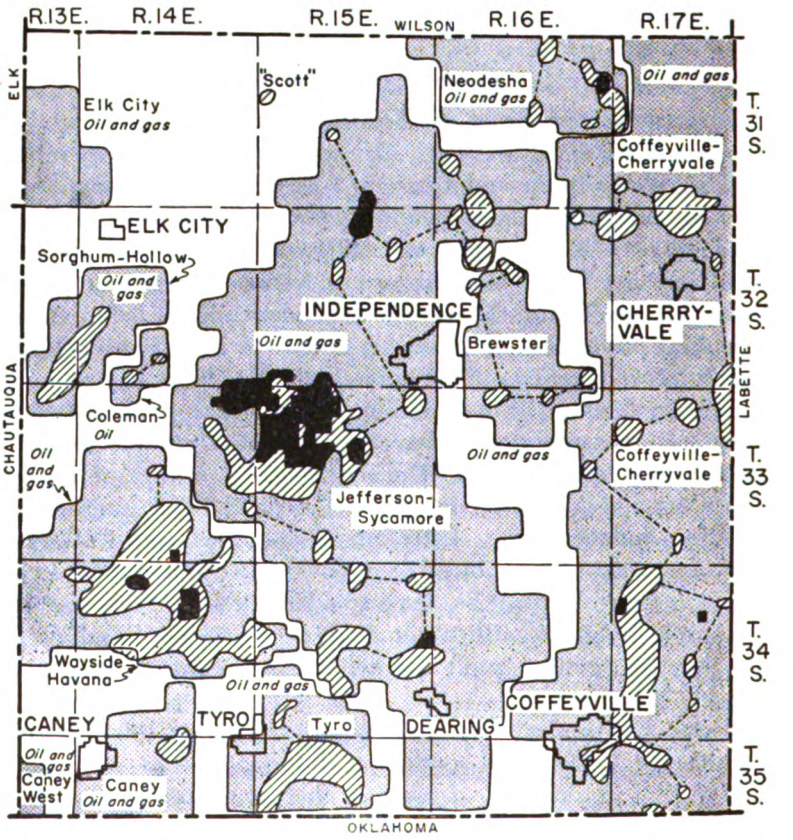

FIG. 47.—Map of Montgomery County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

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sandstone ranges in thickness from 10 to 30 feet. A sandstone in the Bandera shale, known as the "Weiser sand," yields oil and gas; it ranges in thickness from 20 to 60 feet. The "Weiser" has been very prolific; during the more active stages of development a large percentage of the wells drilled into it were producers.

There are three important oil and gas producing zones in the Cherokee shale in Montgomery County. The "Squirrel sand," which occurs locally in the upper part of the Cherokee shale, yields small amounts of gas and some oil. It is separated from the Fort Scott limestone by 10 to 80 feet of shale. The "Bartlesville sand," which occurs as lenses 10 to 100 feet in thickness and 40 to 100 feet above the base of the Cherokee, yields both oil and gas. The "Burgess sand," at or near the base of the Cherokee shale, yields much gas.

Gas occurs in the upper part of the Mississippian rocks both in porous limestone and in beds of fragmental chert, called "chat." The "chat" is believed to be restricted in its distribution to the flanks of "Mississippi lime" hills.

Eight oil pools and one gas pool have been discovered in Arbuckle rocks of Ordovician age in Montgomery County. The oil occurs in a siliceous limestone zone in the upper part of the Arbuckle. The Arbuckle pools are in small but well-defined anticlinal folds.

Because of the widespread occurrence of oil and gas in Montgomery County it is difficult to delineate fields in a satisfactory manner. However Figure 47 shows locations of rather large areas designated as fields by the Kansas Nomenclature Committee. In Table 73 production of oil in the county is assigned to fields as shown in Figure 47. Some smaller "fields" and pools are mentioned in the following discussion.

The **Brewster** oil and gas field has produced for several years from the "Bartlesville sand," but in 1949 an Arbuckle limestone oil pool was found in the field. The **Brewster** Arbuckle pool is in secs. 4 and 5, T. 33 S., R. 16 E. It is reported to occur in a dome with considerable closure and as much as 25 feet of pay zone in the central part. At least one well is reported to have had an initial potential of as much as 1,000 barrels of oil per day. The **Caney** field has been mostly a gas producing area. Gas occurs in basal Pennsylvanian sandstone called "Burgess." Oil is produced from a part of the area from the "Bartlesville sand."

The **Coffeyville-Cherryvale** oil and gas field covers practically all the eastern part of Montgomery County. Oil production at present

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is limited to small areas. The smaller **"Cherryvale"** oil and gas field was developed in 1904 (Abernathy, 1940, p. 26). The chief producing formation is the "Bartlesville sand." The **"Coffeyville"** field is one of the oldest fields in Kansas. The three producing zones are the "Wayside sand" at about 400 feet, the lower part of the Fort Scott limestone at about 600 feet, and the "Bartlesville sand" at about 1,000 feet.

Three Arbuckle dolomite (Jefferson City) oil pools have been found in the **Coffeyville-Cherryvale** area. They are the **Alloway,** the **Bellairs,** and **Thompson** pools. The **Bellairs** pool, secs. 3 and 4, T. 33 S., R. 17 E., was discovered in 1921 (Abernathy, 1940, p. 26). Oil was found in the upper part of the Arbuckle limestone at depths ranging from about 1,250 to 1,300 feet. At least 25 oil wells were completed in the pool. Some of the wells flowed initially 220 barrels of oil per day. Gas was found in the same area in Pennsylvanian and Mississippian rocks. The oil has a very low gasoline content. A small amount of oil was still being produced a few years ago in the field. The **Alloway** pool, secs. 8 and 17, T. 35 S., R. 17 E., was developed in 1924. The initial production from more than 40 wells ranged from 25 to 220 barrels of oil per day. Oil occurs in the upper few feet of the Arbuckle dolomite at a depth of about 1,200 feet. The **Thompson** pool, secs. 12 and 13, T. 33 S., R. 16 E., was discovered in 1924. This pool also contains oil of small gasoline content.

The **Coleman** oil pool produces from the upper part of the Jefferson City dolomite (top of Arbuckle). The field, opened in 1921 in T. 32 S., R. 14 E., found Arbuckle oil at a depth of about 1,700 feet. Initial daily production of the discovery well was reported to have been 4,100 barrels of oil by natural flow. A well drilled in 1948 is reported to have had an initial daily production of 200 barrels of oil and is to be regarded as having extended the field. A small amount of oil was produced in the **Elk City** field as recently as 1947. Several years ago the **Elk City** field was regarded as a well-defined gas field, with production from the upper part of the Mississippian limestone. Later, however, gas wells have been drilled so widely in Montgomery County that this and other fields have almost lost their identities. Now the field may be regarded as a small abandoned oil field in secs. 30 and 31, T. 31 S., R. 14 E. The oil producing rock is the "Weiser sand" in the Bandera formation.

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The **Jefferson-Sycamore** field (the former **Bolton** and **Jefferson-Sycamore** fields combined) is a large area covering the central part of Montgomery County. Oil production is limited now to isolated areas. Oil production chiefly is from the "Bartlesville sand." The **Bolton** oil pool was the first to be discovered in Montgomery County. The discovery well was drilled in 1903 in sec. 18, T. 33 S., R. 15 E. Initial production of this well was about 40 barrels of oil per day but as the field was developed many wells exceeded 1,000 barrels per day (Abernathy, 1940, p. 25). The producing formation, the "Bartlesville sand," lies at depths ranging from 1,150 to 1,200 feet.

The **Neodesha** oil and gas field extends from Wilson County into Montgomery County. Oil occurs in the "Bartlesville sand." Production in the **Sorghum Hollow** field is from the "Weiser sand." The **Wayside-Havana** oil-producing area is in the southwestern part of Montgomery County, where oil was discovered in 1904; more than 500 wells in this area have produced oil. The "Wayside sand" in the Nowata shale, which occurs at an average depth of about 575 feet, is the uppermost productive rock in this area. The "Weiser sand," about 120 feet below the "Wayside," also yields oil. The third producing zone is the "Bartlesville sand" which lies at an average depth of about 1,200 feet and ranges from about 15 to 50 feet in thickness. The **Tyro** pool, discovered in 1904, yields oil and gas from the "Bartlesville sand" which ranges in thickness from 20 to 60 feet and has an average depth of 1,250 feet.

MORRIS COUNTY

Oil is produced in Morris County in three fields, one which was opened in 1949 and two in 1950. No production has been reported since 1949 in another field which was opened in 1928. The county lies west of the Nemaha anticline in an area in which one may expect additional discoveries especially in pre-Mississippian rocks. All oil production in the county has been from the upper part of the Mississippian limestone or from chert accumulations on its upper surface. The known oil pools are about 2,200 feet below the land surface. Gas discoveries in the county have been along the Nemaha anticline. Known gas pools are in lower Permian or upper Pennsylvanian rocks in sandstone sometimes correlated with the Indian Cave sandstone but which actually may be somewhat older

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than the basal Permian deposits; from the Willard shale; the Lawrence shale; and from rocks in the Lansing group. Depths to known gas pools range from about 450 to 1,450 feet.

During 1952 Morris County produced 47,860 barrels of oil and 45,573 thousand cubic feet of gas. Oil production in the county from 1946 through 1952 is listed in Table 3; production in recent years in the various fields is listed in Table 73. Figure 48 shows locations of areas in Morris County that produced oil in 1952.

Geology

SURFACE ROCKS

The outcropping bedrocks in Morris County are Permian in age. Approximately the lower 100 feet of the Sumner group, the Chase group, and nearly all the Council Grove group are exposed (Fig. 3). The total thickness of exposed Permian rocks is about 700 feet. Alluvium in the valleys of recent streams and upland gravel deposits are similar to surficial deposits in other eastern Kansas counties.

A thickness of 100 feet or more of the Wellington shale in the Sumner group is present at the surface in the western part of Morris County. The Chase group occupies an outcrop belt about 20 miles wide. This group is characterized by massive limestones, several of which are flinty, and by highly colored shales; it is about 350 feet thick in Morris County. Included in these rocks are several excellent key horizons for structural mapping. The Florence limestone lies below the most extensive dip slope in the area. The upper surface of the Florence, however, should be used as a datum plane only in places where it is protected by overlying shale beds. Council Grove rocks crop out along Neosho River in the southeastern part of the county. The lowest well-exposed unit is the Grenola formation (which includes the Neva limestone member).

SUBSURFACE ROCKS

The Nemaha anticline extends through Morris County, and in the buried Nemaha fault scarp, rocks as old as the Arbuckle limestone are believed to be in contact with basal Pennsylvanian deposits.

Permian and Pennsylvanian rocks.—The average thickness of Permian and Pennsylvanian rocks in Morris County is about 2,000 feet. The Shawnee group includes much more limestone than shale, and the Lansing and Kansas City groups are chiefly limestone. Higher

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rocks and those of the Douglas group are similar to equivalent strata farther east in the State. The thickness of combined Pleasanton, Marmaton, and Cherokee groups is about 650 feet in the eastern part of the county, but as little as 150 feet or less in the western part.

Mississippian rocks.—On the eastern side of the Nemaha anticline in Morris County the total thickness of Mississippian limestone formations ranges from a featheredge to approximately 350 feet, and on the western side to slightly more than 150 feet. These rocks are absent from a large area (Lee, 1939, pl. 1). The thickness of the Chatttanooga shale in the county ranges from a featheredge to about 150 feet (Lee, 1940, pl. 3).

Pre-Chattanooga rocks.—The "Hunton" limestone is believed to have been eroded from a large part of Morris County in the area of the Nemaha anticline. The maximum thickness is probably not more than 200 feet. The Maquoketa shale is believed to be present in the county on both sides of the Nemaha fault; its maximum thickness is probably less than 100 feet. The Viola limestone has a maximum thickness of probably not more than 200 feet. The thickness of the St. Peter sandstone ranges from a featheredge to about 50 feet or more. Pre-Pennsylvanian areal geology in Morris County is shown by Lee, Leatherock, and Botinelly (1948, pl. 8). It is important to note that rocks included in the section between the base of Mississippian limestone and the base of the St. Peter sandstone were beveled by pre-Pennsylvanian erosion in a band extending from the southeastern part to the northeastern part of the county. The greatest thickness of Arbuckle rocks in the county is believed to be about 400 feet. In the Alta Vista Oil Company No. 1 Helen Taylor well, in the NE¼ SW¼ sec. 5, T. 14 S., R. 8 E., Pre-Cambrian rock was reached at 2,480 feet.

Oil and Gas Developments

Locations of oil and gas producing areas in Morris County are shown in Figure 48. Oil fields are confined to the southeastern part of the county where four pools have been found. Gas production has been along the Nemaha anticline which crosses the county from the northeast to south-central part.

The **Alta Vista** gas-producing area yields gas from several zones near the base of Permian or the top of Pennsylvanian rocks at depths of about 500 feet. The **Burdick** oil field was opened in 1949 when

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a well in sec. 15, T. 17 S., R. 5 E. found oil in the Mississippian limestone in a zone from 2,236 to 2,257 feet. In the **Diamond Springs** field, T. 17 S., R. 6 E., gas production probably is from Lansing rocks. The **Heigle** gas pool was discovered in sec. 11, T. 16 S., R. 7 E., in 1928. The pool is in upper Lansing rocks at a depth of about 1,440 feet. Initial daily production was reported as 1½ million cubic feet of gas. Other wells found gas in the same rocks. Later gas was found in lower Permian or upper Pennsylvanian sandstone at depths of about 440 feet. The area is now called **Wilsey.**

The **Nelson** oil field was opened in sec. 30, T. 17 S., R. 5 E. in 1928. Oil was found in "chat" at a depth of 2,295 feet. The initial daily potential of the discovery well was reported as 40 barrels of oil. In 1945 two oil wells were added to the field. No production has been reported from the field since 1949, when only 85 barrels was recorded. In 1950 a well drilled in sec. 25, T. 16 S., R. 5 E., discovered the **Three Mile Creek** oil pool. The well was rated at 40 barrels of oil per day from the upper part of Mississippian lime-

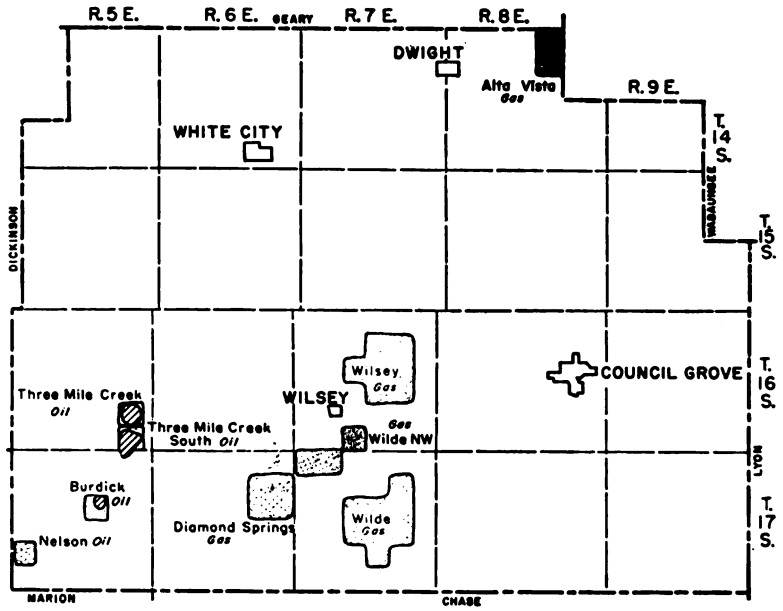

FIG. 48.—Map of Morris County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production.

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stone between 2,208 and 2,252 feet. The **Three Mile Creek South** field was opened in 1950 in sec. 35, T. 16 S., R. 5 E. Initial daily production of 60 barrels of oil was reported. Production is from the upper part of Mississippian limestone from 2,183 to 2,207 feet.

TABLE 53.—*Data on dry wildcat wells drilled in Morris County, 1949 through 1952*

Company and farm	Location	Depth to Kansas City, feet	Depth to Mississippian, feet	Total depth, feet	Remarks
		1949 Wells			
Lance Hill et al. No. 1 Doran	SE SE NE 24-15-8E	1,780	2,571	3,420	"Hunton" 2,934; Viola 3,196 ft.; St. Peter 3,302 ft.; Arbuckle 3,368 ft.
Mouser Drlg. Co. No. 1 Novak	SW SW NE 26-17-5E	1,726	2,195	2,420	Viola 2,387 ft.
Mouser Drlg. Co. No. 1 Peterson	SW SW NE 27-17-5E	1,738	2,213	2,406	Base Mississippian 2,257 ft.
		1950 Wells			
M. F. Bear et al. No. 1 Albritton	NW cor. SW 24-15-5E	.....	2,211	2,268	
Wakefield et al. No. 1 White	NW cor. SE 36-15-8E	1,730	2,522	3,361	
M. F. Bear et al. No. 1 Peterson	NW cor. SW 34-16-5E	.....	2,240	2,280	Kinderhookian rocks 2,341 ft.
Dunn & Strait No. 1 Hutchinson	N½ NE NW 10-16-6E	1,625*	2,096	2,767	"Hunton" 2,336 ft.; Viola 2,541 ft.; Simpson 2,615 ft.; Arbuckle 2,735 ft.
Orville Glick No. 1 Sharp	SW cor. SW 24-16-8E	1,653	2,472	3,228	
Earl F. Wakefield et al. No. 1 Dent	SE NE NE 26-16-9E	1,488	2,356	3,160	"Hunton" 2,835 ft.; Viola 2,935 ft.; St. Peter 3,038 ft.; Arbuckle 3,124 ft.
		1951 Wells			
F. G. Holl No. 1 Whitehair	NW NW NW 17-15-5E	1,970**	2,166	2,205	
Sohio Petro. Corp. No. 1 Granzow	SE SE SW 28-15-5E	1,612*	2,232	2,290	
B & R Drlg. & Sohio Petro. Corp. No. 1 Hogewaning	SW SW NW 29-15-5E	1,670*	2,213	2,336	Kinderhookian rocks 2,274 ft.
Carter Oil Co. No. 1 Lingren	NW NW NE 18-15-8E	1,560*	2,196	2,912	"Hunton" 2,471 ft.; Viola 2,605 ft.; St. Peter 2,776 ft.; Arbuckle 2,867 ft.
Champlin Refg. Co. No. 1 Schruben	NW SW SW 5-15-9E	1,570*	2,535	3,365	
F. G. Holl No. 1 West	SW SW NE 6-17-5E	.....	2,300	2,500	Kinderhookian rocks 2,360 ft.
		No wildcat wells reported in 1952.			

* Depth to Lansing, feet.

** Depth to base Kansas City, feet.

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The **Wilde** gas field was opened in 1929. Three gas pools have been found in the field, in T. 17 S., R. 7 E. The pools are in the Willard shale at about 600 feet, the Lawrence shale at about 1,200 feet, and in Lansing rocks at about 1,400 feet. In 1952, 16 wells produced 43,960 thousand cubic feet of gas. The **Wilde Northwest** gas field is not producing commercially. One well in the **Wilsey** gas field, in sec. 15, produced commercially in 1952. The area of the **Wilsey** field includes the **Heigle** gas pool mentioned above.

Data on dry wildcat wells drilled in Morris County during 1949, 1950, 1951, and 1952 are listed in Table 53. Production data and pool wells drilled for the same period are given in Table 73.

NEMAHA COUNTY

Oil was produced in 1952 from three pools in two fields in Nemaha County. The Sabetha field produces from a "Hunton" limestone pool and the Strahm field contains a "Hunton" and a Viola limestone pool. Cumulative oil production in the county at the end of 1952 stood at 96,836 barrels. At about midyear 1953, the discovery of the county's third field was reported when a well in sec. 26, T. 2 S., R. 14 E. found "Hunton" limestone production at a depth of 2,826 feet. Locations of the three oil fields and of dry wildcat wells in the county are shown in Figure 49. Oil production in the county from 1948 through 1952 is listed in Table 3. Oil production in the two Nemaha County fields, 1949 through 1952, is listed in Table 73.

Geology

SURFACE ROCKS

Exposed consolidated rocks in Nemaha County are Permian and Pennsylvanian in age. The oldest outcropping formation is the Topeka limestone, and the youngest consolidated formation is the Wreford limestone. In Nemaha and neighboring counties the Nemaha anticline and the syncline that borders it on the east have brought about structural conditions that are unique in Kansas. In the western part of the county is a band of exposed Pennsylvanian rocks bordered both on the east and the west by Permian beds.

The Wreford limestone underlies an area in the eastern part of T. 1 S., R. 13 E. and the western two-thirds of T. 1 S., R. 14 E. The

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Topeka limestone is exposed along Nemaha Creek in sec. 2, T. 1 S., R. 12 E. Glacial drift occurs in comparatively thick deposits in all parts of Nemaha County and the country rock is concealed in many places.

SUBSURFACE ROCKS

Pre-Cambrian rocks are nearer the land surface in Nemaha County than elsewhere in Kansas. Crystalline rocks are about 600 feet deep in the highest part of the buried granite ridge of the Nemaha anticline. About 3,500 feet of sedimentary rocks overlie the Pre-Cambrian floor east of the buried fault escarpment of the anticline. Depths to some stratigraphic horizons in five Nemaha County wells are listed in Table 54.

Permian and Pennsylvanian rocks.—The maximum thickness of Permian and Pennsylvanian rocks in Nemaha County is about 2,000 feet. About 600 feet of Pennsylvanian rocks is present over the crest of the buried crystalline core of the anticline (Jewett and Abernathy, 1945, pl. 1).

TABLE 54.—*Depths in feet to some stratigraphic horizons in five Nemaha County wells*

Horizon	Davon Oil Co. No. 1 Kohler, NE NE NW 34-1-14E	The Texas Co. No. 1 Murdock, SE SE SW 16-2-13E	Carter Oil Co. No. 1 Hutfles, NW NW SW 25-3-13E	Woods Oil & Gas Co. No. 1 Whaley, NW NW NE 34-4-13E	Woods Oil & Gas Co. No. 1 Griffiths, SE NE NE 23-5-13E
Top Howard limestone	880	...	575	862	.....
Top Heebner shale	1,164	432	.....	1,184	1,262
Top Lansing group	1,298	538	.....	1,368	1,447
Top Mississippian limestone	2,491	792*	.....	2,606	2,726
Top Kinderhookian rocks	2,617	...	1,804	.....	2,810
Top "Hunton" limestone	2,854	...	2,003	2,947	3,073
Top Maquoketa shale	3,531	...	2,607	3,595	3,626
Top Viola limestone	3,605	...	2,659	3,639	3,683
Top Simpson formation	.....	...	2,933	3,841	3,853
Top Arbuckle rocks	.....	...	.....	.....	3,928
Top Pre-Cambrian rocks	.....	836	2,972	3,916	3,971
Total depth	3,672	846	2,976	3,933	3,971

* Top basal Pennsylvanian sandstone; Pennsylvanian on Pre-Cambrian.

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Mississippian rocks.—Mississippian rocks are absent in Nemaha County in the area west of the buried fault escarpment of the Nemaha anticline, but the Mississippian limestone formations have a total thickness of about 150 feet in the southeastern part of the county. Undifferentiated Burlington-Keokuk limestone is believed to be the uppermost Mississippian limestone in the county. It is probably underlain by the Gilmore City and Chouteau formations.

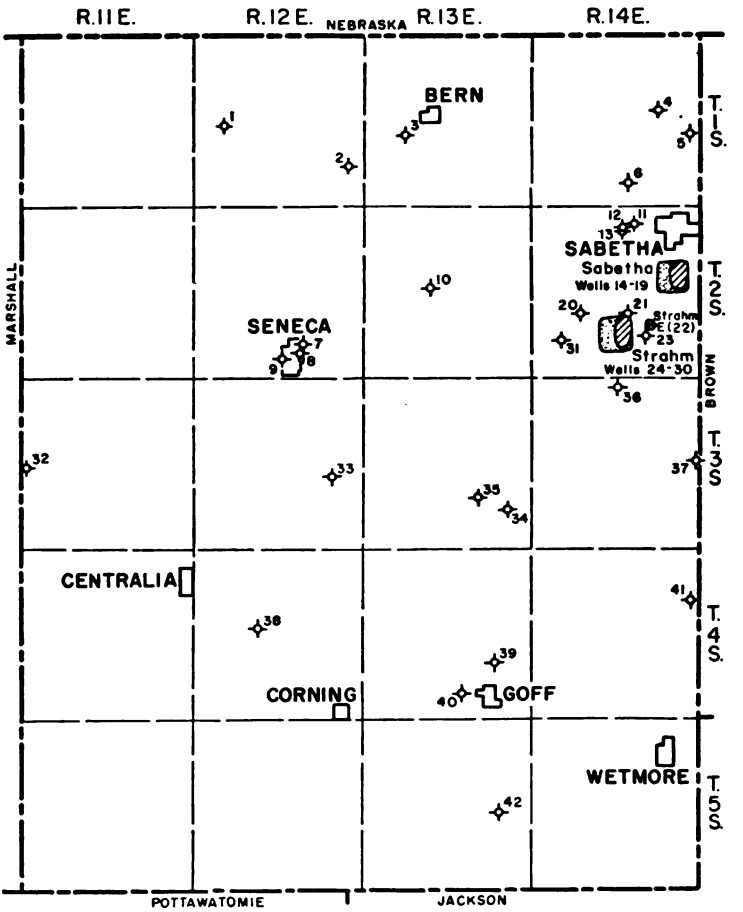

FIG. 49.—Map of Nemaha County showing oil fields as designated by the Kansas Nomenclature Committee and locations of wells listed in Table 55. Diagonal lines show areas of 1952 oil production; crossed lines show 1953 pool discovery.

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Pre-Chattanooga rocks.—According to Lee (1943, fig. 12), the thickness of rocks between the base of the Chattanooga shale and the top of the Maquoketa shale in Nemaha County ranges from a featheredge to about 650 feet. The interval between the top of the Maquoketa shale and the top of the St. Peter sandstone ranges from a featheredge to about 400 feet (Lee, 1943, fig. 11). The maximum thickness of the rocks from the top of the St. Peter sandstone to the Pre-Cambrian floor is about 200 feet (Lee, 1943, fig. 9). Probably the Roubidoux dolomite, Bonneterre dolomite, and Lamotte sandstone are present in the county and possibly a small thickness of rocks of the Van Buren formation is present in the extreme southeastern part.

Oil Developments and Exploration

Wells drilled for oil and gas in Nemaha County, of which the Geological Survey has records, are listed in Table 55, and their locations are shown in Figure 49. There are records of 42 wells in the

Table 55.—*Data on wells drilled for oil and gas in Nemaha County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Partman & McKenna No. 1 Sudbeck	NW NW NW 20-1-12E	1934	409?	Log to 220 ft. only
2	Rock Island R. R. Co. "Bern" well	25-1-12E	?	550	Stopped in Douglas gr.
3	..... No. 1 Wittmer	20-1-13E	?	1,880	Pre-Cambrian, 1,295 ft.
4	Carter Oil Co. No. 1 Dennis Kesler	NW NW NE 14-1-14E	1948	2,773	Top "Hunton," 2,681 ft.
5	Clifton Galle & Towle No. 1 Mills	SE NE 24-1-14E	1934	2,946	Stopped in "Hunton" ls.
6	Davon Oil Co. No. 1 Kohler	NE NE NW 34-1-14E	1950	3,672	Stratigraphic data in Table 54
7	..... No. 1 Williams	SE SE SE 27-2-12E	....	1,100	
8	"Seneca well"	SW NE NE 34-2-12E	1904	736?	May be in sec. 33
9	..... No. 1 Seward	NE SW NW 34-2-12E	1914	....	
10	The Texas Co. No. 1 Murdock	SE SE SW 16-2-13E	1949	846	Stratigraphic data in Table 54
11	Fred D. Culpepper No. 1 Lamparter	W½ SW SE 3-2-14E	1944	2,900	Top "Hunton," 2,830 ft.

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TABLE 55.—*Data on wells drilled for oil and gas in Nemaha County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
12	Ohio Oil Co. No. 1 Lamparter	NE SW 3-2-14E	1944	3,947	Pre-Cambrian, 3,938 ft.
13	Stout & Hahn No. 1 Lamparter	NW NE SW 3-2-14E	1948	2,910	Top "Hunton," 2,828 ft.
14	Carter Oil Co. No. 1 Oren Strahm	NW SW NW 13-2-14E	1950	3,929	Discovery well Sabetha pool; Production from "Hunton," 2,826 ft.
15	Carter Oil Co. No. 1 Graham	NW SE NW 13-2-14E	1951	3,519	Dry hole; top Mississippian, 2,435; top "Hunton," 2,843; top Viola, 3,496 ft.
16	Carter Oil Co. No. 1 Noahl	NW NW SW 13-2-14E	1950	3,600	Dry hole
17	J. E. Palensky & Sons No. 1 Anna Steibler	NE SE NE 14-2-14E	1953	2,852	Initial daily production 50 bbls. of oil & 50 bbls. water
18	J. E. Palensky & Sons No. 2 Anna Steibler	SW NE NE 14-2-14E	1953	2,928	Dry hole; top "Hunton," 2,913 ft.
19	Carter Oil Co. No. 1 Gilbert-Land Bank	NW NW SE 14-2-14E	1949	3,228	Stopped in Silurian rks.
20	Hugoton Production Co. No. 1 Lancaster	SE SE SE 20-2-14E	1950	3,743	Dry hole; Strahm extension wildcat
21	Midstates Refg. Co. No. 1 Dribelbis	SE SE SW 22-2-14E	1952	3,629	Dry hole; top "Hunton," 2,895; top Viola, 3,613 ft.
22	O. O. Wallace et al. No. 1 Edelman	NW NW NW 26-2-14E	1953	2,851	Oil well, Strahm field; initial daily production 25 bbls. of oil
23	Stephens Petro. No. 1 Mouser	NW NW SW 26-2-14E	1950	3,612	Dry hole; top "Hunton" 2,870; top Viola, 3,589 ft.
24	Carter Oil Co. No. 1 Mamie Strahm	SW SW NW 27-2-14E	1948	2,879	Discovery well Strahm "Hunton" pool; initial daily production 54 bbls. of oil
25	Carter Oil Co. No. 2 Mamie Strahm	NE SW NW 27-2-14E	1950	3,577	Discovery well Strahm Viola pool; initial daily potential 408 bbls. of oil
26	Carter Oil Co. No. 1 Parly School Dist.	NE NW SW 27-2-14E	1950	3,559	Oil well; initial daily production 450 bbls. of oil
27	Carter Oil Co. No. 2 Parly School Dist.	NE SW SW 27-2-14E	1950	3,581	Oil well; initial daily production 14 bbls. of oil
28	Carter Oil Co. No. 1 Stoller	NE NE SW 27-2-14E	1950	3,610	Dry hole
29	Carter Oil Co. No. 1 Koch-Ransom	SW NE SE 28-2-14E	1949	2,972	Stopped in "Hunton" ls.
30	Carter Oil Co. No. 2 Koch-Ransom	NE NE SE 28-2-14E	1950	3,968	Salt water disposal well; Strahm field
31	Shelly No. 1 "Sabetha"	NE SW SW 29-2-14E	1876	521	
32	Nemaha Oil & Gas Co. No. 1 "Seneca"	NW NW NW 19-3-11E	1929	3,256	Poor log; Pre-Cambrian, 710 (?) ft.
33	..... No. 1 Noll	SE SE NE 23-3-12E	?	2,190	Very poor log

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34	Carter Oil Co. No. 1 Hutfles	NW NW SW 25-3-13E	1949	2,976	Stratigraphic data in Table 54
35	Davon Oil Co. No. 1 Swart	NW NW NW 26-3-13E	1950	2,438	
36	L. J. Ryan No. 1 Aberle	SW NW NW 3-3-14E	1951	3,798	Top Viola, 3,699 ft.
37	Carter Oil Co. No. 1 Draney heirs	SE SE SE 13-3-14E	1949	3,152	Top Mississippian, 2,637; top "Hunton," 3,078; Pre-Cambrian, 3,152 ft.
38	McCalhoun et al. No. 1 Nightingale	NE SE SW 16-4-12E	1951	808	Pre-Cambrian, 808 (?) ft.
39	Davon Oil Co. No. 1 Hawley	NW NE NE 26-4-13E	1950	3,625	Top Viola, 3,565 ft.
40	Woods Oil & Gas Co. No. 1 Whaley	NW NW NE 34-4-13E	1951	3,933	Stratigraphic data in Table 54
41	Ladd et al. No. 1 Achlen	S½ SE NW 12-4-14E	1941	3,130	Stopped in "Hunton" ls.
42	Woods Oil & Gas Co. No. 1 Griffiths	SE NE NE 23-5-13E	1951	3,971	Stratigraphic data in Table 54

county. Four oil pools (3 fields) have been discovered. They, like several pools farther south, are in the synclinal area east of the Nemaha anticline.

The **Sabetha** oil field was opened in 1950 in sec. 13, T. 2 S., R. 14 E. The pay zone is in "Hunton" limestone between 2,826 and 2,834 feet. Oil was discovered in the "Hunton" limestone in Nemaha County in 1948 by a well in sec. 27, T. 2 S., R. 14 E., which was rated at 54 barrels of oil per day. This is the discovery well of the **Strahm** field and was the first oil well in the county. The pay zone lies between 2,877 and 2,879 feet. A Viola pool was found in the field in 1950 by an offset to the discovery well. The pool lies between 3,559 and 3,778 feet. The **Strahm East** field was opened in 1953 by a well in sec. 26, T. 2 S., R. 14 E. which found production of 25 barrels of oil per day in "Hunton" rocks at a depth of 2,826 feet.

Production of the Nemaha County fields from 1949 through 1952 is given in Table 73.

NEOSHO COUNTY

Oil and gas have been produced in Neosho County for many years. The first active prospecting in the county was in the northeastern part in the vicinity of Humboldt in about 1893 or 1894 when both oil and gas were discovered. The geology and oil and gas

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resources of Neosho County have been described by Moore and Elledge (1920).

During 1952, 645,001 barrels of oil was produced in Neosho County. Production in the county for 1894 to 1952 is given in Tables 2 and 3. Approximately 133,500 thousand cubic feet of gas were produced in the county in 1952. Oil production in the county has increased more than 25 percent in the last 4 years. Oil production in the various fields in Neosho County for 1949 through 1952 is given in Table 73.

It is estimated that 469,624 barrels of oil was produced in 1952 by the 10 secondary recovery projects that operated in the county (Table 4). Locations of oil and gas fields in the county, and of areas that produced oil in 1952 are shown in Figure 50.

Geology

SURFACE ROCKS

The surface rocks of Neosho County consist of alternating beds of limestone and shale and locally some beds of sandstone. With the exception of sand and gravel deposits of Pleistocene and probable Tertiary age, the exposed rocks of Neosho County belong to the Kansas City, Pleasanton, and Marmaton groups of Pennsylvanian age.

Rocks of the Kansas City group (Fig. 5) crop out in the western and central parts of Neosho County. The Lane-Bonner Springs shale is the youngest consolidated rock and is exposed in the area west and north of Chanute. The middle and lower parts of the Kansas City section are modified by a local disconformity in the area east of Chanute. Sandstone in the Chanute shale, which lies next above the disconformity, rests on strata ranging in age from the Drum limestone to the basal part of the Dennis limestone. The rocks of the Bronson subgroup consist of thick beds of limestone separated by thin beds of shale and sandstone. Where the entire Bronson section is present, its thickness is about 150 feet. The Pleasanton group in Neosho County is about 100 feet thick and consists chiefly of shale. It contains a persistent but thin sandstone, the Hepler, a few feet thick in the basal part. Rocks of the Marmaton group (Fig. 5), which are the oldest exposed Pennsylvanian rocks in the county, crop out in the southeastern part and are about 250 feet thick.

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SUBSURFACE ROCKS

Depths to some stratigraphic horizons in three Neosho County wells are listed in Table 56.

Pennsylvanian rocks.—The Cherokee shale is about 420 feet thick in Neosho County. It consists of light and dark shale, sandstone lenses, and thin beds of limestone and coal. Sandstone lenses about 50 feet below the top of the Cherokee shale are called "Squirrel sand." The "Squirrel" is well developed in the central part of the county. The Ardmore limestone, an excellent key bed, lies about 80 feet below the top of the Cherokee. The "Bartlesville sand," which occurs about 100 feet below the top of the Cherokee, is the most productive oil sand in the Cherokee shale. It may be noted that this so-called "Bartlesville sand" is stratigraphically higher and younger than the "Bartlesville sand" in northern Oklahoma and parts of southern Kansas. The Cherokee lies unconformably upon the eroded surface of Mississippian limestone.

Mississippian rocks.—Mississippian rocks in Neosho County consist dominantly of limestone, some of which is cherty or dolomitic. They have a total thickness of about 300 feet. The formations present in the county are the "Warsaw," Keokuk, Burlington, Reeds Spring, and St. Joe limestones, the Northview shale, and the Compton limestone. The Chattanooga shale is less than 50 feet thick (Lee, 1940, pl. 3).

Ordovician and Cambrian rocks.—Very little information pertaining to Ordovician and Cambrian rocks in Neosho County is available. The drillers log of one deep well in Neosho County,

TABLE 56.—*Depths in feet to some stratigraphic horizons in three Neosho County wells*

Horizon	W. M. Wells No. 1 Rensing Heiss, NE NE 36-27-18E	Willis Bros. No. 1 Seidle, 7-28-18E	Deck & Sons No. 1 Arnett, 34-30-18E
Base Kansas City group.....	150	...	...
Base Fort Scott limestone.....	502	640	563
Top "Bartlesville" sandstone..	740	845	810
Top Mississippian limestone....	955	1,055	993
Top Chattanooga shale.....	.....	1,308	1,280
Top Arbuckle rocks.....	.....	1,327?	1,302
Top Pre-Cambrian rocks.....	.....	.....	2,182
Total depth.....	1,043	1,328	2,240

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the Deck and Sons No. 1 Arnett in sec. 34, T. 30 S., R. 18 E., shows 927 feet of limestone, sandstone, and shale between Mississippian and Pre-Cambrian rocks.

From studies of cuttings from wells in neighboring counties, Keroher and Kirby (1948) estimated that (1) the thickness of the Jefferson City-Cotter sequence ranges from about 325 feet in the northeastern part of the county to about 475 feet in the southwestern part; (2) the average thickness of the Roubidoux dolomite is about 150 feet; (3) the thickness of the Van Buren-Gasconade sequence ranges from an amount less than 150 feet in the northeastern part to one slightly in excess of 200 feet in the southwestern part; (4) the Eminence dolomite has an average thickness of about 50 feet; and (5) the Bonneterre dolomite ranges from 100 to 150 feet in thickness in the county. The Lamotte sandstone is believed to be present throughout the county.

Pre-Cambrian rocks. — Pre-Cambrian rocks underlie Neosho County at an average depth of about 2,000 feet. The drillers log of a deep well in the southeastern part of the county records these rocks as granite. Samples of the Pre-Cambrian rocks from a deep well west of Chanute are red granite composed of red feldspar, quartz, mica, and hornblende.

Oil and Gas Developments

Gas was first discovered in Neosho County near Humboldt in 1894. Guffey and Galey drilled a number of dry holes in the vicinity of Chanute a short time later. Oil was discovered in the **Chanute** field in 1899. The greatest development of oil and gas has been in the northwestern part of the county where production is from sands in the Cherokee shale. In the **Erie** pool, in the east-central part of the county, oil has been produced from the "Bartlesville sand" at a depth of about 550 feet. This pool has been extended to the southeast, and more recent drilling has extended the shoestring trend to a point northeast of St. Paul. In the **Island** district, a part of the **St. Paul-Walnut** area, gas was found in the "chat" at the top of the Mississippian limestone. Some wells in this area reported a daily open flow of 5 million cubic feet of gas. Oil and gas wells are so widespread in the northeastern part of the county that it is difficult to differentiate the pools. Oil and gas fields as they have been defined by the Kansas Nomenclature

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Committee are listed and described briefly below. Their locations are shown in Figure 50.

The **Altoona East** oil and gas field extends into Neosho County from Wilson County. The Neosho County part of the field has had minor production for several years. The **Canville Creek,** in T. 27 S., R. 20 E., formerly was regarded as a gas field. Logs of wells in this field are not available. In 1952, 119 barrels of oil was reported from the area. The **Dennis** gas field (now abandoned) extends into Neosho County in T. 30 S., R. 18 E. Gas was produced from sandstone in the Bandera formation. Oil was discovered in the **Erie** oil and gas-producing area in 1903. Later the field was extended to the southeast. Oil and gas are produced from the "Bartlesville sand" at a depth of about 650 feet. The average initial production of the early wells was about 20 barrels of oil per day

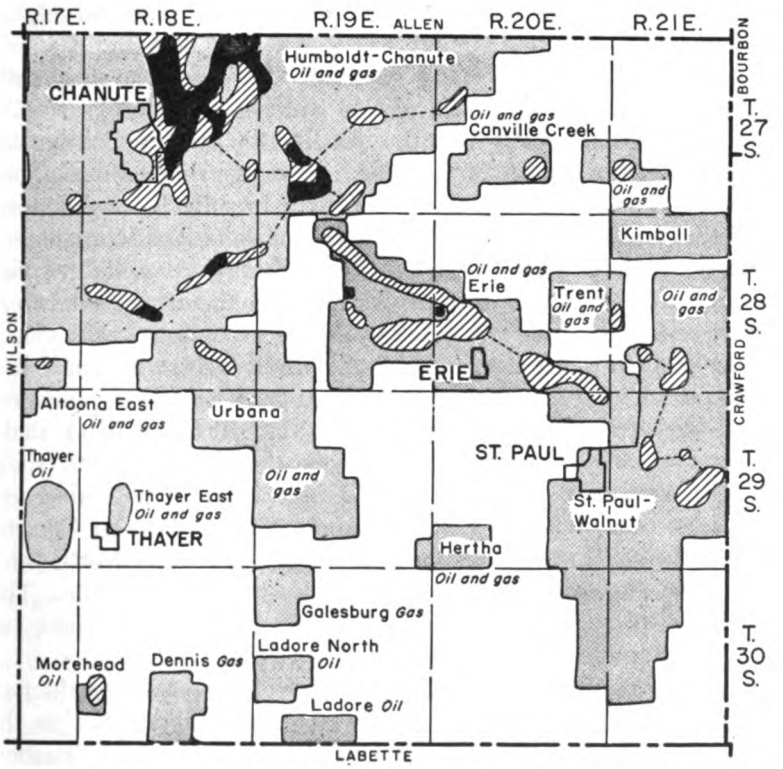

FIG. 50.—Map of Neosho County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

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and after a few months production decreased to 4 to 8 barrels per day. In 1952 oil was produced in three separate areas in the field.

The **Galesburg** gas field is in T. 30 S., R. 19 E. Logs of the wells are not available. Gas was reported at depths of 220 and 982 feet in the log of a nonproducing well in sec. 6. The log shows Mississippian limestone at 973 feet. Oil and gas formerly were produced in the **Hertha** field in T. 29 S., R. 20 E. Gas was produced from Cherokee rocks at a depth of about 570 feet and from the Mississippian limestone at a depth of about 825 feet. Few logs are available. Oil production probably was from "Bartlesville sand" at about 570 feet.

The **Humboldt-Chanute** oil and gas field is one of the oldest in the State. It is, as now defined, a large area covering entirely the northwestern part of Neosho County and extending northward well into Allen County and westward into Wilson County. Development in the Neosho County part of the field took place largely in the late 1890's. Drilling activity was renewed in 1903 and the area was redrilled in 1937 for water flooding. At present large quantities of oil are being produced by nine water-flooding projects. Oil production in this area is from the "Bartlesville sand" which has an average depth of about 700 feet and an average thickness of about 40 feet. The "Bartlesville sand" here is a broadly lensing deposit and hence unlike the "Bartlesville shoestring sands" of Montgomery County. It is probable, however, that the "Bartlesville" of the **Humboldt-Chanute** area is somewhat younger than is the sandstone farther south that is called "Bartlesville."

The **Kimball** field, in the northern part of Neosho County, was developed chiefly as a gas field about 20 years ago. Gas was produced at depths ranging from about 280 to 350 feet. Black shale in the Fort Scott formation probably is the chief reservoir rock. Oil production was reported in 1951 and 1952. The **Ladore** oil field, now abandoned, is in the southern part of Neosho County. Logs of the wells are not available to me. The **Ladore North** field, abandoned also, is in T. 30 S., R. 19 E. No logs are available. The **Morehead** oil and gas field, sec. 30, T. 30 S., R. 18 E., yields oil from "Bartlesville sand" at about 850 feet.

In the **St. Paul-Walnut** oil and gas-producing area oil production is from the "Bartlesville sand" which occurs as a "shoestring" in the northwestern part of the area. Gas production is from the "Bartlesville sand" and the Fort Scott limestone. The "Bartlesville sand"

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has an average thickness of about 30 feet and lies at a depth of about 550 feet.

The **Thayer** field has been abandoned for some time. Production reported for this area in 1950 and 1952 should have been assigned to **Altoona East.** The **Thayer East** field is no longer active. Logs of former producing wells are not in the Geological Survey files. However, sandstones in the Cherokee shale at depths of about 800 and 1,000 feet probably are the reservoir rocks. The **Trent** gas field has yielded gas from shale in or just below the Fort Scott formation at a depth of about 330 feet and probably from the "Bartlesville sand" at a depth of about 530 feet. Logs of most of the wells in the area are not available. Oil was reported from the field for the first time in 1952.

Production in the **Urbana** oil-producing area is from the "Bartlesville sand" which has an average thickness of about 20 feet and lies at a depth of about 750 feet. The area has had several gas wells, but all are now abandoned. Wells that have yielded small amounts of gas have been drilled in several parts of Neosho County in areas not shown as fields in Figure 50. Small amounts of gas have been reported from the upper part of the Mississippian limestone in sec. 35, T. 30 S., R. 17 E. in the southwest corner of the county.

Recent activities.—The new sand-fracturing methods of well completions are especially evident in increasing drilling activities in Neosho County. This is in part responsible for the rather spectacular increase in oil production, although water-flooding is still the dominant method. It is noteworthy that in the past 4 years oil production in the county has increased more than 20 percent. In general activities probably are at an all-time high.

OSAGE COUNTY

Oil and gas in commercial quantities have not been reported from Osage County. The Pomona gas pool, in Franklin County, however, is a short distance east of the Osage-Franklin County line. In that area gas was found in the "Squirrel sand" in the upper part of the Cherokee shale. The Geological Survey has records of 69 wells that have been drilled in Osage County searching for oil. A "strong show of oil" was reported in the upper part of Mississippian limetone in a well in sec. 14, T. 16 S., R. 16 E. (well 26,

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Table 58), and gas wells have been reported in sec. 16, T. 16 S., R. 17 E., and in sec. 5, T. 17 S., R. 17 E.

Geology

SURFACE ROCKS

Like other eastern Kansas counties, scattered surficial deposits of alluvial material are widespread in Osage County. Flint gravel beds a few feet thick are present on the uplands, especially in the southern part of the county. Outcropping consolidated rocks include the lower few feet of the Admire group (Permian), the Wabaunsee and Shawnee groups, and the upper part of the Douglas group (Pennsylvanian). The thickness of the exposed Pennsylvanian rocks is about 850 feet.

Permian rocks.—The lower few feet of the Towle shale (Fig. 3), lowermost Permian formation in Kansas, crops out in the extreme northwestern part of Osage County.

Pennsylvanian rocks.—Wabaunsee rocks (Fig. 4) are well exposed in western and especially northwestern Osage County. The Church limestone member of the Howard formation lies below an extensive dip slope in the west-central part of the county. The thicknesss of Wabaunsee sediments in the county is about 500 feet. Thin fusulinid-bearing limestones and drab clayey and sandy shales are characteristic of the group. The formations of the Shawnee group are well exposed and their total thickness is about 350 feet. The belt of outcrop of these rocks covers the approximate eastern half of the county. Rocks of the Shawnee group are characterized by clayey and sandy shales ranging from a few feet to 25 feet or more in thickness and by limestones generally less than 20 feet thick. Many of the limestones contain abundant fusulinids.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons in two Osage County wells are listed in Table 57.

Pennsylvanian rocks.—The maximum thickness of Pennsylvanian rocks in Osage County is about 2,250 feet.

Mississippian rocks.—Mississippian limestone formations in Osage County range from less than 300 feet to more than 400 feet in total thickness (Lee, 1939, pl. 1). The Chattanooga shale ranges in thickness from about 50 feet to nearly 150 feet (Lee, 1943, fig. 14). The greatest thickness is in the northwestern part of the county.

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TABLE 57.—*Depths in feet at which some stratigraphic horizons were reached in two wells in Osage County*

Horizon	Elmhurst Investment Co. No. 1 Badger, NW 4-15-16E	Gulf Oil Corp. No. 1 Peterson, SW SE SW 20-15-16E
Base Oread limestone	230	...
Top Lansing limestone	628	460
Base Hertha limestone	1,010	845
Top Mississippian limestone	1,700	1,531
Top Chattanooga shale	1,978	1,831
Top "Hunton" limestone	.....	1,928
Top Viola limestone	2,070	1,972
Top St. Peter sandstone	2,240	2,047
Top Arbuckle limestone	2,290	2,079
Top Pre-Cambrian rocks	2,838	.....
Total depth	3,015	2,217

Pre-Chattanooga rocks.—The Chattanooga shale oversteps the upper part of the "Hunton" limestone, the Maquoketa shale, and beveled beds of the Viola limestone in the northwestern part of Osage County. The Viola limestone immediately underlies the Chattanooga in most of the county. Devonian rocks are present only in the northwestern part. Their thickness ranges from a featheredge to less than 100 feet. Silurian rocks are believed to be absent in Osage County (Lee, 1943, fig. 13). A small thickness of Maquoketa (uppermost Ordovician) shale is present in the northwestern part. The average thickness of the Viola limestone is about 175 feet. The interval between the top of the St. Peter sandstone and Pre-Cambrian rocks ranges from about 450 feet in the northwestern corner of the county to nearly 800 feet in the southeastern corner.

Studies by Keroher and Kirby (1948) indicate that (1) the thickness of the Jefferson City-Cotter sequence in Osage County ranges from about 100 feet in the northwest corner of the county to an amount slightly in excess of 250 feet in the southern part, (2) the Roubidoux dolomite has an average thickness about 100 feet, (3) the Van Buren-Gasconade sequence ranges in thickness from about 25 feet in the western part to about 125 feet in the northeast corner of the county, (4) the Eminence dolomite is absent in the southwestern part of the county, and ranges in thickness from a featheredge to about 50 feet, with maximum thickness in the northeast

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corner of the county, and (5) the Bonneterre dolomite has a thickness of about 75 feet, and is in contact with Pre-Cambrian rocks in all parts of Osage County.

Oil and Gas Exploration

Data on wells that have been drilled in Osage County and records of which are in the files of the Geological Survey are shown in Table 58. Locations of the wells are shown in Figure 51.

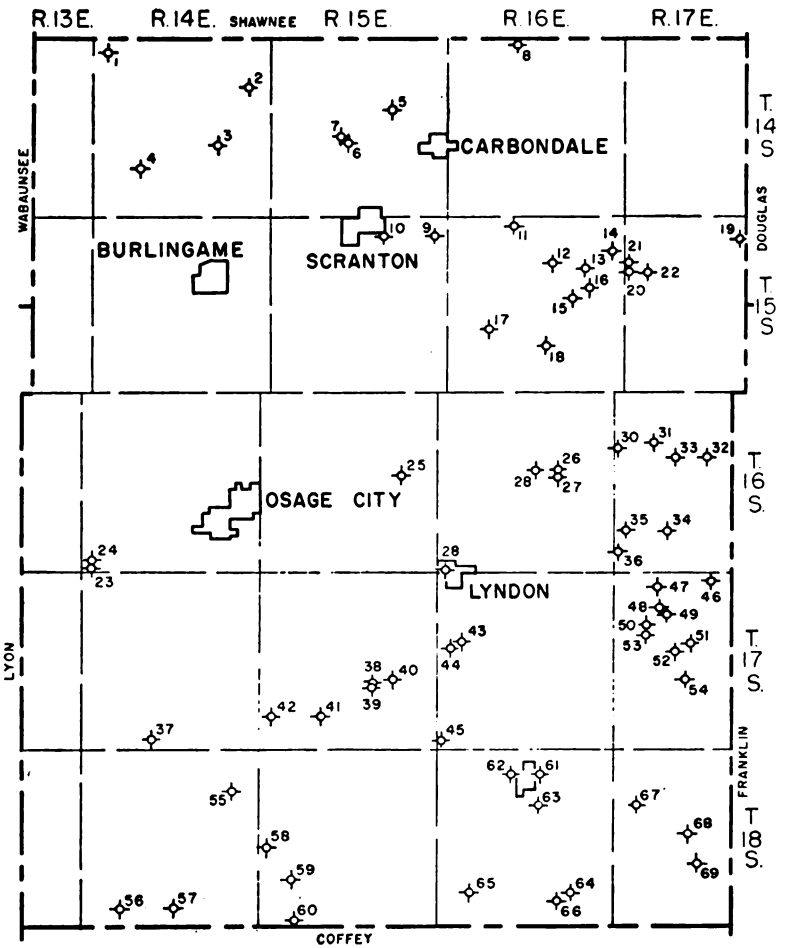

Fig. 51.—Map of Osage County showing location of wells listed in Table 58.

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TABLE 58.—*Data on wells drilled for oil and gas in Osage County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	R. G. Gillespie No. 1 Wylie (or W. W. Lyttle)	SW SW 6-14-14E	1924	2,452	Top Mississippian, 2,145 ft.
2	.....	CNL N½ SW 12-14-14E	?	1,970	No log available
3	Yonkers & Engers No. 1 Miles	CNL N½ SW 23-14-14E	....	3,125	Top Mississippian, 2,055 ft.
4	Hibbomae Oil No. 1 Stevenson	SW SW NE 29-14-14E	1929?	1,705	
5	Woods Oil & Gas Co. No. 1 Oberle	SW SW NW 14-14-15E	1951	2,530	Top Mississippian, 1,800; top "Hunton," 2,252; top Viola, 2,318; top Simpson, 2,426; top Arbuckle, 2,478 ft.
6	J. M. Edwards No. 1 Dietrich	NW SE 21-14-15E	1939	1,638	Stopped in Cherokee sh.
7	Briggs & Smith No. 1 Woods	SE NW 21-14-15E	1932	2,627	Top Mississippian, 1,848; top "Hunton," 2,353; top Viola, 2,410; top Arbuckle, 2,610 ft.
8	.....	NE NE NW 4-14-16E	?	1,750	No log available
9	.....	NW NW SE 1-15-15E	?	1,920	No log available
10	Baker et al. No. 1 Lewis	NE SW SE 3-15-15E	1929	1,700	No log available
11	Elmhurst Invest. Co. No. 1 Badger	Cen. NW 4-15-16E	1921	3,015	See Table 57
12	.....	SW NW SE 10-15-16E	?	2,735	No log available
13	.....	Cen. SE¼ 11-15-16E	....	399	
14	..... No. 1 Daniel	NE NW NE 12-15-16E	1917	1,625	No log available
15	Orlando Petro. No..... Hyde	SE 14-15-16E	?	?	Top Mississippian, 2,065 ft.
16	Red Line Oil & Gas Co. No. 1 Weil	SE SE NE 14-15-16E	?	1,618	Stopped at top Mississippian ls.
17	Gulf Oil Corp. No. 1 Peterson	SW SE SW 20-15-16E	1942	2,217	See Table 57
18	West et al. No. 1 Bailey	SW SW NW 27-15-16E	1929	1,350	No log available
19	..... No. 1 Bryson	SE SE 3-15-17E	1925	1,610?	
20	I. T. I. O. Co. No. 1 Daniels	NW SW SW 7-15-17E	1917	1,625	Top Mississippian, 1,570 ft.
21	I. T. I. O. Co. No. 2 Daniels	SW SE SW 7-15-17E	1917	751	
22	Cities Service Oil Co. No. 1 Dilworth	NW NW SW 7-15-17E	1952	2,202	Top Mississippian, 1,610; top "Hunton," 1,910; top Viola, 1,991; top Simpson, 2,077; top Arbuckle, 2,079 ft.

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TABLE 58.—*Data on wells drilled for oil and gas in Osage County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
23	.....	SE SE SW 31-16-14E	?	2,550	
24	Garden & Staats No. 1 Allison	NW NE SW 31-16-14E	1929	500	
25	Orlando Petro. Co. No. 1 Hyde	SE SE SE 14-16-15E	1921	3,408	Pre-Cambrian, 2,900? ft.
26	McMahon & Leonard No. 1 Kraft	NW SW 14-16-16E	1926?	1,950	Show of oil 1,509–1,512; top Mississippian, 1,565; "Wilcox sd.," 1,880; Arbuckle, 1,883½ ft.
27	Anderson et al. No. 1 Woodward	SE SW SW 14-16-16E	1944	1,610	Top Mississippian, 1,523 ft.; strong show of oil 1,524–1,561 ft.
28	Bailey well	NE NE SW 15-16-16E	1929?	1,309	
29	"Lyndon well"	NW SE SW 31-16-16E	1894	1,007	
30	..... No..... Anderson	SW SW SW 7-16-17E	....	1,248	
31	Foster Invest. Co. No. 1 Haupler	NE SW 8-16-17E	1923	1,880	Top Mississippian, 1,425; top Kinderhookian, 1,760 ft.
32	Roth & Faurot et al. No. 1 Ashwill	SW NW NW 15-16-17E	1924	1,391	
33	Tom Russell No. 1 McDowell	NW NW 16-16-17E	?	1,123	Gas well (?)
34	J. H. VanHorn et al. No. 1 McDonald	SE NE SE 29-16-17E	1924	1,307	Top Mississippian, 1,305 ft.
35	..... No. 1 Hudleson	30-16-17E	1927	1,248	
36	Middleton No. 1 Deavers	W½ NW SW 31-16-17E	?	1,384	Top Mississippian, 1,381 ft.
37	John Starke No. 1 Barnett	SE SW 33-17-14E	1927?	1,847	Top Mississippian, 1,720 ft.
38	C. B. Failar No. 1 Justice	SE SE 22-17-15E	1920?	2,200	Top Mississippian, 1,650; top "Hunton," 2,130 ft.
39	Rosenthal et al. No. 1 Stigewell	SE SE 22-17-15E	1921	2,200	Probably same as No. 1 Justice
40	G. N. Rupe No. 1 Sturdy	NE NE SW 23-17-15E	1952	2,300	Top Mississippian, 1,620; top "Hunton," 2,133; top Viola, 2,151; top Arbuckle, 2,244 ft.
41	Goebel, Bending & Mendenhall No. 1 Bartee	SW SW 28-17-15E	1929	2,240	Top Mississippian, 1,646 ft.
42	G. C. McBride et al. No. 1 Jenkins	SE SW 30-17-15E	1927	2,204	Top Mississippian, 1,712 ft.
43	..... No. 1 Carmen Bros.	SE NE 18-17-16E	?	1,678	Top Mississippian, 1,640 ft.
44	.....	18-17-16E	....	1,420	No log available

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45	L. E. Smith & L. G. Cameron No. 1 J. W. Vanderscise	NW NW SW 31-17-16E	1952	2,171	Top Mississippian, 1,544; to Viola, 2,033; top Arbuckl , 2,112 ft.
46	Hazlett et al. No. 1 Windett	NW cor. 3-17-17E	1926	1,422	Stopped in basal Cherokee rks.
47	Pettit et al. No. 1 Hewitt	5-17-17E	1937	430	Gas well
48	Millinett Drlg. Co. No. 1 Neill	SW NW NE 8-17-17E	1929	2,738	Pre-Cambrian, 2,578? ft.
49	Gutherie et al. No. 2 Neill	NW SW NE 8-17-17E	?	1,505	
50	..... No. 1 Pierce	SW SW SW 8-17-17E	1916	1,548	Top Mississippian, 1,452 ft.
51	Reynolds et al. No. 1 Dean	SW SW NE 16-17-17E	1936	1,281	
52	Kansas Natural Gas Co. "Quenemo"	NW NW SE 16-17-17E	1916	1,548	Top Mississippian, 1,454 ft.
53	..... No. 1 O'Donnell	NW NW 17-17-17E	?	1,396	Stopped in Cherokee sh.
54	Ralph Bros. No. 1 Gaston	NE NE SW 21-17-17E	1924	1,400	Stopped in Cherokee sh.
55	Wentworth Bros. No. 1 Booth	NE SW NW 12-18-14E	1924	2,184	Top Mississippian, 1,623; base Mississippian, 2,025 ft.
56	J. V. McMahon No..... Rogers	SE NW 32-18-14E	1926	1,765	Top Mississippian, 1,738 ft.
57	Papoose Oil Co. No. 1 Evans	SW SW NW 34-18-14E	1929	1,781	Top Mississippian, 1,720 ft.
58	York State Oil Co. No. 1 Jones	SE SW NW 19-18-15E	1928	2,118	Top Mississippian, 1,666 ft.
59	..... No. 1 George et al.	SW NW 29-18-15E	....	1,718	Top Mississippian, 1,698 ft.
60	Empire Gas & Fuel Co. No. 1 Woodbury	SW¼ 32-18-15E	1923	2,290	Top Mississippian, 1,708 ft.
61	Shanner et al. No..... Hallem	SW SW SE 3-18-16E	?	1,430	Top Mississippian, 1,430 ft.
62	..... No. 1 Brink	NW SW SE 4-18-16E	?	1,435	Stopped in Cherokee sh.
63	W. W. Trigg No..... Van Buskirk	SW SW SE 10-18-16E	?	1,840	Top Mississippian, 1,461 ft.
64	..... No. 1 Fisher	SW SW SE 26-18-16E	?	1,553	
65	Bert Young et al. No. 1 Catlin	SE SW NW 29-18-16E	1927	2,081	Top Mississippian, 1,644 ft.
66	Troth & Orland Oil Co. No. 1 Minnie Wells	S½ NW NW 35-18-16E	?	2,410	Top Mississippian, 1,545 ft.
67	Sheppard No. 1 Alley	NE NW SW 7-18-17E	1951	1,502½	Top Mississippian, 1,408 ft.
68	Shale & Smith No. 1 Varnsdell	SE SW SW 16-18-17E	?	1,603	Top Mississippian, 1,488 ft.
69	V. L. Ferrell No. 1 Ramagee	SW SE SE 21-18-17E	1951	1,490	Top Mississippian, 1,470 ft.

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POTTAWATOMIE COUNTY

Oil and gas in commercial quantities have not been found in Pottawatomie County. This county is in the northern part of the Nemaha anticline area.

Geology

SURFACE ROCKS

Outcropping consolidated rocks in Pottawatomie County include strata from the Barneston limestone of Permian age (Fig. 3) to about the horizon of the Reading limestone of Pennsylvanian age (Fig. 4). Glacial drift conceals the bedrock in some areas.

Permian rocks.—Permian rocks of Wolfcampian age crop out in most of Pottawatomie County. The exposed Permian section is about 650 feet thick.

Pennsylvanian rocks.—Exposed Pennsylvanian rocks in Pottawatomie County include the Brownville limestone (uppermost Pennsylvanian formation in Kansas) and about 250 feet of older rocks. The oldest rock exposed is the Reading limestone or the upper part of the Auburn shale.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons in three wells in Pottawatomie County are listed in Table 59.

Permian and Pennsylvanian rocks.—About 1,000 feet of Pennsylvanian rocks is present in the Nemaha anticline area in Pottawatomie County. In the western part of the county, where there are both Permian and Pennsylvanian rocks, the combined thickness is about 2,250 feet.

Mississippian rocks.—Mississippian limestone formations are absent in Pottawatomie County west of the buried fault escarpment of the Nemaha anticline (Lee, 1943, fig. 16). The total thickness of limestones of Mississippian age in the eastern part of the county ranges from a featheredge to more than 200 feet. The western edge of Mississippian limestones crosses the northern boundary of the county near the northwest corner of T. 6 S., R. 12 E., and it crosses the southern boundary near the center of the south line of T. 10 S., R. 10 E. The Chattanooga shale also is absent in Pottawatomie County west of the fault escarpment of the Nemaha anticline. The thickness of the Chattanooga shale in the eastern part of the county

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TABLE 59.—*Depths in feet to some stratigraphic horizons in three wells in Pottawatomie County*

Horizon	Coronado Oil Co. No. 1 R. P. Welter, SW SW SW 36-8-8E	Anderson-Prichard & Stanolind Oil & Gas Co. No. 1 McFarland, NE NE SE 14-8-11E	Ajax Oil Co. No. 1 Miller. NW NW SW 22-8-12E
Top Heebner shale	914	1,137	.....
Top Lansing group	1,045	1,339	1,260
Top Kansas City group	1,135	1,466	1,377
Top Marmaton group	1,326	.....	.....
Top Mississippian limestone	.....	2,405	2,397
Top Kinderhookian rocks	1,412	2,488	2,516
Top "Hunton" limestone	1,432	2,718	2,772
Top Viola limestone	1,885	3,273	3,277
Top Simpson group	1,964	3,399	3,374
Top Simpson sandstone	2,026	3,417	.....
Top Arbuckle limestone	2,110	.....	.....
Pre-Cambrian rocks	2,113	3,486	3,480
Total depth	2,119	3,495	3,495

ranges from a featheredge to about 250 feet (Lee, 1940, pl. 3; 1943, fig. 14).

Pre-Chattanooga rocks.—"Hunton" limestone (Devonian-Silurian) is present in Pottawatomie County east of the Nemaha fault escarpment; there is a thin wedge of Silurian limestone between Pennsylvanian rocks and the Sylvan (Maquoketa) shale in the extreme western part of the county (Ockerman, 1935, fig. 2). According to Lee (1943, fig. 12), the thickness of rocks between the base of the Chattanooga shale and the top of the Maquoketa shale in eastern Pottawatomie County ranges from about 225 feet in the southeastern corner to about 450 feet in the northeastern part. The thickness of rocks between the top of the Maquoketa shale and the top of the St. Peter sandstone (interval including the Maquoketa shale and Viola limestone) in both eastern and western Pottawatomie County ranges from about 200 to 300 feet (Lee, 1943, fig. 11); these rocks are absent in the Nemaha anticline. The St. Peter sandstone is believed to be present in all of Pottawatomie County except in the northern part of the Nemaha anticline area (Lee, 1943, fig. 9). The thickness of the St. Peter sandstone probably does not exceed 100 feet except in the southeastern part of the county; it is more than 200 feet in the extreme southeastern part. In the Turner No. 1 Umscheid

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well, in sec. 32, T. 8 S., R. 9 E., the St. Peter sandstone is 20 feet thick and is separated from Pre-Cambrian rocks by 20 feet of Bonneterre dolomite and 5 feet of Lamotte sandstone (Lee, 1943, fig. 5). The St. Peter sandstone is believed to lie on Pre-Cambrian rocks in much of western Pottawatomie County. About 200 feet is the greatest vertical distance between the top of the St. Peter sandstone and the Pre-Cambrian rocks in the eastern part of the county (Lee, 1943, fig. 9).

Oil and Gas Exploration

The Geological Survey has records of 34 test wells that have been drilled in Pottawatomie County. Data on these wells are listed in Table 60. About half of the wells of record in the county have been drilled in the past 4 years. Locations of test holes in the county are shown in Figure 52.

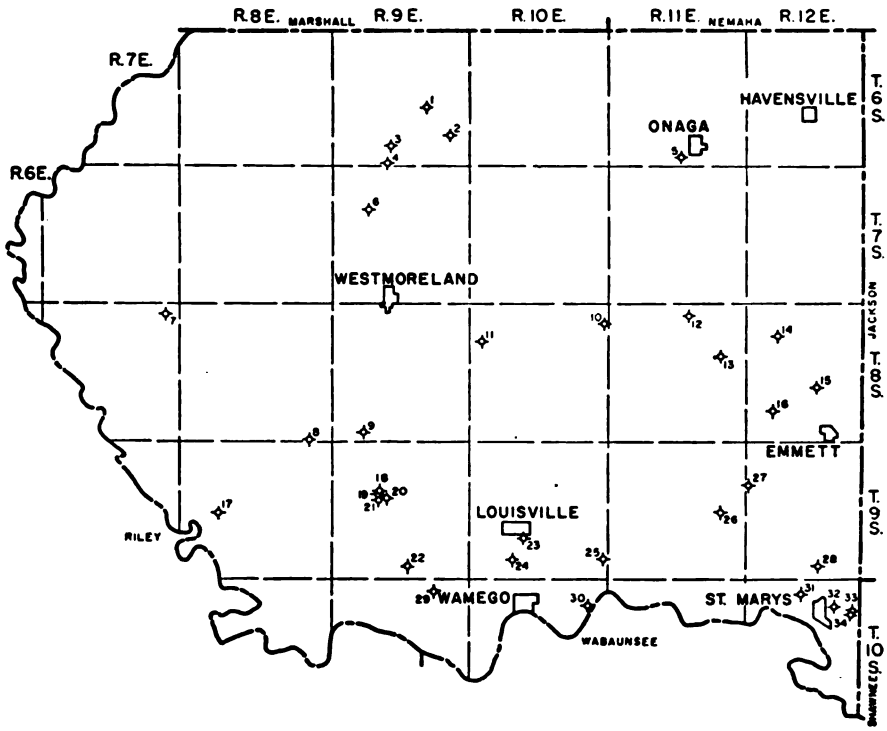

Fig. 52.—Map of Pottawatomie County showing location of wells listed in Table 60.

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TABLE 60.—*Data on wells drilled for oil and gas in Pottawatomie County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Tri-State No. 1 Pierce	NW NW 23-6-9E	?	1,773	Pennsylvanian rks. on Maquoketa sh., 1,425?; Pre-Cambrian, 1,770? ft.
2	D. J. Woods No. 1 Meeham	NW NW SW 25-6-9E	1947	1,755	Pre-Cambrian, 1,753 ft.
3	Malyhon, Harper & Quigley No. 1 Shearer	NW NW NE 33-6-9E	1951	1,915	Top "Hunton," 1,450; top Viola, 1,650; Pre-Cambrian, 1,911 ft.
4	Leo V. Wentworth Drlg. Co. No. 1 Moser	SE SE SW 33-6-9E	1951	1,818	Top "Hunton," 1,462; top Viola, 1,677; top Arbuckle, 1,744 ft.
5	Empire Gas & Fuel Co. No. 1 Rokes	W½ NW 34-6-11E	1917	1,735	Pre-Cambrian, 975? ft.
6	E. A. Howley et al. No. 1 Pendergast	SE SW SE 8-7-9E	1951	1,825	Top Viola, 1,500; top Arbuckle, 1,818; Pre-Cambrian, 1,824 ft.
7	Olson & McCole No. 1 Anderson	NW SW NW 1-8-7E	1942	1,095	Incomplete log
8	Coronado Oil Co. No. 1 R. P. Welter	SW SW SW 36-8-8E	1951	2,119	See Table 59
9	Turner et al. No. 1 Umscheid	NE SW 32-8-9E	1938	1,985	Top Pre-Cambrian, 1,915 ft.
10	Shell core hole	SW SE SE 1-8-10E	1945	2,006	Pre-Cambrian, 2,003 ft.
11	Shell core hole	NW NW NE 7-8-10E	1945	1,881	Pre-Cambrian, 1,878 ft.
12	.....	3-8-11E	....	1,734	Incomplete log
13	Anderson-Prichard & Stanolind Oil & Gas Co. No. 1 McFarland	NE NE SE 14-8-11E	1949	3,495	See Table 59
14	Carter Oil Co. No. 1 Browning	SE SE NW 8-8-12E	1950	3,624	Top Mississippian, 2,516; top "Hunton," 2,850; top Viola, 3,396; top St. Peter, 3,552 ft.
15	Ajax Oil Co. No. 1 Miller	NW NW SW 22-8-12E	1950	3,495	See Table 59
16	Woods Oil & Gas Co. No. 1 Johnson	NE NW SW 29-8-12E	1951	3,470	Top Mississippian, 2,400; top "Hunton," 2,752; top Viola, 3,248; top St. Peter, 3,392; Pre-Cambrian, 3,457 ft.
17	Howard Allman No. 1 Fredrich	NW NW NW 20-9-8E	1951	2,305	Top Viola, 2,071; top Simpson, 2,197; Pre-Cambrian, 2,299 ft.
18	Lincoln Oil & Uhl Drlg. Co. No. 1 Umscheid	SE NW NW 16-9-9E	1951	1,961	Top Kansas City, 872; top "Hunton," 1,275; top St. Peter, 1,912; Pre-Cambrian, 1,954 ft.
19	Lashelie Oil Co. No. 1 Umscheid	NW NW 16-9-9E	1943	2,075	Top "Hunton," 1,292; Simpson, 1,944; Plattin, 1,984; St. Peter, 2,002 ft.
20	D. J. Woods et al. No. 1 Umscheid	NW SE NW 16-9-9E	1948	1,500	Top "Hunton," 1,251 ft.

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TABLE 60.—*Data on wells drilled for oil and gas in Pottawatomie County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
21	D. J. Woods No. 2 Umscheid	SW NW NW 16-9-9E	1947	1,500	
22	Crawford No. 1 Hoofer	NE SE NW 34-9-9E	?	2,225	Pre-Cambrian, 1,850 ft.
23	.....	SE NE NW 28-9-10E	1902?	1,184?	No log available
24	Caddo Oil Co. No. 1 Ebel	NE NE NE 32-9-10E	1950	1,715	Pre-Cambrian, 1,704 ft.
25	F. J. Weller & W. F. Bush No. 1 Bruner	NE NE NE 36-9-10E	1950	2,995	Top Mississippian "chat," 1,933; top "Hunton," 2,286; top Viola, 2,754; top St. Peter, 2,915; Pre-Cambrian, 2,984 ft.
26	Westgate-Greenland Oil Co. No. 1 Pessemier	NE NE NE 23-9-11E	1949	3,270	Top Viola, 3,244 ft.
27	Milo Siegel et al. No. 1 Matt Rezac	SW SW SW 7-9-12E	1951	3,607	Pre-Cambrian, 3,605 ft.
28	H. E. Sloan No. 1 Brown	SW SW NW 34-9-12E	1951	3,350	Top Mississippian, 2,228; top "Hunton," 2,689; top Viola, 3,106; top St. Peter, 3,232; top Arbuckle, 3,307 ft.
29	.....	2-10-9E	1905	895	No log available
30	Wamego Coal Hole	Cen. NW 12-10-10E	1887	930	
31	J. J. Crawford No. 1 Doyle	SE SE SW 4-10-12E	?	2,700	
32	St. Marys Coal, Oil & Gas Co. No. 2 St. Marys College	NE NE 10-10-12E	1908	1,700	Stopped in upper part of Mississippian ls.
33	Crawford No. 1 St. Marys	SW NE 11-10-12E	?	2,190	Incomplete log
34	Skelly Oil Co. No. 1 St. Mary's	NE SW NE 11-10-12E	1951	3,300	Top Mississippian, 2,211; top "Hunton," 2,662; top Viola, 3,047; top Simpson, 3,138; top Arbuckle, 3,250 ft.

RILEY COUNTY

Neither oil nor gas has been discovered in Riley County, but there has not been sufficient drilling to prove the county barren of petroliferous materials. Because of favorable structural conditions, it is expected that oil or gas or both may be discovered there. The Geological Survey has records of 19 wells that have been drilled in the county, which has an area of about 600 square miles. The geology of Riley County was described by Jewett (1941).

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Geology

SURFACE ROCKS

With the exception of glacial drift, loess, alluvium, and probable lake deposits, the outcropping sedimentary rocks in Riley County are chiefly early Permian to late Pennsylvanian in age. A few feet of Cretaceous sandstone is present on the uplands in the extreme northwestern part of the county. There are five known outcrops of basic igneous rock of probable Cretaceous age. The oldest exposed rock is the Auburn shale of the Wabaunsee group.

Cretaceous and younger rocks.—A few feet of Dakota sandstone caps the uplands in a small area in northwestern Riley County. This rock is coarse-grained ferruginous quartz sandstone. Unconsolidated deposits of doubtful classification, commonly called loess, cover much of the upland area of the county. Some easily identified glacial drift is present, and probably some of the material that has been called loess is deeply weathered drift.

Permian rocks.—Permian strata, about 800 feet thick, are exposed in Riley County. The youngest of these is the lower part of the Wellington shale, which consists of about 5 feet of silty limestone underlain by about 45 feet of highly colored shale. The combined thickness of rocks of the Chase group (Fig. 3) in the county is about 350 feet. Massive limestones, some of which are flinty, and bright-colored shales are characteristic rocks. Flint is abundant in the lower member of the Winfield limestone, in the Florence limestone, and in the Wreford limestone.

Rocks assigned to the Council Grove group (Fig. 3) have a total thickness of slightly more than 300 feet in Riley County. The Cottonwood limestone member of the Beattie formation and the Neva limestone member of the Grenola formation are easily recognized and traced along their lines of outcrop. The Americus limestone member of the Foraker formation at the base of the group is a conspicuous marker bed. Red and green shales are characteristic of these rocks. The Admire group (Fig. 3) is poorly exposed in eastern Riley County. The combined thickness of rocks in this group is about 150 feet or perhaps less. The group is characterized by yellow and gray shales and thin limestones. The Falls City limestone, locally the thickest limestone, has a maximum thickness of about 3 feet. Sandstone formerly classed as Indian Cave (Jewett,

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1941, pl. 5) probably occurs in the upper part of Pennsylvanian rocks.

Pennsylvanian rocks.—Pennsylvanian rocks assigned to the Wabaunsee group (Fig. 4) crop out in the valley of Deep Creek in the eastern part of Riley County. Rocks older than the Auburn shale are not exposed in the county, and rocks between the upper part of the Pony Creek shale and the lower part of the French Creek shale are concealed by mantle deposits or removed by intraformational erosion. The Tarkio limestone is the most easily recognized exposed stratum in the Wabaunsee group. It is about 12 feet thick, massive, weathers to a deep brown color, and contains myriads of large fusulinids which resemble large wheat grains. Individual fusulinids are smaller and less numerous in other Wabaunsee limestones. Other limestones in the group are much thinner and generally are light gray where weathered. The Wabaunsee rocks in Riley County have a total thickness of about 575 feet. Approximately the upper 175 feet is exposed.

SUBSURFACE ROCKS

Depths to some stratigraphic horizons in five Riley County wells are listed in Table 61.

Permian rocks.—Logs of wells in the western part of Riley County indicate much lateral variation in the shallow subsurface, and detailed study of cuttings is necessary before definite statements can be made about these shallow Permian rocks. The same is true of the upper part of the Pennsylvanian section.

Pennsylvanian rocks.—Pennsylvanian rocks which are probably no older than late Desmoinesian (Marmaton) overstep older Paleozoic rocks and overlap pre-Paleozoic rocks. Pennsylvanian rocks in this area are about 1,500 feet thick. They consist chiefly of limestone and gray shale and include a small thickness of sandstone and red shale or siltstone. Although the Permian-Pennsylvanian contact can be readily recognized at the surface, it is not so easily identified in the subsurface. However, studies of drill cuttings should allow such identification.

Mississippian rocks.—Limestone of Mississippian age ranging in thickness from a featheredge to about 100 feet is present in the western part of Riley County. Shale about 150 feet thick believed to be of Kinderhookian age and probably correlative with the Chatta-

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TABLE 61.—*Depths in feet to some stratigraphic horizons in five Riley County wells*

Horizon	Ben F. Brack Oil Co. No. 1 Erickson, NE NE SW 15-7-5E	Arkansas Fuel Oil Co. No. 1 Martin, SE NE SW 24-8-4E	Veeder Supply & Develop. Co. No. 1 Gravenstein, NW NW NW 21-8-6E	Coronado Oil Co. No. 1 Parks, SE SE SE 16-10-8E	Parker Oil Co. No. 1 Bardwell, SW NE 28-10-9E
Top Topeka limestone	980	.....	1,045	450	250
Top Lansing group	1,280	1,405	1,345	840	660
Top Kinderhookian	1,720	1,860	1,777	.....	...
Top Misener sandstone	.....	.....	1,964	.....	...
Top "Hunton" limestone	1,776	2,000	1,970	.....	...
Top Maquoketa	2,210	2,425	2,420	1,690	...
Top Viola limestone	2,283	2,495	2,525	1,760	...
Top Simpson shale	2,445	2,650	2,650	1,890	...
Top Arbuckle limestone	.....	2,725	.....	.....	...
Pre-Cambrian rocks	2,550	2,770	2,676	1,970	945
Total depth	2,561	2,942	2,702	1,989½	1,093

nooga shale is the oldest rock assigned to the Mississippian System. This rock has been identified in the western part of the county.

Pre-Chattanooga rocks.—The "Hunton" limestone lies next below Mississippian and younger rocks in most of Riley County (McClellan, 1930, fig. 2; Lee, 1939, pl. 1). The "Hunton" has a maximum thickness in this area of about 400 feet and lies unconformably between the Chattanooga and Maquoketa shales. It consists of limestone and dolomite.

The Maquoketa shale, the Viola limestone, and the Simpson sandstone are present in Riley County. The Maquoketa, which consists chiefly of shale but contains some sandstone, has a maximum thickness of about 100 feet; the Viola has an average thickness of perhaps 150 feet; and the Simpson is probably not more than 40 or 50 feet thick. These rocks are separated by uncomformities. The Simpson sandstone is believed to overstep older rocks, including Pre-Cambrian, in Riley County. The overstep is toward the east; that is, the Simpson extends across the Arbuckle limestone and the Lamotte (?) sandstone and lies on granite in the eastern part of the county. Paleozoic rocks older than those of some part of the Missourian Series

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are not continuous over the buried Nemaha fault escarpment, the crest of which lies below the extreme eastern part of Riley County. Very little definite information about older Paleozoic rocks in this county is available. It is believed, however, that in the western part the Lamotte (?) sandstone and the Arbuckle limestone range in thickness from a featheredge to 150 feet or more. The Lamotte (?) sandstone is not known to be more than 85 feet thick in this area.

Because of the presence of the Nemaha uplift, the surface of the Pre-Cambrian floor in this part of Kansas is very irregular, having

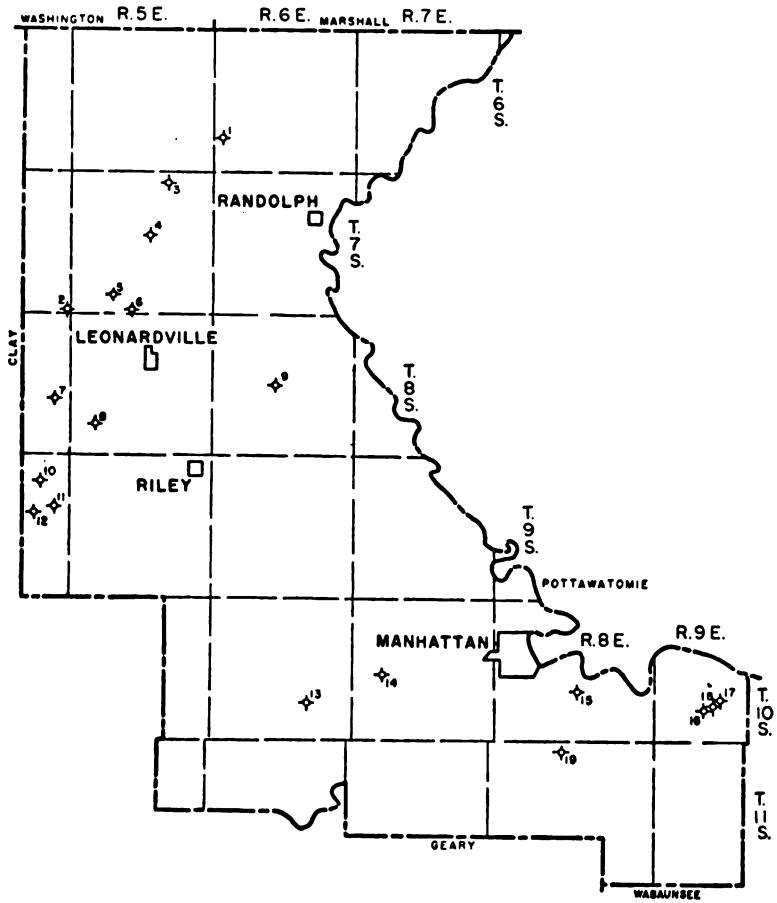

FIG. 53.—Map of Riley County showing location of wells listed in Table 62.

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a relief in Riley County of 2,000 feet or more. The Pre-Cambrian rocks are igneous and metamorphic and are believed to be chiefly granite and schist. Younger rocks ranging in age from Middle Pennsylvanian to Late Cambrian lie on the surface of the crystalline

TABLE 62.—*Data on wells drilled for oil and gas in Riley County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	General Utilities et al. No. 1 Hay	NE NE SE 30-6-6E	1929	2,535	Top Lansing, 1,358; base Kansas City, 1,625; top "Hunton" 1,801; top Viola, 2,260 ft.
2	C. Gentler et al. No. 1 Doyle	SE SE SE 36-7-4E	1923	2,601	Stopped in Maquoketa sh.
3	Gypsy Oil Co. No. 1 Droll	SE SW NW 2-7-5E	1917	2,520	Pre-Cambrian rks. 2,385 ft.
4	Ben F. Brack Oil Co. No. 1 Erickson	NE NE NW 15-7-5E	1951	2,56[illegible]	St. Peter, 2,508; Pre-Cambrian, 2,551 ft. See Table 61
5	Derby Oil Co. No. 1 Lindstrom	NE NE NE 32-7-5E	1929	2,226	Stopped in "Hunton" (?)
6	Ben F. Brack Oil Co. No. 1 Johnson	SW SW SE 33-7-5E	1951	2,610	Top "Hunton," 2,068; top Viola, 2,581 ft.
7	Arkansas Fuel Oil Co. No. 1 Martin	SE NE SW 24-8-4E	1930	2,942	Stratigraphic data in Table 61
8	P. M. Polhamus et al. No. 1 Hannan	NE NW SW 29-8-5E	1945	2,727	Top "Hunton," 2,052; top Viola, 2,555; top Simpson, 2,710; granite wash, 2,715 ft.
9	Veeder Supply & Develop. Co. No. 1 Gravenstein	NW NW NW 21-8-6E	1946	2,702	Stratigraphic data in Table 61
10	Salina Drlg. Co. No. 1 Lewellen	NE NE NE 11-9-4E	1953	2,815	Pre-Cambrian, 2,813 ft.
11	Federal Royalty Co. No. 1 Gordon	NE NE NW 13-9-4E	1953	2,684	Top Kinderhookian, 1,942; top "Hunton," 2,104; top Viola, 2,550 ft.
12	Empire Gas & Fuel Co. No. 1 Woodbury	SW SW NE 14-9-4E	1925	2,804	
13	Pawnee Oil & Gas No. 1 Marks	SW NE NW 26-10-6E	1923	1,853	
14	F. J. Heeley et al. No. 1 Thier	NW NE NW 20-10-7E	1929	2,965	Pre-Cambrian, 2,400 ft.
15	Coronado Oil Co. No. 1 Parks	SE SE SE 16-10-8E	1938	1,989½	Stratigraphic data in Table 61
16	Cain Bloom No. 1 Zeandale	NW NW SW 28-10-9E	1914	1,020	Pre-Cambrian, 928 ft.
17	Cain Bloom No. 2 Zeandale	NW NE NE 28-10-9E	1915	1,020	Stopped in Pre-Cambrian
18	Parker Oil Co. No. 1 Bardwell	SW NE 28-10-9E	?	1,080	Stratigraphic data in Table 61
19	W. R. Wilson No. 1 Rannels	Cen. W½ 4-11-8E	1928	2,112?	Stopped in "Hunton"

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rocks. The Cain Bloom No. 1 Zeandale well, in the NW cor. SW¼ sec. 28, T. 10 S., R. 9 E., reached granite at a depth of 928 feet. The Parker Oil Company No. 1 Bardwell well, in the SW¼ NE¼ sec. 28, T. 10 S., R. 9 E. is reported to have reached granite at 945 feet. The oldest Paleozoic rock encountered in this well is probably the Hertha limestone. The Empire Gas and Fuel Company No. 1 Woodbury well, in the SW¼ NE¼ sec. 14, T. 9 S., R. 4 E., reached granite at 2,760 feet. In this well, as in some others in the county, Simpson sandstone lies next above the Pre-Cambrian granite. The Arkansas Fuel Oil Company No. 1 Martin well, in the SE¼ NE¼ SW¼ sec. 24, T. 8 S., R. 4 E., reached granite at about 2,938 feet. Seemingly Simpson rocks are in contact with the Pre-Cambrian there.

Exploration for Oil and Gas

Data on wells in Riley County that are recorded are listed in Table 62. Their locations are shown in Figure 53. After some years of inactivity drilling was resumed in the county in 1950 when two dry wildcats (wells 4 and 6, Table 62) were started. It is to be noted that the county is still quite inadequately tested.

SHAWNEE COUNTY

Neither oil nor gas is produced in Shawnee County. The Geological Survey has records of 29 test wells that have been drilled in the county. This indicates that exploration is still inadequate.

Geology

SURFACE ROCKS

Rocks of Permian age are exposed in two small areas in the southwestern part of Shawnee County. The exposed bedrock elsewhere in the county is Pennsylvanian in age. Thin deposits of glacial till and outwash material are found in most parts of the county.

Pennsylvanian rocks.—Outcropping Pennsylvanian rocks in Shawnee County extend from uppermost Pennsylvanian strata to beds in the upper part of the Douglas group (Fig. 4). Several limestones cap conspicuous escarpments that cross the county in a general

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north-south direction. The most prominent are those of the Topeka, Deer Creek, Lecompton, and Oread limestones of the Shawnee group. A few feet of shale in the upper part of the Douglas group occurs at the surface along Wakarusa Creek in the eastern part of the county.

SUBSURFACE ROCKS

Table 63 shows the depths at which some key pre-Chattanooga horizons were reached in three Shawnee County wells. Data are from studies made by Lee (1943, figs. 5, 7).

Pennsylvanian rocks.—In southwestern Shawnee County, where the uppermost Pennsylvanian rocks are present, the total thickness of these rocks is about 2,000 feet.

Mississippian rocks.—According to Lee (1943, fig. 16), the total thickness of the Mississippian limestones in Shawnee County ranges from slightly less than 200 feet to slightly more than 350 feet. The youngest Mississippian formation that has been identified in the county is the "Warsaw" limestone, which is believed to lie next below the Pennsylvanian deposits in all parts of the county (Lee and Payne, 1944, fig. 17). In the McBride and Givens No. 1 Shirley

TABLE 63.—*Depths in feet at which some key stratigraphic horizons were reached in three wells in Shawnee County*

Horizon	Forrester et al. No. 1 Hummer, SW SE NE 14-11-16E	McKnab No. 1 Frits, SW SE SW 4-12-14E	Green et al. No. 1 Ripley, NW NW NE 12-12-16E
Top Mississippian limestone....	1,790	1,893	1,780
Top Chattanooga shale.....	2,040	2,139	2,052
Top Devonian ("Hunton" limestone)....	2,160	2,292	2,140
Top Silurian limestone.....	.....	2,345	.....
Top Maquoketa shale.....	2,260	2,430	2,255
Top Viola limestone.....	2,330	2,494	2,275
Top Decorah shale.....	2,450	2,565	.....
Top St. Peter sandstone.....	2,465	2,631	2,405
Top Arbuckle rocks.....	2,535	2,680	2,475
Top Gasconade dolomite.....	2,735	.....	.....
Top Eminence dolomite.....	2,800	.....	.....
Top Lamotte sandstone.....	2,980	.....	.....
Top Pre-Cambrian rocks.....	3,008	.....	.....
Total depth.....	3,023	2,722	3,320

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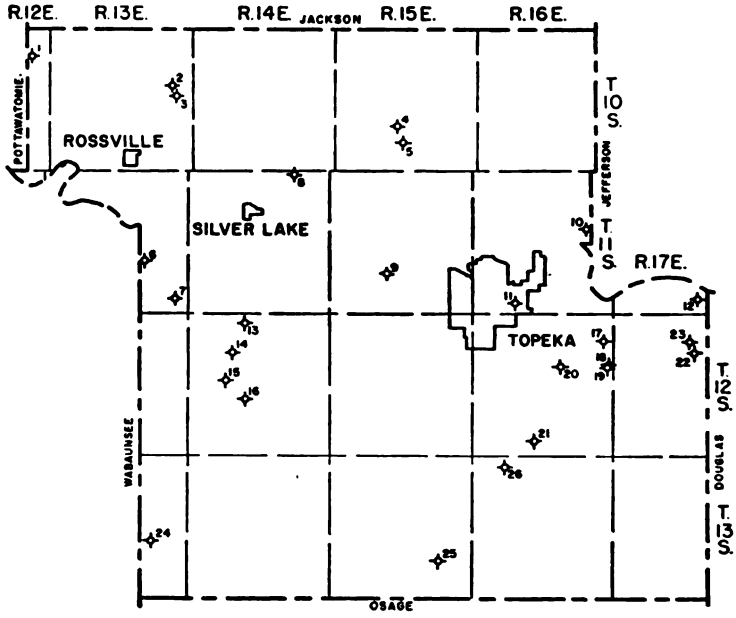

FIG. 54.—Map of Shawnee County showing location of wells listed in Table 64.

well, in sec. 21, T. 12 S., R. 14 E., Lee (1940, pl. 6) identified 50 feet of "Warsaw" limestone. In the same well 25 feet of Keokuk limestone was found overlying 47 feet of Burlington limestone. This is underlain by 29 feet of limestone of Fern Glen age. The Sedalia limestone, which is 13 feet thick, occurs next below. In the basal part of the Mississippian section, 60 feet of Gilmore City limestone was identified. The thickness of the Chattanooga shale ranges from less than 100 feet in the southeastern part of the county to slightly less than 250 feet in the southwestern part (Lee, 1943, fig. 14).

Pre-Chattanooga rocks.—Lee's studies indicate that the Silurian limestone and the Maquoketa shale have been removed from southeastern Shawnee County. The maximum thickness of rocks between the base of the Chattanooga shale and the top of the Maquoketa shale is about 250 feet (Lee, 1943, fig. 12). The interval from the top of the Maquoketa shale to the top of the St. Peter sandstone is not more than 200 feet (Lee, 1943, fig. 11), and the interval from the top of the St. Peter sandstone to Pre-Cambrian rocks ranges from about 200 to 600 feet (Lee, 1943, fig. 9).

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Oil and Gas Exploration

Data on 29 test wells in Shawnee County, records of which are in the Geological Survey files, are listed in Table 64. Locations of the wells are shown in Figure 54.

Table 64.—*Data on wells drilled for oil and gas in Shawnee County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	St. Marys Coal, Oil & Gas Co. No. 1 St. Marys College	SE NW NW 12-10-12E	1908	1,892	Top Mississippian, 1,871 ft.
2	Adanac Oil & Refg. Co. No. 1 Adanac	SW NW 13-10-13E	1920	2,700	Top Mississippian, 2,115; Chattanooga, 2,316; "Hunton," 2,563 ft.
3	Skelly Oil Co. No. 1 Wallace	NW SE SW 13-10-13E	1944	3,147	Top Mississippian, 2,094; "Hunton," 2,523; Arbuckle, 3,067 ft.
4	Jenkins & Scott No. 1 Asherman	NE NW NE 28-10-15E	1930	862	Stopped in Kansas City-Lansing rks.
5	C. W. Murchison No. 1 Federal Land Bank	SE SE SE 28-10-15E	1943	2,885	Top Arbuckle, 2,865 ft.
6	Barnsdall No. 1 Stacey	NW NW SW 23-11-13E	1918	1,951	Stopped in Cherokee rks.
7	Holl et al. No. 1 Werner	SE SE NW 36-11-13E	1926	2,006	Stopped in upper part of Mississippian
8	Jones, Davisson, et al. No. 1 Allen	SE NE NW 2-11-14E	1929	2,471	Top Mississippian,2,080; top Chattanooga, 2,305; "Hunton," 2,450 ft.; stopped in "Hunton"
9	Corbett et al. No. 1 Security Benefit Assn.	SW SE NW 28-11-15E	1940	2,170	Top Mississippian, 1,767; Chattanooga, 1,984?; "Hunton," 2,119 ft.; stopped in "Hunton"
10	Forrester et al. No. 1 Hummer	SW SE NE 14-11-16E	1930	3,023	See Table 63
11	Diamond Core hole	NW NE SE 32-11-16E	1886	1,638	Stopped in Cherokee rks.
12	----------	SW SW NE 34-11-17E	?	1,435	Stopped in Cherokee rks.
13	McKnab No. 1 Fritz	SW SE NW 4-12-14E	1939	2,720	See Table 63
14	Jenkins & Scott Oil Co. No. 1 Hayden	NE NE SE 8-12-14E	1930	2,693	Drillers log is similar to that of McKnab No. 1 Fritz; stopped in St. Peter ss.
15	Rinker No. 1 Flickinger	SW SW SE 17-12-14E	?	1,880	Stopped in Cherokee rks.
16	McBride & Givens No. 1 Shirley	NE SW 21-12-14E	1927	2,469	Top Mississippian, 1,960; Chattanooga, 2,306 ft.; stopped in Chattanooga sh.

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TABLE 64.—*Data on wells drilled for oil and gas in Shawnee County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
17	Green et al. No. 1 Ripley	NW NW NE 12-12-16E	1923	3,320	See Table 63
18	.....	NE¼ 13-12-16E	?	525	Incomplete log
19	Goodwin et al. No. 1 Decker	SE NE NE 13-12-16E	?	1,435	Log not available
20	..... Bahnmeier	NE¼ 15-12-16E	1905	1,310	Incomplete log; stopped in Cherokee rks.?
21	J. J. Lynn No. 1 Nelson	SW SW NE 33-12-16E	1951	2,518	Top Kansas City, 795; top Mississippian, 1,755; top Chattanooga, 1,982; top "Hunton," 2,098; top Viola, 2,233; top Arbuckle, 2,401 ft.
22	Sterling Drlg. Co. No. 1 Milliken	W½ NW SE 10-12-17E	1944	2,511	Top Mississippian, 1,714; Arbuckle, 2,409 ft.
23	Jenkins & Scott No. 1 Milliken	SE SE NW 10-12-17E	1930	550	No log available
24	..... No. 3 Marshall	23-13-13E	?	1,812	Top Mississippian reported 1,765 ft.
25	Wapeka Oil Co. No. 1 Neal	SW NE 26-13-15E	1917	2,430	
26	J. J. Lynn No. 1 Blacke	SE SE NW 5-13-16E	1951	2,375	Top Mississippian, 1,700; top Chattanooga, 1,920; top " Hunton," 2,102; top Viola, 2,140; top Simpson, 2,250; top Arbuckle, 2,314 ft.
27	Milliken, Trott, et al. No. 1 Zeidler	NE NE NE 18-13-16E	1946	2,278	Top Mississippian, 1,820; Chattanooga, 2,081 ft.
28	J. J. Lynn No. 1 Anna Warner	SW SE NW 5-13-17E	1951	2,433	Top Kansas City, 750; top "Bartlesville," 1,681; top Mississippian, 1,756; top Kinderhookian, 1,958; top "Hunton," 2,040; top Simpson, 2,287; top Arbuckle, 2,346 ft.
29	..... No. 1 Hotchkiss	CSL NE SE 9-13-17E	?	?	No log available

WABAUNSEE COUNTY

About 30 drill test holes had been made in Wabaunsee County before oil was discovered in the county in April 1949. This discovery —by a well in sec. 33, T. 13 S., R. 10 E., which had an initial daily potential of 2,580 barrels of oil from a reservoir in the upper part of

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the Viola limestone—was the most important in eastern Kansas for many years. Exploration that followed has resulted in the finding of 6 other oil pools in the county. Of the county's 7 known pools, 1 is in the "Hunton," 1 in the Simpson, and 5 in the Viola limestone. At the end of 1952 the cumulative oil production of the county stood at 1,115,298 barrels. Production statistics for the county's oil fields are listed in Table 73.

The Wabaunsee County oil pools are in small anticlines in a trend to the east of and nearly parallel to the Nemaha anticline and are in the deeper part of the Forest City basin, a broad synclinal area that had not attracted much attention before the discovery of the Davis Ranch pool.

The geology of the Davis Ranch pool was described by Smith and Anders (1951). It and following discoveries in the area were discussed by Jewett (1950, 1951).

Geology

Surface rocks

Both Permian and Pennsylvanian rocks crop out in Wabaunsee County. The exposed Permian section is about 750 feet thick, and the exposed Pennsylvanian section is about 200 feet thick. Surficial deposits of unconsolidated sediments include alluvium in the valleys of Kansas River and other streams, attenuated glacial drift, and scattered gravel beds. The youngest bedrock in the county is the Doyle shale near the top of the Wolfcampian Series. The Willard shale (Wabaunsee group) is the oldest surface rock of the county. That shale and the overlying Tarkio limestone are exposed along Kansas River in the northwestern part of the county.

Permian rocks.—Outcrops of rocks of the Chase group (Fig. 3) occupy most of the western part of Wabaunsee County. The Fort Riley and Florence limestone members of the Barneston formation, the Wreford limestone, and several highly colored shales are easily identified. Rocks of the Council Grove group crop out in a belt extending in a general northeast direction from the southwest corner of the county. The outcrop belt ranges from about 6 to 20 miles in width. As in other eastern Kansas counties, the thickness of the Council Grove rocks is about 300 feet. Rocks of the Admire group crop out in the eastern half of the county. Exposures along Mill Creek are especially well adapted to study. The Red Eagle

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formation, in the lower part of the Wabaunsee group, shows striking lateral changes in the county (O'Connor and Jewett, 1952). The basal Admire deposit in a part of Wabaunsee County is a sandstone (Indian Cave member of the Towle formation) that lies above a disconformity. This disconformity locally seemingly reaches 135 feet or more below the youngest Pennsylvanian rocks of the region, but probably the thick sandy deposit comprises, in its lower part, channel fillings in upper Pennsylvanian rocks. Sandstone is especially well exposed in the SW¼ NW¼ sec. 3, T. 13 S., R. 13 E. Its base in this area is a few feet above the Maple Hill limestone (Wabaunsee) (Moore and others, 1936, fig. 30). The Admire rocks are chiefly clastic and the limestones are only a few feet thick.

Pennsylvanian rocks.—The thickness of the Wabaunsee group (Fig. 4) along the outcrop in Kansas shows little variation, although the thicknesses of the formations are quite variable. In Wabaunsee County and elsewhere in the State, the thickness of the group is about 500 feet. Clayey and sandy shales, light-colored limestones, and minor amounts of sandstone characterize this rock division. Only the upper part of the group, the Willard shale and higher formations, is exposed in the county. These rocks crop out in the northwestern part of the county.

SUBSURFACE ROCKS

The crest of the buried crystalline core of the Nemaha anticline underlies the western part of Wabaunsee County. Rocks of Marmaton age are believed to lie on Pre-Cambrian crystalline rocks in this area, and a little farther east the Cherokee shale oversteps the upturned and beveled edges of Mississippian limestone formations, the Chattanooga shale, and older rocks.

Depths to some key horizons in four wells in Wabaunsee County are given in Table 65.

Pennsylvanian rocks.—The average thickness of Pennsylvanian rocks in Wabaunsee County is about 2,000 feet. The section is thinner in the western part of the county in the area of the Nemaha anticline.

Mississippian rocks.—According to Lee (1939, pl. 1; 1943, fig. 16), Mississippian limestone formations in Wabaunsee County have a total thickness ranging from a featheredge to slightly more than 350 feet. The greatest thickness is in the southeast corner of the county.

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TABLE 65.—*Depths in feet to some key horizons in four wells in Wabaunsee County*

Horizon	Amerada Petro. Corp. No. 1 Willig, SE SE SE 5-11-10E	Ramsey Petro. Co. No. 1 Kaul, SE NE NE 2-11-11E	Empire Oil & Rfg. Co. No. 1 Schwalm, SE SE 19-12-11E	Williams et al. No. 1 Henderson, NE 15-13-12E
Top Shawnee group	473	560	900	525
Top Douglas group	...	970	1,255	915
Top Lansing group	981	1,170	1,495	1,305
Base Marmaton group	...	1,748	2,070	1,705
Top Mississippian rocks	...	2,225	2,485	2,230
Top Chattanooga shale	1,528	2,375	2,805	2,553
Top "Hunton" limestone	1,745	2,590	2,990	2,727
Top Maquoketa shale	2,095	.....	3,215	2,822
Top Viola limestone	2,185	.....	3,285	2,908
Top St. Peter sandstone	2,292	.....	3,400	3,030
Top Arbuckle limestone	2,438	.....	.....	3,088
Top Pre-Cambrian rocks	2,475	.....	.....	.....
Total depth	2,489	2,830	3,431	3,652

These rocks are absent in the extreme western part. The Chattanooga shale ranges in thickness from a fraction of a foot to more than 150 feet (Lee, 1943, fig. 14). It was removed by post-Mississippian erosion west of a line from the northern boundary of Wabaunsee County at about the middle of R. 10 E. to the southern boundary at about the middle of R. 9 E.

Pre-Chattanooga rocks.—Lee's studies (1943, fig. 7) indicate that a well in sec. 19, T. 12 S., R. 11 E. was drilled through 41 feet of Devonian limestone, and that 179 feet of Silurian limestone was penetrated. Lee also identified 72 feet of Maquoketa shale, 103 feet of Fernvale (?) and Kimmswick limestone, 23 feet of Decorah shale and Plattin limestone, and 19 feet of St. Peter sandstone. Arbuckle rocks lie below the St. Peter sandstone. Pre-Cambrian rocks are 958 feet below the surface in sec. 26, T. 10 S., R. 9 E., and 3,625 feet below the surface in sec. 15, T. 13 S., R. 12 E. The difference in elevation of the Pre-Cambrian floor between these two places is approximately 2,400 feet. The well in which granite was found at the shallow depth is near the crest of the Nemaha anticline where Pennsylvanian rocks are in contact with the Pre-Cambrian. Although there has been a great many more wells drilled since Lee's studies which are referred to above, the over-all picture has not changed.

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Exploration and Development

Locations of Wabaunsee County oil fields and of dry wildcat wells are shown in Figure 55. Gas has not been produced commercially in the county, although the Coleman-Edgerton No. 1 "B" Smith well, sec. 9, T. 12 S., R. 10 E., is reported to have found 44 thousand cubic feet daily of helium-bearing gas (Ockerman, 1935, p. 71). The gas pool lies between 266 and 276 feet.

The **Davis Ranch** oil field was opened in 1949 by the Carter Oil Company in sec. 33, T. 13 S., R. 10 E. The oil pool is in the upper part of the Viola limestone at a depth of 3,201 feet. This discovery aroused much interest in Wabaunsee County and neighboring areas.

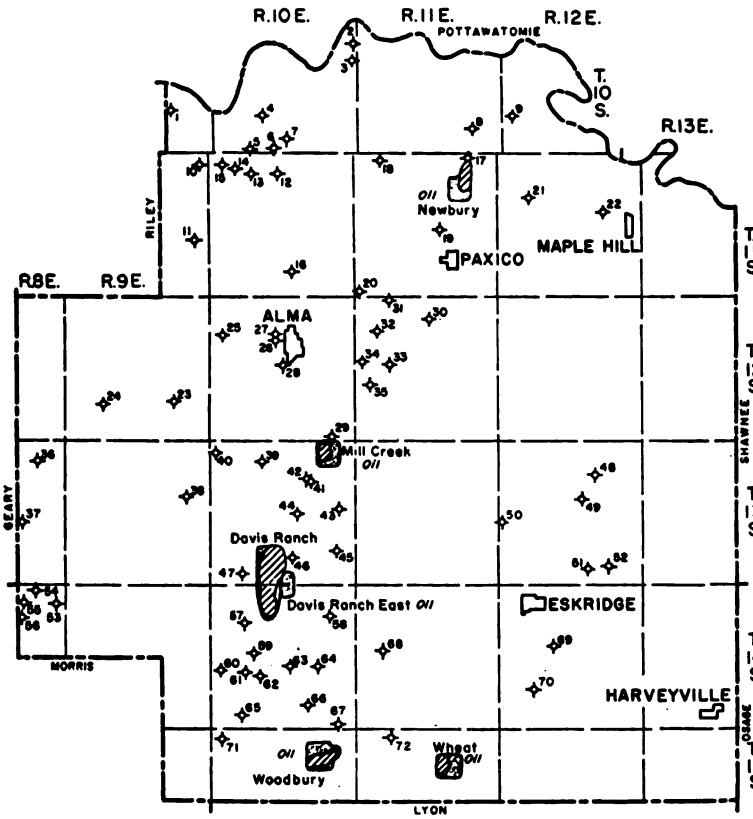

Fig. 55.—Map of Wabaunsee County showing oil fields as designated by the Kansas Nomenclature Committee and locations of wells listed in Table 66. Diagonal lines show areas of 1952 oil production.

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Much surface mapping, core drilling, and geophysical work followed. A rather large number of dry holes were drilled; but six other pools were found in the county. In 1951 a new producing zone was found in the **Davis Ranch** field in a "Hunton" limestone at a depth of 2,929 feet. Data on wells drilled in the field are listed in Table 73. The **Davis Ranch East** field was opened in 1950 in sec. 34, T. 13 S., R. 10 E. The Viola limestone reservoir lies at a depth of 3,305 to 3,314 feet. This is on the east and downthrown side of the Davis Ranch structure. The field was abandoned in 1950 after producing 7,599 barrels of oil.

The **Mill Creek** field was opened in 1950 in sec. 2, T. 13 S., R. 10 E., about 6 miles north of the **Davis Ranch** area. The **Mill Creek** pool is in the upper part of the Viola limestone in a zone from 2,923 to 2,927 feet. The **Newbury** field was opened in the fall of 1950 in sec. 11, T. 11 S., R. 11 E. It is about 12 miles north and slightly east of the **Mill Creek.** The two pools and the **Davis Ranch** are along the same trend, in higher parts of an elongated fold, or in *en echelon* folds, paralleling the larger Nemaha anticline. The upper Viola limestone reservoir of the **Newbury** field lies between 2,901 and 2,904 feet.

Two oil pools were discovered in Wabaunsee County in 1951. The **Wheat** field was opened in sec. 10, T. 15 S., R. 11 E. in the Simpson group between 3,230 and 3,234 feet. A well in sec. 11, T. 15 S., R. 10 E., opened the **Woodbury,** a Viola limestone pool between depths of 3,323 and 3,328 feet.

All dry wildcat wells in Wabaunsee County, records of which are in the Geological Survey's files, are listed in Table 66.

TABLE 66.—*Data on dry wildcat wells drilled in Wabaunsee County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Lowest formation penetrated
1	Parker Oil Co. No. 2 Bardwell	NW cor. 26-10-9E	1915?	1,093	Pre-Cambrian
2	Jennings Oil Co. No. 1 Miller	NW SE NE 12-10-10E	1918	2,215	Lower Pennsylvanian?
3	Ben F. Brack Oil Co. No. 1 Uhlrig	NE NE NE 13-10-10E	1950	3,206	Arbuckle
4	Amerada Petro. Corp. No. 1 L. E. Morton	SW SW NW 28-10-10E	1948	1,918	Maquoketa
5	Amerada Petro. Corp. No. 1 W. W. Bolton	SW SW SE 32-10-10E	1948	1,720	Pre-Cambrian
6	Amerada Petro. Corp. No. 1 Adelaide Enlow	SW SW SE 33-10-10E	1948	2,705	Pre-Cambrian

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TABLE 66.—*Data on dry wildcat wells drilled in Wabaunsee County, continued*

No. on map	Name of well	Location	Year completed	Total depth, feet	Lowest formation penetrated
7	Amerada Petro. Corp. No. 1 Marie Stewart	SE SW NW 34-10-10E	1948	2,371	Mississippian
8	Adkins & Appleman No. 1 McLaughlin	SE SE SE 26-10-11E	1950	3,243	Arbuckle
9	B & R Drilling, Inc. No. 1 McKenna	SW SW NE 30-10-12E	1949	3,200	Arbuckle
10	Empire Oil & Gas Co. No. 1 Root	SW NE 1-11-9E	1917	1,895	Pre-Cambrian
11	S. W. Forrester et al. No. 1 Frank Jones	NE NE SW 24-11-9E	1928	1,597	Pre-Cambrian
12	Amerada Petro. Corp. No. 1 Elizabeth Enlow	SE SE SE 4-11-10E	1948	2,575	Kinderhookian
13	Amerada Petro. Corp. No. 1 Allie Willig	SE SE SE 5-11-10E	1948	2,489	Pre-Cambrian
14	Amerada Petro. Corp. No. 2 Allie Willig	NW NW SW 5-11-10E	1948	1,523	Pre-Cambrian
15	Amerada Petro. Corp. No. 1 Sherman Mertz	SW SW NE 6-11-10E	1948	1,234	Pre-Cambrian
16	Carter Oil Co. No. 1 Hankammer	SW SW SE 27-11-10E	1949	3,365	Arbuckle
17	Ramsey Petro. Co. No. 1 Kaul	SE NE NE 2-11-11E	1926	2,830	"Hunton"
18	Kansas Oil Assoc. No. 1 Louis Willie	SW NW NW 5-11-11E	1918	2,700	Chattanooga
19	..... No. 1 Newbury	NW NE? 22-11-11E	?	500	Douglas?
20	M. C. Bullock No. 1 McFarland	SW cor. 31-11-11E	1892	2,006	Cherokee?
21	Helmerich & Payne No. 1 Uhlrig	SE SE SW 8-11-12E	1949	3,227	Arbuckle
22	R. E. Adams & Murfin No. 1 Adams	N½ SW NE 14-11-12E	1950	3,094	Simpson
23	Sunflower Drlg. Co. No. 1 Reichman	SW SW NE 26-12-9E	1950	3,135	Viola
24	Carter Oil Co. No. 1 Meseke	SE SE NE 29-12-9E	1949	2,421	Arbuckle
25	Woods Oil & Gas Co. No. 1 Crosby	SE NW SE 7-12-10E	1951	3,563	Arbuckle
26	Coleman-Edgerton No. 1-B Smith	NW SE SE 9-12-10E	1929	276	?
27	American Petro. Corp. No. 1 Schmidt	SE SE 9-12-10E	1927	2,339	Mississippian
28	Honaker et al. No. 1 Mathies	NE SW SW 15-12-10E	1951	3,051	Viola
29	Ray Anderson No. 1 Morris	NE SW SW 36-12-10E	1950	3,063	Viola
30	Thrifty Drlg. Co. No. 1 Strowig	SE SW SW 3-12-11E	1949	3,383	Arbuckle

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31	E. F. Wakefield No. 1 Schwalm	NW NW NE 5-12-11E	1950	3,184	Arbuckle
32	Adkins Drlg. Co. et al. No. 1 Schwalm	SW SW NW 8-12-11E	1951	3,130	Viola
33	Cosden Oil & Gas Co. No. 1 Renker	SW SE 17-12-11E	1916	1,880	Cherokee?
34	Skelly Oil Co. No. 1 Wolgast	SE NE SW 18-12-11E	1951	3,168	Viola
35	Empire Oil & Refg. Co. No. 1 Schwalm	SE SE 19-12-11E	1928	3,431	Simpson
36	Forrester-Cook No. 1 Schultz	NW SE SE 2-13-8E	?	2,385	?
37	Continental Oil Co. No. 1 Folk	SW SW NW 23-13-8E	1953	2,401	Arbuckle
38	Woods Oil & Gas Co. No. 1 Munzer	NW SW NW 13-13-9E	1951	3,436	Arbuckle
39	Jones, Shelburne & Farmer No. 1 Joss	SE SW SW 4-13-10E	1950	3,430	Viola
40	Sunflower Oil Co. No. 1 McComb	SE SW NW 6-13-10E	1950	3,307	Arbuckle
41	Manhattan Oil Co. No. 1 Steinmeyer	NE W½ SW 11-13-10E	1927	2,405	Mississippian
42	Skelly Oil Co. No. 1 Stuewe	NW NW SW 11-13-10E	1949	3,320	Arbuckle
43	C. L. Carlock No. 1 Waugh	SE SE SW 13-13-10E	1950	3,405	Viola
44	W. E. Bakke & Aladdin No. 1 Schutter	NE NW NE 22-13-10E	1949	3,360	Arbuckle
45	El Capitan No. 1 Buckli	SE SE NW 25-13-10E	1950	3,518	Arbuckle
46	Plains Exploration & Sterling No. 1 Schwanke	SW SW SE 27-13-10E	1949	3,290	Viola
47	Westgate-Greenland Oil Co. No. 1 Kirkham	NE NE SW 32-13-10E	1949	3,382	Simpson
48	Alf M. Landon et al. No. 1 Waugh	SW SW NW 11-13-12E	1949	3,142	Arbuckle
49	Williams et al. No. 1 Henderson	SW NE 15-13-12E	?	3,652	Pre-Cambrian
50	C. W. Chapman No. 1 Schwarting	SW SW NW 19-13-12E	1949	3,410	Arbuckle
51	Waugh Brothers No. 1 Martin	SE SE NE 34-13-12E	1949	3,270	Arbuckle
52	Pinnacle Oil & Gas Co. No. 1 E. Martin	NE 35-13-12E	1919	3,640?	?
53	John Zinn No. 1 Langvardt	NE SW SE 1-14-8E	1937	625	Lower Permian
54	C. B. Rose No. 1 Hartcraft	Cen. NE 2-14-8E	1934	618	Lower Permian
55	C. B. Rose No. 2 W. W. Stice	SW cor. 2-14-8E	1933	700	Lower Permian
56	C. B. Rose No. 1 W. W. Stice	SW NW 11-14-8E	1932	604	Lower Permian
57	Carter Oil Co. No. 1 G. H. Davis	SW NW SE 8-14-10E	1952	3,394	St. Peter ss.

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TABLE 66.—*Data on dry wildcat wells drilled in Wabaunsee County, concluded*

No. on map	Name of well	Location	Year completed	Total depth, feet	Lowest formation penetrated
58	L. S. Abercrombie No. 1 Lockhart	NW SW NW 12-14-10E	1950	3,515	Arbuckle
59	Carter Oil Co. No. 1 Wingate "A"	SE SE SE 17-14-10E	1950	3,398	Viola
60	Sterling Drlg. Co. No. 1 Hoch	NW NW SE 19-14-10E	1949	3,522	Arbuckle
61	Carter Oil Co. No. 1 Olsen	SW NW SE 20-14-10E	1950	3,490	Arbuckle
62	Davis & Childs et al. No. 1 Hock	SW SW SW 21-14-10E	1950	3,472	Arbuckle
63	B & R Drlg., Inc. et al. No. 1 Schultz	SE SE NW 22-14-10E	1949	3,614	Arbuckle
64	El Capitan Oil Co. No. 1 Converse	SW SW NE 23-14-10E	1949	3,409	Viola
65	Valley Steel Products Co. No. 1 Mayer	SE SE NW 32-14-10E	1952	3,396	Simpson
66	El Capitan No. 1 Converse	NW NW NW 35-14-10E	1950	3,401	Simpson
67	Trans-Era Petro., Inc. No. 1 Maxfield	SE SE SW 36-14-10E	1953	3,395	St. Peter
68	Benedum & Trees No. 1 Lockhart	SW cor. 17-14-11E	1917	2,665	Cherokee
69	Phillips & Ajax No. 1 Glick	NE NE SW 16-14-12E	1950	3,223	Arbuckle
70	Holborne Oil Co. No. 1 Stevenson	SW SW NE 29-14-12E	1926	2,510	Mississippian
71	Carter Oil Co. No. 1 Mary Dorgan	SW SW NE 6-15-10E	1949	3,446	Arbuckle
72	Earl et al. No. 1 Wilson	NE NE NE 5-15-11E	1918	1,052	Upper Pennsylvanian?

WASHINGTON COUNTY

Oil and gas have not been found in Washington County. The county is on the eastern margin of the Salina basin and in the northern part of the Kansas part of the North Kansas basin. Studies by Lee, Leatherock, and Botinelly (1948) of the stratigraphy and structural history of the Salina basin in Kansas are especially valuable in evaluating oil possibilities in Washington and other Salina basin counties.

The Geological Survey has records of six wells that have been drilled in the county.

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Geology

SURFACE ROCKS

Cretaceous rocks.—The youngest exposed rock in Washington County is a part of the Carlile shale which caps hills in the northwestern part of the county. Older Cretaceous rocks exposed include the Greenhorn limestone, the Graneros shale, the Dakota formation, and probably the Kiowa shale. Sandstones of the Dakota formation crop out in a large part of the area.

Permian rocks.—Outcropping Permian rocks in Washington County extend from the lower part of the Wellington shale to the upper part of the Matfield shale (Fig. 3).

SUBSURFACE ROCKS

Depths at which some stratigraphic horizons were reached in a well in sec. 1, T. 1 S., R. 2 E. are given in Table 67. Data were supplied by Constance Leatherock of the United States Geological Survey.

Younger Paleozoic rocks.—The average thickness of Permian and Pennsylvanian rocks in Washington County is about 2,000 feet (Moore and Jewett, 1942, fig. 2).

The Chattanooga shale is believed to underlie Pennsylvanian rocks in the southwestern part of the county (Lee, 1943, fig. 14). A thin wedge of Mississippian limestone is believed to separate Pennsylvanian and Chattanooga rocks in the western part of the county. The maximum thickness of the Chattanooga shale is slightly more than 200 feet.

Table 67.—*Depths to some key horizons in the Gulf Oil Corporation No. 1 Baker well, NW¼ SE¼ SE¼ sec. 1, T. 1 S., R. 2 E., Washington County*

Horizon	Depth, feet
Base Pennsylvanian rocks and top Devonian ("Hunton") rocks	2,185
Top Silurian rocks	2,340
Top Maquoketa shale	2,600
Top Kimmswick (Viola) limestone	2,655
Top Simpson formation	2,970
Top Bonneterre dolomite	3,105
Top granite wash	3,149
Total depth	3,153

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Pre-Chattanooga rocks.—The "Hunton" limestone, which has an average thickness of about 400 feet, is believed to be present in all parts of Washington County. The Sylvan (Maquoketa) shale probably underlies all the county. Its thickness probably does not exceed 75 feet. The Viola limestone probably is present in all parts of the county; its average thickness is believed to be about 400 feet. A small thickness of Simpson (St. Peter) sandstone probably lies between the Viola limestone and Pre-Cambrian rocks in most of the county. There is a thin wedge of Arbuckle (or Bonneterre) dolomite below the Simpson sandstone in the western part.

Oil and Gas Exploration

Data on six wells that have been drilled in Washington County

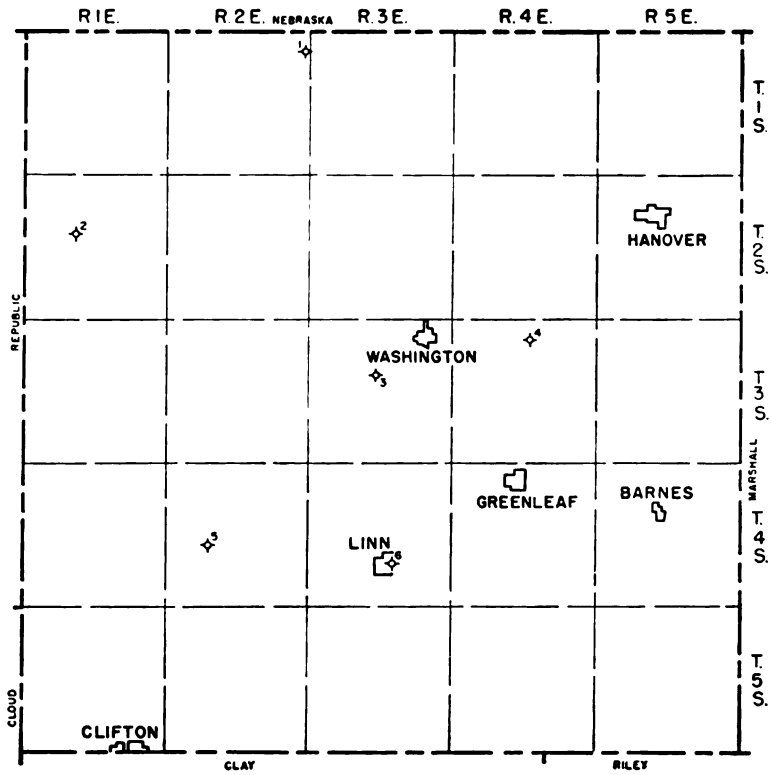

FIG. 56.—Map of Washington County showing location of wells listed in Table 68.

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TABLE 68.—*Data on wells drilled for oil and gas in Washington County*

No. on map	Name of well	Location	Year completed	Total depth, feet	Remarks
1	Gulf Oil Corp. No. 1 Baker	NW SE SE 1-1-2E	1942	3,153	See Table 67
2	Westfield Oil & Gas Corp. No. 1 Canfil	SW SW NW 16-2-1E	1923	4,085	Pre-Cambrian, 3,321 ft.
3	Sincox No. 1 Penwell	NW SE NE 16-3-3E	1932	1,720	
4	Elder & Ward No. 1 Stamm	SW SW SW 3-3-4E	1925	3,400	Pre-Cambrian, 3,005 ft.?
5	Phillips Petro. Co. No. 1 Helms	SE NE 20-4-2E	1943	3,027	Top Viola, 2,730; Simpson, 2,750; St. Peter, 2,959; Arbuckle, 2,998 ft.
6	McCole et al. No. 1 Swartzfoyer	NW NW NE 27-4-3E	1930	3,167	Stopped in St. Peter ss.?

and of which the Geological Survey has records are given in Table 68. Locations of these wells are shown in Figure 56. As far as we know, no tests have been drilled since 1943.

WILSON COUNTY

Oil and gas have been produced in every township in Wilson County. Oil was first discovered in the county near Neodesha in 1890 (Haworth, 1908, p. 24). Neodesha was supplied with gas on July 4, 1894. More than 40 wells were producing gas in this area by the close of 1894. Oil and gas were produced near the towns of Fredonia, Benedict, and Buffalo in 1900. Neodesha, Altoona, Fredonia, Buffalo, and Vilas are nearly surrounded by producing areas. The oil and gas resources of Wilson County were described by Moore and Boughton (1921); and the subsurface geology of the county was described by Stryker (1925). These reports are useful both in reference to early developments and in possibilities of new discoveries or in reference to water flooding in present fields.

In 1952, 67,271 barrels of oil were produced in Wilson County. Oil production for 1890 through 1952 is given in Tables 2 and 3. Production for 1949 through 1952 in the various Wilson County fields is given in Table 73. Gas production recorded for 1952 was 185,316 thousand cubic feet.

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Geology

SURFACE ROCKS

The surface rocks in Wilson County consist of alternating beds of shale, limestone, and sandstone. The Oread limestone of the Shawnee group or possibly a few feet of overlying shale (Fig. 4) is the youngest consolidated rock exposed in the county. It crops out in the extreme northwestern part. The Douglas group, which consists of thick massive or cross-bedded sandstones, shaly sandstones, and sandy shales, is about 230 feet thick in the county. Pedee rocks (Fig. 5) have a thickness of about 60 feet, Lansing rocks are about 165 feet thick, and Kansas City rocks are about 250 feet thick.

SUBSURFACE ROCKS

Pennsylvanian rocks.—Rocks of the Bronson subgroup are about 100 feet thick in Wilson County. The Pleasanton rocks are mostly silty to sandy shale; their thickness in the county is probably about 100 feet. The Marmaton group of rocks consists of about 250 feet of shale, sandstone, and limestone and a minor amount of coal. The Cherokee shale ranges in thickness from about 200 feet in the central part of Wilson County to about 425 feet in the east-central part (Bass, 1936, pl. 1). It is composed principally of light and dark shale containing sandstone lenses and thin beds of limestone and coal. The "Bartlesville sand" is separated from the underlying Mississippian limestone by about 100 feet of shale. A sandstone occurs locally in the basal part of the Cherokee shale.

Mississippian rocks.—The total thickness of the Mississippian rocks in Wilson County ranges from 150 to 300 feet (Lee, 1939, pl. 1).

TABLE 69.—*Depths to some stratigraphic horizons in the No. 3 Marion Smith well, SE¼ NW¼ sec. 10, T. 29 S., R. 15 E., Wilson County*

Horizon	Depth, feet
Base Kansas City group	515
Base Fort Scott limestone, top Cherokee shale	815
Top Mississippian limestone	995
Top Chattanooga shale	1,209
Top Arbuckle rocks	1,231
Top Lamotte sandstone	2,180
Top Pre-Cambrian rocks	2,211
Total depth	2,246

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The identified Mississippian rocks and their thicknesses in a well in sec. 22, T. 30 S., R. 15 E., are: "Warsaw" limestone, 97 feet; Keokuk limestone, 44 feet; Burlington limestone, 54 feet; Reeds Spring limestone, 121 feet; St. Joe limestone, 5 feet; Northview shale, 7 feet; Compton limestone, 5 feet; and Chattanooga shale (Mississippian or Devonian), 17 feet. The Chattanooga shale lies unconformably on the Ordovician rocks.

Ordovician and Cambrian rocks.—The drillers log of the No. 3 Marian Smith well in sec. 10, T. 29 S., R. 15 E. records 980 feet of rocks that are Arbuckle and other lower Paleozoic rocks. According to this log, granite was penetrated at a depth of 2,211 feet. Keroher and Kirby (1948) indicated that the Jefferson City-Cotter sequence has an average thickness of 450 feet in Wilson County; the Roubidoux about 150 feet; and the Van Buren-Gasconade about 200 feet. Their studies show that the Eminence dolomite is present only in the eastern and southeastern parts of the county and is less than 50 feet thick. The average thickness of the Bonneterre is about 100 feet. About 60 feet of Lamotte sandstone is indicated on the log of the Marian Smith well, mentioned above; depths to some stratigraphic horizons in this well are listed in Table 69.

Oil and Gas Developments

Pennsylvanian rocks in Wilson County seemingly have been thoroughly tested for oil and gas, but modern methods of well completions, especially by sand-fracturing, may extend the fields. In the past the county has been more important as a gas producer than as an oil producer. In 1935 more than 800 gas wells were reported in the county. The 1952 gas production amounted to 185,316 thousand cubic feet; oil production was 67,271 barrels. Most of the petroliferous rocks are lenticular sandstones in the Cherokee shale. Some oil has been produced from the upper part of the Mississippian limestone and from the upper part of Arbuckle rocks.

Figure 57 shows the distribution of the oil and gas producing areas in Wilson County as defined by the Kansas Nomenclature Committee. Gas and perhaps some oil has been produced in interlying areas also.

The **Altoona** oil and gas field is in the east-central part of Wilson County. Oil production is from the "Bartlesville sand." Gas has been produced from "Bartlesville" and higher Pennsylvanian rocks.

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The **Altoona East** oil and gas field along the central part of the eastern border of Wilson County extends into Neosho County.

The **Benedict** oil and gas field in the central part of the county produces from sandstone in Cherokee rocks at a depth of about 975 feet. The **Buffalo** oil and gas field is a large area in the northeastern part of Wilson County (Fig. 57). Oil and gas were found chiefly in the "Bartlesville sand" at a depth of about 1,025 feet. Some oil has been produced from sandstone near the base of the Cherokee section. Some gas wells were reported to have had an initial daily production of 5,000 cubic feet.

The **Buxton** gas field is in the southwest part of Wilson County. Logs of gas wells are not available, but production probably comes from a sand body nearly 100 feet thick at a depth of about 1,100

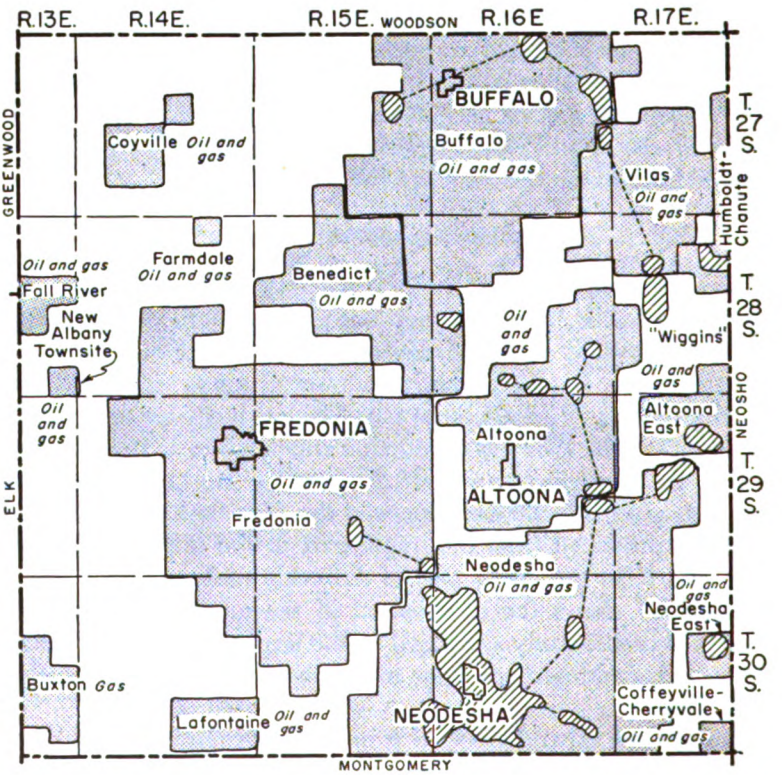

FIG. 57.—Map of Wilson County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production.

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feet. The top of Mississippian rocks in this area is about 1,225 feet below the surface.

The **Coffeyville-Cherryvale** oil and gas field, chiefly in Montgomery County, extends into the southeast corner of Wilson County. No oil production has been reported for the Wilson County part of the field for several years. Oil production has not been reported from the **Coyville** field since 1949 when the field produced 110 barrels. Gas and oil have been reported in the area in several Pennsylvanian formations. Production chiefly was from sandstone in the lower part of the Cherokee shale or from the upper part of Mississippian limestone.

The **Fall River** oil and gas field has not produced oil for several years. Former production was from sandstone in the lower middle part of the Cherokee section. Logs of former producing wells in the **Farmdale** oil and gas field, sec. 2, T. 28 S., R. 14 E., are not available. No oil production has been reported from the field during the last several years.

The **Fredonia** oil and gas field covers a large area in the south-central part of Wilson County. Oil and gas were found chiefly in a thick sandstone in the lower part of the Cherokee group. Some gas has been produced from higher rocks, especially in the Fort Scott formation. Many wells in the area were drilled a few feet into Mississippian rocks. The area was developed largely in the late 1920's.

The **Humboldt-Chanute** oil and gas field, chiefly in Allen and Neosho Counties, extends into Wilson County. The **Lafontaine** oil and gas field is in T. 30 S., R. 14 E. Few logs are available. Oil and gas have been reported from sandstone in the upper part of the Cherokee section and gas from Mississippian limestone.

The **Neodesha** oil and gas field is a large area covering most of the southeastern part of Wilson County. Oil production has been chiefly from sandstone in the Cherokee group at depths ranging from about 825 to 850 feet. In 1952 oil was produced in isolated parts of the field. The **Neodesha East** oil and gas field produced gas from sandstones in the lower and middle parts of the Cherokee shale. In 1926, a deep test, the Wilson No. 1 Birk well, sec. 21, was drilled to a total depth of 2,310 feet. This well stopped probably a few feet above Pre-Cambrian rocks. The **New Albany Townsite** field, T. 28 S., R. 13 E., is no longer active. Logs of the

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wells are not available. No oil has been reported from the field for several years.

The Vilas oil and gas field, in northeastern Wilson County, yields oil in small areas. The "Wiggins" oil field in the central part of T. 28 S., R. 17 E. has produced oil for the past several years.

WOODSON COUNTY

There are many scattered oil and gas producing areas in Woodson County. The largest oil production comes from the west-central part and the "Bartlesville sand" is the most prolific known reservoir rock for oil and gas. However the Mississippian limestone yields a great amount of oil. A new Mississippian limestone field was opened in 1952.

The 1952 oil production in Woodson County amounted to 631,511 barrels, and about 42 million cubic feet of gas was reported. Yearly oil production in the county is listed in Tables 2 and 3. Oil production in the various fields during the period 1949 to 1952 is listed Table 73. Figure 58 is a map of the county showing locations of areas that produced oil in 1952 and locations of the oil and gas fields as defined by the Kansas Nomenclature Committee.

Geology

SURFACE ROCKS

Granite is exposed at the surface in sec. 13, T. 26 S., R. 15 E. in a small anticline known as Rose dome. Quartzitic sandstone and other metamorphic rocks, believed to have been formed by hydrothermal action, and basic igneous rock occur at the surface in sec. 32, T. 26 S., R. 15 E. in another anticline, the Silver City dome.

Pennsylvanian rocks.—Surface rocks of Woodson County include the Shawnee, Douglas, Pedee, and Lansing groups. The Topeka limestone of the Shawnee group is the surface rock in the northwestern part of the county. The oldest exposed rock is the Plattsburg limestone of the Lansing group which is the surface rock in the southeastern part.

The thickness of the Shawnee group in Woodson County is about 300 feet. The Douglas group consists chiefly of shale, sandy shale, and sandstone and some thin beds of limestone and coal. These rocks are about 300 feet thick and occupy a broad band of prominent

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sandstone hills about 6 miles wide which trends in a northeast-southwest direction across the middle of the county. Pedee rocks crop out in eastern Woodson County in a narrow band immediately east of the broad outcrop of Douglas rocks. The total thickness of the Lansing group is about 90 feet.

SUBSURFACE ROCKS

Rose dome, a small anticline in sec. 13, T. 26 S., R. 15 E., and "Silver City" are two of the few places in the State where igneous rocks are intruded into sedimentary rocks. Occurrence of coarse-grained granite at the surface at Rose dome has been interpreted as an igneous dike (Moore and Landes, 1937). A well drilled on the east flank of Rose dome penetrated igneous rocks, which were reported by Knight and Landes (1932) as "apparently an altered dike rock." Samples of a well south of Rose dome in sec. 19 were studied by Twenhofel and Bremer (1928, p. 758). They reported peridotite between 1,151 and 1,253 feet. "Silver City" is another area with geologic conditions unusual for Kansas. Very firmly cemented sandstone is underlain there by metamorphic sediments and basic igneous rock. The drillers log of the McGinns No. 1 Hill well, in the SW¼ SE¼ sec. 32, T. 26 S., R. 15 E. on the flank of the Silver City dome, records "red rock and mica," "shale and mica," and "mica" between depths of 775 and 840 feet. Core drilling has revealed a sill-like body of basic igneous rock at shallow depths.

Depths to some stratigraphic horizons reached in a well in sec. 10, T. 25 S., R. 15 E. are listed in Table 70.

TABLE 70.—*Depths to some stratigraphic horizons in the Reinhart and Donivan No. 1 Eades well, NW¼ NE¼ NE¼ sec. 10, T. 25 S., R. 15 E., Woodson County*

Horizon	Depth, feet
Base Fort Scott limestone	1,040
Top "Cattleman sand"	1,295
Top "chat"	1,426
Top Mississippian limestone	1,430
Top Chattanooga shale, base Mississippian	1,780
Top "Wilcox sand"	1,807
Top Simpson	1,819
Top Arbuckle limestone	1,827
Granite wash and quartzite (Pre-Cambrian)	2,590
Total depth	3,120

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Pennsylvanian rocks.—The Kansas City group has an average thickness of about 420 feet in Woodson County and consists chiefly of limestone and shale. Gas occurs near Neosho Falls in a porous zone in the Dennis limestone in the Kansas City group at a depth of about 325 feet. The Pleasanton shale consists chiefly of clayey and sandy shale and is about 120 feet thick in the county. The Marmaton rocks consist of alternating beds of shale, limestone, and sandstone; they are about 210 feet thick.

The Cherokee rocks in Woodson County have an average thickness of about 330 feet. They are composed chiefly of clayey and sandy shale, sandstone, and thin beds of limestone and coal. The "Bartlesville sand" lies in the upper middle part of the Cherokee, and thick lenses of sandstone occur near the base. The "Bartlesville" yields both gas and oil in the Iola-Humboldt area which extends into southeastern Woodson County from Allen County.

Mississippian rocks.—The total thickness of Mississippian limestones in Woodson County ranges from 250 to 350 feet (Lee, 1939, pl. 1). Formations present are the "Warsaw" limestone; the Keokuk limestone which is absent in the northeastern one-third of the county; the Burlington limestone; the Reeds Spring limestone; the St. Joe limestone which is absent in the northeastern corner of the county; the Sedalia limestone which is absent in the western and southwestern parts; the Northview shale; the Compton limestone; and the Chattanooga shale (Mississippian or Devonian). Oil is produced from a porous zone in the upper part of the Mississippian limestones in the Neosho Falls and Yates Center area, in the newly found Steele and other fields.

Ordovician and Cambrian rocks.—Woodson County lies on the Chautauqua arch; the Chattanooga shale lies on the Arbuckle limestone there. The thickness of Lower Ordovician and Upper Cambrian rocks in Woodson County is about 700 feet. These rocks are chiefly limestone and dolomite. Keroher and Kirby (1948) indicate thicknesses of Lower Ordovician and Upper Cambrian rocks in the county as follows: (1) the Jefferson City-Cotter sequence about 400 feet; (2) the Roubidoux dolomite about 100 feet; (3) the Van Buren-Gasconade sequence about 100 feet; (4) the Eminence dolomite, present only in the eastern part, ranging from a featheredge to about 25 feet; and (5) the Bonneterre about 100 feet. The Bonneterre dolomite probably lies on "granite wash" or Pre-Cambrian rocks in all parts of the county.

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Oil and Gas Developments

Most of the oil and gas pools that are known in Woodson County were discovered many years ago. A large amount of drilling was done in the county in 1919. In April of that year a well in the SW¼ sec. 22, T. 25 S., R. 15 E., which had come in at more than 5 million cubic feet of gas, started flowing oil at a rate estimated at more than 200 barrels daily. It is reported that at about that time 23 drilling machines were operating in the county.

The important Mississippian limestone **Neosho Falls** oil pool, however, was not found until 1928. Later exploration resulted in extending the **Quincy** field into Woodson from Greenwood County and the opening of the **Sheedy** field in 1932. The **Evans** oil field was opened in 1938, the **Silver City** in 1946, and the **Tichenor** gas field in 1947. More recent discoveries include the **Batesville Southwest,** a Lansing limestone pool, and the **Zlab,** a small Mississippian limestone pool in 1949; and the Mississippian limestone **Steele** pool in 1952.

The county's oil and gas fields, as defined by the Kansas Nomenclature Committee, are described briefly here.

Oil in the **Batesville** field is produced from the "Bartlesville sand." Probably the field should be regarded as joined with the **Quincy.** The pool was discovered in 1934 in T. 25 S., R. 14 E. No production was reported from the field in 1952.

The **Batesville Southwest** oil pool was found in 1949 in sec. 32, T. 25 S., R. 14 E. Oil was found in Lansing rocks in a zone between 677 and 692 feet. Initial daily production was reported as 6 barrels of oil. No sales of oil from the field have been recorded. At least 12 dry holes have been drilled in the vicinity, most of them previous to the discovery well.

The **Big Sandy** oil and gas field produces oil from the "Bartlesville sand" at a depth of about 1,230 feet. The top of Mississippian rocks in the area is reached at about 1,400 feet. The **Buffalo** oil and gas field extends from Wilson County into T. 26 S., R. 16 E. The producing formation is the "Bartlesville sand." The **Evans** oil field is in T. 23 S., R. 15 E. The discovery well was drilled in 1938. Production is from the upper part of the Mississippian limestone at a depth of about 1,540 feet.

In the **Halligan** oil field, now inactive, oil was produced from sandstone at a depth of about 770 feet. Logs of the wells are not

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available. The **Hoagland** field yields oil from the upper part of the Mississippian limestone at a depth of about 1,635 feet. Most of the wells in the field had initial daily productions of 30 or less barrels of oil. However, a well in sec. 2, T. 24 S., R. 14 E. was reported to have had an initial production of 135 barrels of oil per day.

The large **Humboldt-Chanute** oil and gas field extends into the southeastern part of Woodson County from Neosho County. Production is from the "Bartlesville sand." Logs of wells in the **"Keowen"** oil field, sec. 34, T. 24 S., R. 17 E., are not available. Small amounts of oil were reported produced in 1949 and 1950 (Table 73). The **Laidlow** oil field is inactive. Logs of the oil wells are not available. Production is reported to have been from the "first break" in the Mississippian limestone.

Oil is produced in the **Neosho Falls** field from the "first break" in the Mississippian limestone (Cowley formation) at an average depth of about 1,200 feet. The discovery well was drilled in sec. 31, T. 23

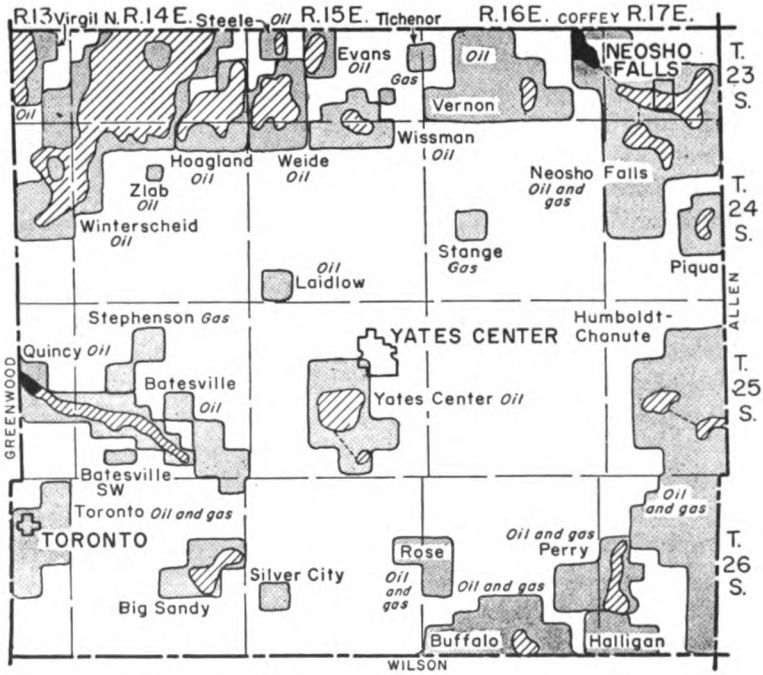

FIG. 58.—Map of Woodson County showing oil and gas fields as designated by the Kansas Nomenclature Committee. Diagonal lines show areas of 1952 oil production; secondary recovery projects are shown in black.

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S., R. 16 E. in 1928. The average initial daily production of wells has been about 20 barrels of oil. Daily production usually declines to about 10 barrels or less within the first year. Gas occurs in this area in a sandy zone in the Winterset limestone at a depth of about 325 feet. The accumulation of oil and gas seems to be controlled by changes in porosity and by structure. The field has been gradually extended and now reaches as far northeastward as sec. 26, T. 23 S., R. 17 E., Allen County. A secondary recovery project was started in the field in 1952.

Oil production for the first time in several years was reported from the **Perry** oil and gas field in 1950. Production is in T. 26 S., R. 17 E. (Fig. 58). Two new oil wells reported drilled in 1948 were rated at 15 barrels of oil per day from sandstone between 816 and 830 feet and 25 barrels of oil in sandstone between 828 and 852 feet. Seemingly records of recent developments in the area are not available.

The **Piqua** field perhaps should be regarded as a southeast extension of the **Neosho Falls** field. Production is from the upper part of the Mississippian limestone. Only 127 barrels of oil was reported from the field in 1952, dropping from nearly 3,000 barrels in 1949.

The Quincy is a shoestring oil pool that was extended into Woodson County from Greenwood County in 1932. The extension well had an initial production of about 100 barrels of oil per day from the "Bartlesville sand" at a depth of about 1,500 feet. A secondary recovery project was operating in the field in 1952.

In 1951 a "Bartlesville sand" well with production of about 12 barrels of oil daily was reported in the **Rose** field. It is the D. P. Oak No. 6 Mathies well, sec. 7, T. 26 S., R. 16 E. This well is of interest because it is in the Rose dome structural area where granite crops out and because it seemingly marks the discovery of oil in the immediate area. The field was named several years ago when gas was found in sec. 13, T. 26 S., R. 15 E., and in sec. 18, T. 26 S., R. 16 E. Oil production which was mentioned in some previous reports seemingly was based on misinformation. No commercial production has been recorded from the field.

The Silver City oil pool was discovered in 1946. The discovery well, in sec. 19, T. 26 S., R. 15 E., was reported as having initial production of 30 barrels of oil per day. The last oil production from the field is 30 barrels in 1950.

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The **Stange** pool was opened in T. 24 S., R. 16 E. in 1938. Initial daily production of 887 thousand cubic feet of gas was reported from Marmaton and Cherokee rocks. The **Steele,** a Mississippian limestone pool, was discovered in 1952 in sec. 20, T. 23 S., R. 15 E. The initial potential of the well was reported as 15 barrels of oil daily. Two additional oil wells were drilled in the field later in 1952. In the **Stephenson** field, in T. 25 S., R. 14 E., gas was found in the "Bartlesville sand" at a depth of about 1,425 feet.

The **Tichenor** gas pool was discovered early in 1947. The discovery well had a reported initial production from Mississippian rocks of 1 million cubic feet of gas per day. The **Toronto** oil and gas field extends from T. 26 S., R. 13 E. into Greenwood County. This is a "Bartlesville shoestring sand" pool. It formerly yielded much oil.

The **Vernon** field now produces oil from small areas. Oil production is from the upper part of the Mississippian limestone at a depth of about 1,420 feet. The **Virgil North** field extends into Greenwood and Coffey Counties. Production is from the "Bartlesville sand" and the upper part of the Mississippian limestone. The **Weide** oil field was opened in T. 23 S., R. 15 E. in 1937. Oil was found about 28 feet below the top of the Mississippian limestone at 1,571 feet. Initial production of the well was 30 barrels of oil per day.

The **Winterscheid** field covers a comparatively large area in the northwestern part of Woodson County. The field extends into Coffey County. No oil had been recorded from the **Wissman** field, sec. 3, T. 24 S., R. 15 E., for several years previous to 1949 (Jewett, 1949a, p. 295) but production was revived that year. Oil occurs there in the upper part of the Mississippian limestone at an average depth of about 1,520 feet.

Oil production in the **Yates Center** field is from the upper part of the Mississippian limestone at an average depth of about 1,480 feet. In 1949 a well in sec. 9, T. 24 S., R. 14 E., found a small amount of oil in upper Mississippian rocks at a depth of 1,655 feet. The area was named the **Zlab** field. However, it may be regarded as an extension of the **Winterscheid** field.

Recent activities.—Like other eastern Kansas counties Woodson County is an area of revived interest. Data on pool wells drilled from 1949 through 1952 are listed in Table 73. Production for these years is given also in Table 73.

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WYANDOTTE COUNTY

Gas was discovered in Wyandotte County soon after the first drilling for oil in Miami County. Comparatively small amounts of gas have been produced in the county for many years and a small amount of oil is reported to have been taken from several wells. The widespread occurrence of gas, mostly in modest quantities, is rather remarkable.

The geology of Wyandotte County was described by Jewett and Newell (1935). Their report includes a description of outcropping rocks and areal and structural geologic maps. The subsurface geology of Wyandotte and other northeastern Kansas counties was discussed by Ockerman (1935). More recent studies of the Forest City basin by Lee (1943) and by Lee and Payne (1944) are of interest in regard to oil and gas possibilities in the county. Studies of the ground water in the Kansas City area by Fishel (1948) are important to industrial developments of all kinds.

Reported gas production in Wyandotte County during 1951 and 1952 has been about 5 million cubic feet.

Geology

SURFACE ROCKS

Deposits of glacial drift in Wyandotte County are fairly thin and are scattered. However, much of the county is covered by deposits of loess—accumulations of clay and silt which are believed to have been deposited by wind. The trenches of Missouri and Kansas Rivers are partly filled with gravel, sand, and silt. The maximum thickness of valley-fill deposits is about 100 feet.

The outcropping consolidated rocks in Wyandotte County are of Pennsylvanian age. The youngest of these is the Tonganoxie sandstone member of the Stranger formation or possibly the Ireland sandstone in the Lawrence shale, and the oldest is the Bethany Falls limestone member of the Swope formation. The Tonganoxie sandstone, which comprises the basal part of the Douglas group, is the surface rock in the upland areas in the western part of Wyandotte County. It consists of sandstone and shale and commonly a limestone conglomerate in the basal part. The maximum thickness is about 30 feet. A regional disconformity separates the Tonganoxie sandstone from underlying rocks. A few feet of the Weston shale

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of the Pedee group is locally present in the county between the disconformity and the Stanton limestone, but in most of the area the sandstone or conglomerate lies on the Stanton limestone. Locally in the northwestern part of the county the disconformity cuts deeply into or through the Stanton formation.

The Lansing group in Wyandotte County is about 75 feet thick. The outcrops of the Stanton limestone in Wyandotte County are near the uplands capped by the Tonganoxie sandstone, but the Plattsburg limestone lies below a dip slope 5 miles or more in width in the north-central part of the county. Rocks of the Kansas City group are not entirely exposed in the county, but the thickness of the Zarah and Linn subgroups (Fig. 5) ranges from about 160 to 225 feet. The range in thickness is due to abrupt lateral changes, particularly in the shale units. Limestones that show abrupt lateral changes in lithology and to a lesser degree in thickness include especially the Farley limestone member of the Wyandotte formation and the Westerville limestone. The Dennis limestone, Galesburg shale, and most of the Swope limestone of the Bronson subgroup are exposed in a quarry about one-half mile east of Morris in the W½ sec. 27, T. 12 S., R. 24 E. These rocks are less prominent eastward along the valley wall of Kansas River.

SUBSURFACE ROCKS

Depths to some key horizons reached in a well in sec. 35, T. 10 S., R. 23 E. are listed in Table 70.

TABLE 71.—*Depths to some stratigraphic horizons in the Benson-Ruf-Gabrel well, NW cor. NE¼ sec. 35, T. 10 S., R. 23 E., Wyandotte County*

Horizon	Depth, feet
Top Lansing group	21
Top Kansas City group	108
Base Kansas City group	342
Top Marmaton limestone	480
Base Fort Scott limestone	588
Top "Squirrel sand"	720
Top Verdigris limestone	772
Top Mississippian limestone	1,020
Base Mississippian limestone	1,349
Top "Hunton" limestone	1,375
Total depth	1,428

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Pennsylvanian rocks.—The base of the Hertha limestone, which is the base of the Kansas City group, is a convenient datum horizon in Wyandotte County, as elsewhere in eastern Kansas. The average thickness of rocks between the Hertha limestone and the Mississippian rocks in Wyandotte County is about 700 feet.

Mississippian rocks.—The average total thickness of Mississippian limestone formations in Wyandotte County is about 450 feet (Lee, 1939, pl. 1). According to Lee and Payne (1944, figs. 12-17), the St. Louis limestone is the uppermost Mississippian limestone formation in the county. Lee's studies (1943, fig. 14) of wells in Wyandotte and surrounding counties indicate that the maximum thickness of the Chattanooga shale in the county is slightly more than 50 feet and that the thickness decreases to the east.

Devonian rocks.—Lee (1943, fig. 7, pp. 53, 55) concluded that Devonian limestone underlies all parts of Wyandotte County. He identified 36 feet of Cooper and undifferentiated limestone in the McCain No. 1 Doane well, in sec. 34, T. 12 S., R. 22 E., Johnson County, about 11 miles southwest of the southwest corner of Wyandotte County. Lee (1943, p. 53) points out that about 200 feet of Devonian limestone is present in Clay and Platte Counties, Missouri.

Ordovician and Cambrian rocks.—Silurian and Upper Ordovician rocks (Maquoketa shale and some older beds) are believed to be absent in Wyandotte County (Lee, 1943, figs. 6, 11, 13). The uppermost Ordovician rock in the county is believed to be the Kimmswick (Viola) limestone. Its maximum thickness is probably about 100 feet. A few feet of Decorah and Plattin limestones is probably present in all parts of the county. The St. Peter sandstone probably is less than 100 feet thick in the county. According to Lee (1943, fig. 9), the thickness of rocks between the top of the St. Peter sandstone and the top of Pre-Cambrian rocks in Wyandotte County ranges from slightly less than 800 feet to slightly more than 900 feet. The thickness of rocks between the top of the Roubidoux formation and the top of the Lamotte sandstone ranges from slightly more than 600 feet to more than 700 feet (Lee, 1943, fig. 10). Formations older than the St. Peter sandstone in Wyandotte County are believed to include Cotter and Jefferson City dolomites, Roubidoux formation, Gasconade and Van Buren dolomites, Gunter sandstone, Eminence dolomite, Potosi dolomite (?), Bonneterre dolomite, and Lamotte sandstone.

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Oil and Gas Developments

Gas was discovered in Wyandotte County soon after the first drilling for oil in Miami County. The first wells were within the present Kansas City area. For many years small amounts of gas have been produced in several areas (Jewett and Abernathy, 1945, pp. 237-238). Shows and small amounts of oil have been reported in several Pennsylvanian sandstones in Wyandotte County. In 1904, a well drilled near Argentine is said to have produced about 1 barrel of oil in 24 hours from a depth of 139 feet. About 25 years ago a small amount of oil was produced from a well in the SE¼ sec. 1, T. 11 S., R. 23 E.; and several years ago some oil was reported to have been bailed from the "Peru sand" and used as fuel when a well in sec. 33, T. 10 S., R. 23 E. was being drilled. Late in 1948 a well in the same section was reported to be yielding oil. A well in sec. 20, T. 11 S., R. 23 E. is reported to have come in, in 1916, at about 95 barrels of oil per day.

In Wyandotte County there are several gas fields that are abandoned except for a few wells that supply gas for local use (Fig. 59). The **Fairfax** field, which was in the present Fairfax industrial dis-

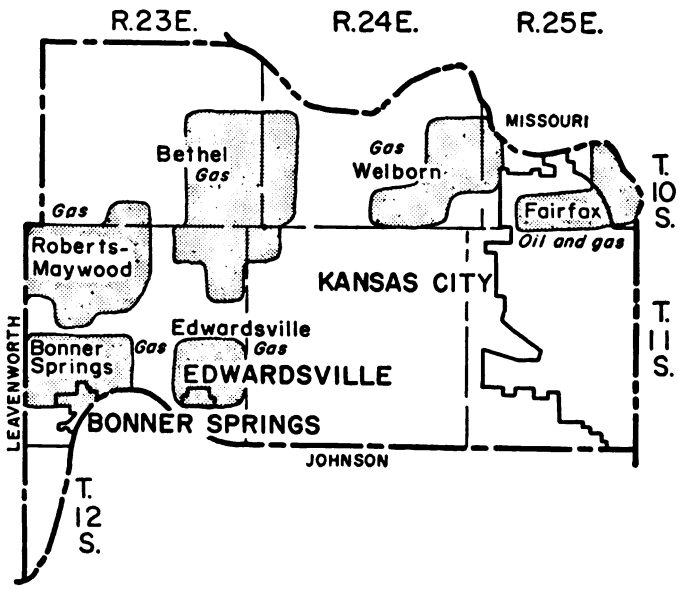

Fig. 59.—Map of Wyandotte County showing oil and gas fields as designated by the Kansas Nomenclature Committee.

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trict and airport of Kansas City, was opened in 1931. There were about 40 wells, some of which had initial daily productions as high as 2 million cubic feet. The average was slightly less than 1 million. Gas in this field was found in a zone 225 to 275 feet below the land surface, and in the "Peru sand" at a depth of 350 to 400 feet. The "Peru" has an average thickness of about 30 feet. Some years ago the **Bethel** field contained 60 or more producing gas wells. Marmaton rocks and the "Squirrel sand" were the reservoir rocks.

The **Roberts-Maywood** area in the west-central part is now the most important gas-producing area in the county. Production is from a Marmaton sandstone, locally called "Peru," and the "Squirrel sand." The **Bonner Springs, Edwardsville,** and **Welborn** fields now are not producing commercially.

Data on Wyandotte County wells, records of which are in the Geological Survey files, are listed in Table 72. The amount of widespread shallow gas that has been found in the county is rather amazing. It is believed that the data listed in the table, and on the well logs, are of value in planning future operations. It is expectable that underground storage may be feasible in some places.

TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County*

Name of well	Location	Year completed	Total depth, feet	Remarks
..... No. 1 Wiehe	Cen. SW 7-10-23E	?	1,100	Stopped in lower part of Cherokee sh.
Judd et al. No. 1 Vering	SE NE SW 11-10-23E	1931	816	
De Groat et al. No. 1 Gustafson	NE NW SW 13-10-23E	1931	470	
Charles T. Judd No. 1 Hartig	NE NW 14-10-23E	1930	550	
George Bennett No. 1 Bennett	SW SE 17-10-23E	1951	600	Gas show 555–560 ft.; oil show 560–570 ft.
..... No. 1 Orchard	SW NW NW 17-10-23E	?	1,067	Show of gas 1,016–1,019 ft; stopped in Cherokee sh.
Dr. Frances Roark, et al. No. 1 Vining	SW NW NW 17-10-23E	1929	1,055	
Hazlett et al. No. 1 Vining	NE SE NE 20-10-23E	1930	758	
R. P. Roark No. 2 Hewitt	SE SE 22-10-23E	?	705	
Hewitt No..... Rourk	SE SE SE 22-10-23E	?	880	

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
Ruf et al. No. 1 Belshe	SE SE SE 23-10-23E	1931	637	
Ruf et al. No. 2 Belche	SE SE SE 23-10-23E	1931	632½	
Ruf Drlg. Co. No. 3 Mrs. Belche	SE SE SE 23-10-23E	1932	850	
Paul Ruf No. 1 Mrs. B. A. Jackson	SW SE 24-10-23E	1930	500	Show of oil 400–403 ft.; gas 416–419 ft.; gas 463–466 ft.; gas 470–500 ft.
Paul Ruf No. 1 Doc Mailer	SE SE SE 24-10-23E	1930	625	
Paul Ruf No. 1 Wahlin Estate	NW SW SE 24-10-23E	1930	765?	150 M cu. ft. gas
Paul Ruf No. 2 Wahlin Estate	SE SE SW 24-10-23E	1930	641	1,000 M cu. ft. gas
Paul Ruf No. 3 Wahlin Estate	SW SW SE 24-10-23E	1930	530	1,438 M cu. ft. gas
Paul Ruf No. 4 Wahlin Estate	SW SE SW 24-10-23E	1930	583½	¾M cu. ft. gas
Ruf Brothers No. 5 Wahlin	NE SW 24-10-23E	1931	750	Gas well
Ruf Drlg. Co. No. 1 Winters Estate	SW SW SW 24-10-23E	1931	647	500 M cu. ft. gas
Ruf Drlg. Co. No. 2 Winters Estate	NW SW SW 24-10-23E	1931	618	Tools lost in well, plugged and abd.
..... No. 1 Bellamy	NW SE SE 25-10-23E	1920(?)	420	
Bellamy No. 3 Bellamy	S½ SE 25-10-23E	1930	600	50 M cu. ft. gas 166–169 ft.; show of gas 186–188 ft.; gas 397–405 ft.; gas 418–422 ft.; show of gas 499–505 ft.; listed dry and abd.
A. E. Judd No. 1 (3) G. Bellamy	SE NW SE 25-10-23	1930	633	
Paul Ruf No. 1 Bellamy	SW SE SE 25-10-23E	1930	515	Show of oil & gas 402–410 ft.; gas 490–515 ft.; 175 M cu. ft. gas well
Ruf et al. No. 1 Bellamy	SW SE SW 25-10-23E	1931	571	Dry and abd.
Ruf Drlg. Company No. 3 G. Bellamy	SW NE 25-10-23E	1932	825	Dry hole
C. H. Brunker No. 1 Brunker	NW NW SW 25-10-23E	1930	655	150 M cu. ft. gas well
Brunker et al. No. 3 Brunker	SW SW SW 25-10-23E	1931	605	431 M cu. ft. gas well
Brunker et al. No. 4 Brunker	SE SW SW 25-10-23E	1931	595	597 M cu. ft. gas well
Judd et al. No. 4 Brunker	NW NW SW 25-10-23E	1930	655	120 M cu. ft. gas well
Paul Ruf No. 1 Brunker	SW SW NW 25-10-23E	1930	640	431 M cu. ft. gas well

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Paul Ruf No. 2 Brunker	NE SE NW 25-10-23E	1930	782	200 M cu. ft. gas in "Peru sand" 538–550 feet; 30M cu. ft. gas 724–727 feet; abd.
Paul Ruf No. 3 Brunker	SW NW SW 25-10-23E	1930	660	78 M cu. ft. gas well
Ruf Drlg. Co. No. 3 Brunker	SW NW NW 25-10-23E	1931	631½	1,571 M cu. ft. gas well
Ruf Drlg. Co. No. 4 Brunker	NE SW NW 25-10-23E	1931	627	1,400 M cu. ft. gas well
Judd et al. No. 1 Courtney	NW SW NE 25-10-23E	1930	645	Show of gas 335–337 ft.; gas 532–538 ft.; show of gas 576–582 ft.; dry
Chas. T. Judd No. 2 Courtney	NW NW NE 25-10-23E	1930	587	175 M cu. ft. gas well
Chas. T. Judd No. 1 Jaggard	NW NE NE 25-10-23E	1930	532	150 M cu. ft. gas well (estimated)
Benson et al. No. 1 John Winters Estate	E½ NW NW 25-10-23E	1945	1,200	Dry hole
Chas. T. Judd No. 1 Winters	NE NE NW 25-10-23E	1930	538	1,691 M cu. ft. gas well
Chas. T. Judd No. 2 Winters	NW NE NW 25-10-23E	1930	610	800 M cu. ft. gas well
Judd et al. No. 3 Winters	NE NE NW 25-10-23E	1931	591	1,320 M cu. ft. gas in "Squirrel sand"; 78 M cu. ft. gas in "Peru sand".
Chas. T. Judd Co. No. 4 Winters	SW NW NW 25-10-23E	1931	636½	1,500 M cu. ft. gas well
Chas. T. Judd No. 1 Blankenship	SE SW SW 26-10-23E	1930	485	1,088 M cu. ft. gas well
Chas. T. Judd No. 2 Blankenship	NE SW SW 26-10-23E	1930	600	Dry hole
Judd et al. No. 4 Blankenship	SW 26-10-23E	1931	740	Dry hole
Brunker & Patrick No. 1 C. H. Brunker	NE NE NE 26-10-23E	1931	640	1,640 M cu. ft. gas well
Brunker et al. No. 2 Brunker	NE NW NE 26-10-23E	1931	578	2,200 M cu. ft. gas well
Juranich No. 1 Fee	SE SW NE 26-10-23E	1931	613	Gas well
Chas. T. Judd No. 1 Gress	SW SW SE 26-10-23E	1930	590	554 M cu. ft. gas well
Chas. T. Judd No. 2 J. Gress	NW NW NW ? 26-10-23E	1931	613	700 M cu. ft. gas well
Kirk & Abrahams No. 1 Haff	SE SE SE 26-10-23E	1931	623	962 M cu. ft. gas well
Ruf Drlg. Co. No. 1 Frank Haff	SW SE SE 26-10-23E	1931	650	Abd.; small gas well
Chas. T. Judd No. 1 John Haff	NW SE SE 26-10-23E	1930	670	62 M cu. ft. gas well
Chas. T. Judd No. 2 John Haff	SE SE 26-10-23E	1931	653	277 M cu. ft. gas well
Chas. T. Judd No. 1 Mike Haff	NE NE SE 26-10-23E	1930	602½	554 M cu. ft. gas well
Judd & Campbell No. 2 Mike Haff	NW NE SE 26-10-23E	1931	583	681 M cu. ft. gas well

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
Chas. Judd No. 1 Ingram	NE SE NE 26-10-23E	1930	563	1,200 M cu. ft. gas well
Chas. Judd No. 2 Ingram	SE NE NE 26-10-23E	1931	588	1,100 M cu. ft. gas well
Judd Drlg. Co. No. 3 Ingram	SW NE NE 26-10-23E	1931	612	800 M cu. ft. gas well (estimated)
Judd No. 4 O. Ingram	NE SW NE 26-10-23E	1931	585	1,470 M cu. ft. gas well
Lindsey et al. No. 1 Jaccard	SE NE SW 26-10-23E	1931	607	600 M cu. ft. gas well (estimated)
Messler et al. No. 2 Jaccard	NE SW 26-10-23E	?	505	600 M cu. ft. gas well
Messler et al. No. 6 Jaccard	NE SE SW 26-10-23E	?	623	250 M cu. ft. gas well
Jaranick No. 2 Jaranick	SW SE NE(?) 26-10-23E	1931	593	1,039 M cu. ft. gas well
Chas. T. Judd No. 1 Annie Mallott	SW NE SE 26-10-23E	1930	645	Dry hole
Judd et al. No. 1 Randall	SE NW NW 26-10-23E	1931	524	400 M cu. ft. gas well
Judd Drlg. Co. No. 1 Blankenship	SE SE SE 27-10-23E	1931	635	43 M cu. ft. gas well
Messler et al. No. 1 Blankenship	SW SW SW 30-10-23E	1930	645	Dry hole
C. B. Smith No. 1 Dunlap	NW NW SW 31-10-23E	1939	675	Dry hole
Pine No. 1 Holyfield	SW SW SW 33-10-23E	?	720	Small gas well
Mahafee No. 2 Mahafee	SW SW 33-10-23E	1947	579	Gas well (?)
Archie Newland No. 1 Piper	SW SE NE 33-10-23E	1944	702	Dry hole (?)
Newland & Gross No. 1 Wise	SW SE NW 33-10-23E	?	555	25 M cu. ft. gas 605–607; dry
Hazlett et al. No. 1 Adams	SW SW SE 34-10-23E	1931	725	Dry hole
Quindaro Gas Company No. 2 Ditzen	SW NE NE 34-10-23E	1931	651	Dry hole
Kirk & Abrahams No. 1 Mendenhall	NE SE SE 34-10-23E	1930	698	Dry hole
Messler et al. No. 1 Albang	NW SW NW 35-10-23E	1930	551	Gas well
Messler et al. No. 2 Albang	SW SE NW 35-10-23E	1930	581	150 M cu. ft. gas well
Messler, Kirk et al. No. 3 Albang	NW SE NW 35-10-23E	1930	625	431 M cu. ft. gas well
Brown et al. No. 1 Brown	NW NW SE 35-10-23E	1931	680	492 M cu. ft. gas well
Brown & J. T. Patrick No. 1 Brown	NW SW SE 35-10-23E	1930	578	Gas well

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Cirrese No. 1 Cunningham	NE SE 35-10-23E	1931	667½	Very small gas well
Quindaro Gas Co. No. 1 Ditzen	NW NW NW 35-10-23E	1930	651½	554 M cu. ft. gas well
Benson-Ruf-Gabrel No. 1 Falk	NW NW NE 35-10-23E	1945	1,428	See Table 71 for stratigraphic data
Ruf Drlg. Co. No. 1 Joe Falk	NW NW NE 35-10-23E	1936	872	Dry hole
Ruf Drlg. Co. No. 4 Falk	NE NE NE 35-10-23E	1931	669	786 M cu. ft. gas well
Ruf Drlg. Co. No. 5 Falk	NE SE NE 35-10-23E	1931	600	170 M cu. ft. gas well
Ruf Drlg. Co. No. 6 Falk	NW NE NE 35-10-23E	1931	675½	600 M cu. ft. gas well
Ruf Drlg. Co. No. 7 H. Falk	SW SW NE 35-10-23E	1931	885	Dry hole
Ruf Drlg. Co. No. 8 Falk	SW NE NE 35-10-23E	1931	675	138 M cu. ft. gas well
Ruff Brothers No. 1 Faulk	NW NW NE 35-10-23E	1930	613	1,272 M cu. ft. gas well
Ruff Brothers No. 2 Faulk	NE SW SE 35-10-23E	1930	640	554 M cu. ft. gas well
W. C. Rickel No. 2 Fee	NE NW SW 35-10-23E	1930	710	200 M cu. ft. gas well
Lindsley et al. No. 1 Flint	SE SW SE 35-10-23E	1931	658	500 M cu. ft. gas well
Messler et al. No. 1 Jaccard	NE NW NW 35-10-23E	1930	476	500 M cu. ft. gas well
Messler et al. No. 2 Jaccard	NE NW NW 35-10-23E	?	535	3 M cu. ft. gas well (estimates)
Messler et al. No. 3 Jaccard	NE NW NW 35-10-23E	1930	483	1,500 M cu. ft. gas well
Messler et al. No. 4 Jaccard	NW NW 35-10-23E	1930	496	1,000 M cu. ft. gas well
Messler et al. No. 5 Jaccard	SE NW NW 35-10-23E	1930	624	300 M cu. ft. gas well
Midwest Oil Company No. 1 Lavin	SW SW 35-10-23E	1930	697	Dry hole
Ruf Drlg. Co. No. 1 Wm. Northern	SE NE NW 35-10-23E	1930	658	Dry
Deepened		1936	851	1,180 M cu. ft. gas well
Ruf Drlg. Co. No. 2 Wm. Northern	NE NE NW 35-10-23E	1931 Deepening record	655	Dry hole
R. A. Barton et al. No. 1 A. W. Porter	SE NE SE 35-10-23E	1930	993	Dry hole
Kirk et al. No. 2 Rickel	NE NE SW 35-10-23E	1930	667	250 M cu. ft. gas well
F. E. Messler et al. No. 1 Roberts	NW SW NW 35-10-23E	1930	577	Gas well
Messler et al. No. 2 Roberts	NE SE 35-10-23E	1930	671½	Gas well
Messler et al. No. 1 Sexton	SW SW SE 35-10-23E	1930	590	Gas well
Messler et al. No. 1 Stanley	NE SE SW 35-10-23E	1930	705	Gas well

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
Kirk & Abrahams No. 1 Baker	NE NW NW 36-10-23E	1931	611	554 M cu. ft. gas well
Messler et al. No. 1 Burrichter	SW NW 36-10-23E	1930	582	Gas well
R. A. Barton, Hazlett, et al. No. 1 B. F. Daniels	SW SW NW 36-10-23E	1930	696	170 M cu. ft. gas well
Messler et al. No. 2 Gress	NW NE NW 36-10-23E	?	552	Gas well, oil show 550–552 ft.
Messler et al. No. 1 Mangrun	SW NW 36-10-23E	1930	638	554 M cu. ft. gas well
Kirk & Abrahams No. 1 Sass	SE SW SW 36-10-23E	1930	649	Dry hole
Blair & Smith No. 1 Snyder	SW SW NE 36-10-23E	1931	815	Dry hole
Blair & Smith No. 2 Snyder	SE SE NE 36-10-23E	?	610	40 M cu. ft. gas well
Kirk et al. No. 1 Voland	NW NW 36-10-23E	1931	600	138 M cu. ft. gas well
J. H. O'Rear No. 1 Walker	NW NW NW 36-10-23E	1930	621	800 M cu. ft. gas well
Paul Ruf No. 1 Zellar Brothers	SE NE 36-10-23E	1930	537	35 M cu. ft. gas well
Beckman No. 1	15-10-24E	?	434	
Beckman No. 2	15-10-24E	?	434	
Barcus No. 1 Fee	NW SW 18-10-24E	1945	860	Top Mississippian, 858 ft.
Ruf & Sons No. 11 Loma Vista	NW SW SE 18-10-24E	1933	571	Dry hole
Newburg No. 1 Loma Vista	NW NE 19-10-24E	1931	470	Dry hole
Newburg No. 2 Loma Vista	NW NW 19-10-24E	1931	565	Dry hole
Ruf Brothers No. 1 Loma Vista Ranch	NE NE SW 19-10-24E	1932	350	248 M cu. ft. gas well
Ruf Brothers No. 2 Loma Vista Ranch	NE NE SW 19-10-24E	1932	445	219 M cu. ft. gas well
Ruf Brothers No. 3 Loma Vista Ranch	SW NW SE 19-10-24E	1932	702	Dry hole
Ruf Brothers No. 4 Loma Vista Ranch	SW NE SE 19-10-24E	1932	475	850 M cu. ft. gas well
Ruf Brothers No. 5 Loma Vista Ranch	SW NE NE 19-10-24E	1932	582	Dry hole
Ruf Brothers No. 6 Loma Vista Ranch	SE SW NE 19-10-24E	1932	392½	1,000 M cu. ft. gas well
Ruf Brothers No. 7 Loma Vista Ranch	SW SE NE 19-10-24E	1932	500	Dry hole
Ruf Brothers No. 8 Loma Vista	NE SW NE 19-10-24E	1932	455	Dry hole

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Ruf Brothers No. 9 Loma Vista Ranch	SW NE SW 19-10-24E	1932	445	450 M cu. ft. gas well
Ruf Drlg. Co. No. 10 Loma Vista	19-10-24E	1933	637½	Dry hole
Brush & Missouri Kansas Pipe Line Co. No. 1 Tough	20-10-24E	1930(?)	697	Dry hole
Missouri Kansas Gas Co. No. 1 Barker	21-10-24E	?	608	Dry hole
Brusha et al. No. 1 Carl A. Reader	SE SE 23-10-24E	1930	476	Dry hole
Hazlett, Decker, Wells No. 1 Atlas Powder Co.	SE SE SE 24-10-24E	1931	446	431 M cu. ft. gas well
Hazlett, Decker, Wells No. 2 Atlas Powder Co.	SE SE 24-10-24E	1931	457	554 M cu. ft. gas well
Hazlett, Decker, Wells No. 3 Atlas Powder Co.	SE SE 24-10-24E	1931	385	544 M cu. ft. gas well
Hazlett, Decker, Wells No. 4 Atlas Powder Co.	NE NW SE 24-10-24E	1931	765	Dry hole
Quindaro Oil & Gas Co. No. 1 Geib	SE NW 24-10-24E	1931	435	Dry hole
Todd et al. No. 1 Harrison & Banks	NE NE SW 24-10-24E	1930	410	250 M cu. ft. gas well (estimated)
Quindaro Gas Co. No. 1 Misler	SE NE 24-10-24E	1930	349	Gas well
Cannon et al. No. 1 Sorter	SW NE SE 24-10-24E	1931	770	Dry hole
Brusha et al. No. 1 Cutler	SW SE 25-10-24E	1930	500	Dry hole
Quindaro Gas Co. No. 1 Hibbler	SW NE NE 25-10-24E	1930	522	554 M cu. ft. gas well
Quindaro Gas Co. No. 2 Hibbler	NW NE NE 25-10-24E	1930	461	500 M cu. ft. gas well
Quindaro Gas Co. No. 1 Joe Lisac	NE NE NE 25-10-24E	1930	484	900 M cu. ft. gas well
Quindaro Gas Co. No. 2 Joe Lisac	SE NE NE 25-10-24E	1930	471	900 M cu. ft. gas well
Quindaro Gas Co. No. 1 Jno. Stype	NW NE 25-10-24E	1930	538	300 M cu. ft. gas well
Stevenson & Budy No. 1 Budy	SW SE 26-10-24E	1931	494	Dry hole
Newland Drlg. Co. No. 1 Gilbert	SW SE 28-10-24E	1931	794	Dry hole
Bradford & Gates Develop. Co. No. 1 Malott	SW SE 29-10-24E	1930	680	Dry hole
Bradford-Gates Develop. Co. No. 1 Boydston	S½ NE SW 30-10-24E	1930	270	Gas well
Bradford No. 1 Campbell	SE SW 30-10-24E	1932	580	Gas well
Bradford No. 1 Griffith	SW SE 30-10-24E	?	615	494 M cu. ft. gas well
L. M. Williams No. 1 Hinman	SW SW SE 30-10-24E	1931	655	Dry hole
L. M. Williams & Co. No. 2 Hinman	NW SW SE 30-10-24E	1931	637	437 M cu. ft. gas well
Lindsey et al. No. 1 Meek	NE NE SE 30-10-24E	1932	640	Dry hole

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
Bradford & Gates No. 1 Geo. Sass, Jr.	NW NW SW 30-10-24E	1930	508	Dry hole
Graham & Kelley No. 1 Sass	SW SE 30-10-24E	1932	590	962 M cu. ft. gas well
Kelley et al. No. 2 Sass	SE SW 30-10-24E	?	593	430 M cu. ft. gas well
Bradford & Gates Develop. Co. No. 1 Stermolie	SE NE SW 30-10-24E	1930	270	170 M cu. ft. gas well
A. E. Judd No. 1 Warner	SE SE NW 30-10-24E	1930	642	100 M cu. ft gas 516 ft.; well abd.
Paul Ruf No. 1 Harold Bellamy	NW NW NW 31-10-24E	1930	570	100 M cu. ft. gas well
Ruf et al. No. 1 Braeckleine	NE NE NW 31-10-24E	1936	861	Dry hole
L. M. Williams & Co. No. 1 Braechline	SE NW 31-10-24E	1931	610	497 M cu. ft. gas well
L. M. Williams & Co. No. 1 Drashwich	SE SW SW 31-10-24E	1931	440	481 M cu. ft. gas well
Baker et al. No. 1 Ellstum	SE NE NW 31-10-24E	1930	544	498 M cu. ft. gas well
Roper et al. No. 1 Fee	SW NE SW 31-10-24E	1943	610	200 M cu. ft. gas well
L. M. Williams & Co. No. 1 R. E. Hamilton	SE SE SW 31-10-24E	1931	395	248 M cu. ft. gas well
L. M. Williams & Co. No. 1 Hovey Estate	SE SE SW 31-10-24E	1931	605	Dry hole
L. M. Williams & Co. No. 1 Hubbard	NW SE NW 31-10-24E	1931	636½	Gas well
Reed No. 1 Reed	SW NW NE 31-10-24E	1932	560	431 M cu. ft. gas well
L. M. Williams & Co. No. 1 Roper	NW SW SW 31-10-24E	1931	643	300 M cu. ft. gas well
L. M. Williams & Co. No. 1 Stockhoff	NE SW 31-10-24E	1931	418	540 M cu. ft. gas well
L. M. Williams & Co. No. 2 Stockhoff	NE SW 31-10-24E	1931	580	Dry hole
Smith & Blair No. 1 Alan Thompson	NW SE NW 31-10-24E	1931	599	169 M cu. ft. gas well
Judd et al. No. 1 Collins	SW SW NE 32-10-24E	1930	600	Dry hole
Western States Co. No. 1 Powers	SW SW 33-10-24E	1932	544	Dry hole
Western States Co., Inc. No. 1 Hartman Deepened by Ruff Drlg. Co.	SW SW SW 34-10-24E	1932 1937	522 822	521 M cu. ft. gas well Dry
J. F. Pigg & Co. No. 1 Oscar Mahoney	SE SW SW 34-10-24E	1932	529	516 M cu. ft. gas well
Mid West Oil Co. No. 1 Budy	NE SE SW 35-10-24E	1930	438	116 M cu. ft. gas well

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Mid West Oil Co. No. 1 Filling Station	SE SE SW 35-10-24E	1930	525	Gas well
Marion Imes No. 1 Marion Imes	NE NE NW 35-10-24E	1930	490	Dry hole
..... No. 2 Perry	SW NE SW 35-10-24E	1930	487½	Dry hole
Armentrout No..... Roark	SW NW SW 35-10-24E	1931	795	Dry hole
Wynne Oil Co. No. 1 Malone	NE NE SW 36-10-24E	1930	614	Dry hole
Shondall & Hickey No. 1 John Barnett	SW SE SW 19-10-25E	1930	385	Dry hole
Shondall & Hickey No. 2 John Barnett	NE NE SW 19-10-25E	1930	360	500 M cu. ft. gas (estimated)
Dove et al. No. 1 A. L. Fisher	SW SW NW 19-10-25E	?	371	20 M cu. ft. gas 231–243 ft., 486 M cu. ft. gas 333–335 ft.
Shondall & Hickey No. 1 Kansas City, Kansas Pest House	NW SW SW 19-10-25E	1930	460	554 M cu. ft. gas well
Shondall & Hickey No. 2 Kansas City, Kansas Pest House	SW SW SW 19-10-25E	1930	459	750 M cu. ft. gas well (estimated)
Shondall & Hickey No. 3 Kansas City, Kansas Pest House	SE SW SW 19-10-25E	1930	460	Dry hole
Todd & Cannon et al. No. 1 Sorter	SW NW SW 19-10-25E	1930	343	962 M cu. ft. gas well
Fairfax Air Port No. 8 Fairfax	NW NW 26-10-25E	1929	376	1,360 M cu. ft. gas well
Fairfax Air Port No. 9 Fairfax	NW NW SW 26-10-25E	1929	522	Dry hole
Fairfax Air Port No. 10 Fairfax	SW NW NW 26-10-25E	1929	378	1,060 M cu. ft. gas well
Fairfax Air Port No. 11 Fairfax	SW SW NW 26-10-25E	1929	385	65 M cu. ft. gas well
Fairfax Air Port No. 12 Fairfax	SW NW 26-10-25E	1929	371	475 M cu. ft. gas well
Fairfax Air Port No. 13 Fairfax	NW NW SW 26-10-25E	1929	375	Dry hole
Fairfax Air Port No. 14 Fairfax	NE SE SW 26-10-25E	1929	383	Dry hole
H. S. Clark & Son No..... H. H. Clark	On Goose Island, Missouri River, 27-10-25E	1889	815	
Fairfax Air Port No. 1 Fairfax	Cen. NE¼ 27-10-25E	1929	370	1,736 M cu. ft. gas well
Fairfax Air Port No. 2 Fairfax	SE NE 27-10-25E	1929	390	700 M cu. ft. gas well
Fairfax Air Port No. 3 Fairfax	S½ NE 27-10-25E	1929	390	1,000 M cu. ft. gas well
Fairfax Air Port No. 4 Fairfax	NW SE NE 27-10-25E	1929	363	2,200 M cu. ft. gas well
Fairfax Air Port No. 5 Fairfax	N½ NE 27-10-25E	1929	370	2,069 M cu. ft. gas well
Fairfax Air Port No. 6 Fairfax	SE NE NE 27-10-25E	1929	370	1,243 M cu. ft. gas well

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
Fairfax Air Port No. 7 Fairfax	SE NE NE 27-10-25E	1929	376	1,500 M cu. ft. gas well
Fairfax Air Port No. 15 Fairfax	CSL SE 27-10-25E	1929	555	1,100 M cu. ft. gas well
Fairfax Air Port No. 16 Fairfax	SE SE NE 27-10-25E	1929	385	990 M cu. ft. gas well
Fairfax Air Port No. 17 Fairfax	NW NW NE 27-10-25E	1929	367	1,211 M cu. ft. gas well
Fairfax Air Port No. 18 Fairfax	NW NW NE 27-10-25E	1929	367	1,108 M cu. ft. gas well
Fairfax Air Port No. 19 Fairfax	NW NW NE 27-10-25E	1929	365	2,278 M cu. ft. gas well
Wilson et al. No. 20 Airport	NW NE NE 27-10-25E	1945?	264	Dry hole
American Eagle Aircraft Corp. No. 1 Porterfield	SE SE 27-10-25E	1929	590	Dry hole
Kansas City Industrial Land Co. No. 6 U. P.	NW NW NE 27-10-25E	1928	362	892 M cu. ft. gas well
Kansas City Industrial Land Co. No. 8 U. P.	SW SW SE 27-10-25E	1928	425	Dry hole
Kansas City Industrial Land Co. No. 9 U. P.	SE SE NW 27-10-25E	1928	541	231 M cu. ft. gas well
Kansas City Industrial Land Co. No. 10 U. P.	SE NW NW 27-10-25E	1929	387	666 M cu. ft. gas well
Kansas City Industrial Land Co. No. 11 U.P.	NW NE NW 27-10-25E	1929	369	1,242 M cu. ft. gas well
Kansas City Industrial Land Co. No. 12 U. P.	SE NE NW 27-10-25E	1929	385	398 M cu. ft. gas well
Kansas City Industrial Land Co. No. 13 U. P.	SW NW NW 27-10-25E	1929	550	17 M cu. ft. gas well
Kansas City Industrial Land Co. No. 14 U. P.	SW SW NE 27-10-25E	1929	390	879 M cu. ft. gas well
Kansas City Industrial Land Co. No. 15 U. P.	SE SE NW 27-10-25E	1929	550	73 M cu. ft. gas well
Kansas City Industrial Land Co. No. 16 U. P.	NW SW NE 27-10-25E	1929	385	1,130 M cu. ft. gas well
Kansas City Industrial Land Co. No. 17 U. P.	NE SE NW 27-10-25E	1929	385	444 M cu. ft. gas well
Kansas City Industrial Land Co. No. 18 U. P.	NW SE NW 27-10-25E	1929	385	527 M cu. ft. gas well
Kansas City Industrial Land Co. No. 19 U. P.	NE SW NW 27-10-25E	1929	385	428 M cu. ft. gas well
Kansas City Industrial Land Co. No. 20 U. P.	NE NE NW 27-10-25E	1929	368	1,175 M cu. ft. gas well
Kansas City Industrial Land Co. No. 21 U. P.	SW SW NW 27-10-25E	1929	385	377 M cu. ft. gas well
Kansas City Industrial Land Co. No. 22 U. P.	SW SW NW 27-10-25E	1929	400	Dry hole

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Kansas City Industrial Land Co. No. 23 U. P.	SW SE NW 27-10-25E	1929	385	42 M cu. ft. gas well
Kansas City Industrial Land Co. No. 27 Fairfax District	SW SW SE 28-10-25E	?	570	Dry hole
..... No..... Michael Cudahy	Cen. SW¼ 28-10-25E	1906	800	1,000 M cu. ft. gas well
Kansas City Industrial Land Co. No. 7 U. P.	NE SE NE 28-10-25E	1928	400	Oil well, 4 bbls. of oil per day
Kansas City Industrial Land Co. No. 24 U. P.	SE NE NE 28-10-25E	1929	415	Oil well, 5 bbls. of oil per day
Kansas City Industrial Land Co. No. 25 U. P.	SE NE NE 28-10-25E	1929	400	Dry hole
Kansas City Industrial Land Co. No. 1 Kansas City Kansas Waterworks	SE SE NE 29-10-25E	1929	370	Dry hole
..... No. 2 Kansas City, Kansas Waterworks	29-10-25E	1929	600	Dry hole (?)
.....	32-10-25E	1931	647	150 M cu. ft. gas well
..... No..... Garvey	(1228 Greeley St.) 32-10-25E	1932	636	Gas well
Midland Gas Co. No. 1 Ruisinger	NE NE SE 32-10-25E	1935	684	Gas well (?)
..... No. 3 Spurgen	(On Waverly Avenue between 12 & 13 Sts.)32-10-25E	1931	682	Gas well (?)
..... No. 5.....	(13th & Cleveland)32-10-25E	1932	658	Dry hole (?)
..... No..... Austin	(12th and Stewart) 33-10-25E	1931	647	Gas well (?)
Kansas City Industrial Land Co. No. 28.....	NW NW NE 33-10-25E	1930	425	Gas well (?)
..... No..... Adams	33-10-25E	1931	627	Gas well; no location in section
Kansas City Industrial Land Co. No. 1 Carolyn Barker	NE NE 33-10-25E	?	403	Dry hole (?)
Kansas City Industrial Land Co. No. 2 Carolyn Barker	33-10-25E	?	485	Shows of oil; 260–273 ft., 349–354 ft.
..... No..... Ed Barker	33-10-25E	1930	397	Dry hole (?)
Kansas City Industrial Land Co. No. 1 Darby	SW SW SE 33-10-25E	1929	390	90 M cu. ft. gas well
Roarak et al. No. 1 Gooseland	S½ W½ SW 33-10-25E	?	790	400 M cu. ft. gas well
Midland Natural Gas Co. No. 2 7th & Roswell	NE NE 33-10-25E	1930	408	Gas well
Midland Natural Gas Co. No. 5 6th & Howland	NW NW SE 33-10-25E	1930	295	Gas well
Hans E. Reimer No. 1 Scammon Place	CWL SE 33-10-25E	1930	528	554 M cu. ft. gas well

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
..... No..... Spurgeon	(Waverly St. between 11 & 12th Sts.) 33-10-25E	1931	682	165 M cu. ft. gas well
..... No. 1 Cullem	(Near entrance to Fairfax District) 34-10-25E	1929	421	554 M cu. ft. gas well
..... No. 2 Cullem	34-10-25E	1929	320	Gas well (?)
Midland Natural Gas Co. No. 1 Grant & Cubbison	34-10-25E	1930	248	1,145 M cu. ft. gas well
Kansas City Industrial Land Co. No. 26.....	NW NW 34-10-25E	1930	390	120 M cu. ft. gas well
Kansas City Industrial Land Co. No. 29 Kansas City Industrial Land Co.	34-10-25E	1930	400	143 M cu. ft. gas well
Kansas City Industrial Land Co. No. 1 U. P.	SW SW SE 34-10-25E	1928	385	315 M cu. ft. gas well
Kansas City Industrial Land Co. No. 2 U. P.	SW NW SE 34-10-25E	1928	828	Dry hole
Kansas City Industrial Land Co. No. 5 U. P.	SW SE SE 34-10-25E	1928	503	Dry hole
Kansas City Industrial Land Co. No. 3 U. P.	SW cor. 35-10-25E	1928	517	Dry hole
Kansas City Industrial Land Co. No. 4 U. P.	NW cor. 35-10-25E	1928	455	Dry hole
U. S. Geyer Near Kansas City University	10-25E	1923	456	
Kansas City University No. 1	10-25E	1923	421	
Kansas City University No. 2	10-25E	1923	486	
..... No..... Lucas	10-25E	1923	665	Near Kansas City University
Homes Dairy No. 1 Homes	10-25E	....	681	Reported near Overland Park, may be Johnson County
Homes Dairy No. 2 Homes	10-25E	1920	661	Reported near Overland Park, may be Johnson County
..... No..... Albert Wedd	10-25E	1920	517	Close to Homes dairy farm, Overland Park; may be Johnson County
..... No..... Henry Wedd	10-25E	1920	571	Close to Homes dairy farm, Overland Park; may be Johnson County
Messler et al. No. 1 Barker	SE SE NW 1-11-23E	1930	467	Dry hole
Messler No. 1 Barret	SE SE SW 1-11-23E	1930	475	Dry hole (?)
Kirk & Abrahams No. 1 Evans	NE NW NW 1-11-23E	1930	655	213 M cu. ft. gas well
Lindsay et al. No. 1 Addison	NE SW SE 2-11-23E	1932	543	500 M cu. ft. gas well

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Lindsay et al. No. 2 Addison	NW NE SE 2-11-23E	1932	529½	318 M cu. ft. gas well
F. Lindsay No. 1 Brown	SW NE NE 2-11-23E	1932	553	Gas well
F. Lindsay No. 2 Brown	NE SW NE 2-11-23E	1932	523½	290 M cu. ft. gas well
Steve Sknoblac No. 1 Steve Sknoblac	2-11-23E	1931	700	
Steve Sknoblac No. 2 Steve Sknoblac	2-11-23E	1931	495	900 M cu. ft. gas well
Johnson et al. No. 1 Skokodal	NE SE SE 2-11-23E	1931	700	Dry hole
Johnson et al. No. 2 Skokodal	SE SE SE 2-11-23E	1930	494	400 M cu. ft. gas well
Lindsay et al. No. 1 Treff	NE SE SW 2-11-23E	1932	563	681 M cu. ft. gas well
Hazlett et al. No. 1 Green	N½ NE SW 3-11-23E	1931	615	393 M cu. ft. gas well
Hazlett et al. No. 2 Green	SW NE SW 3-11-23E	1931	740	Dry hole
Hazlett et al. No. 3 Green	NE NW SW 3-11-23E	1931	910	Dry hole
Hazlett et al. No. 1 Tabler	SW SE NW 3-11-23E	1931	731	Dry hole
Hazlett et al. No. 2 Tabler	SE SE NW 3-11-23E	1931	590	Dry hole
Patrick No. 1 Holleyfield	SW SE SW 4-11-23E	1931	685	Dry hole
..... No. 1 A. J. Poor	NE NE NW 6-11-23E	?	830	Dry hole
..... No. 2 A. J. Poor	SE SE NW 6-11-23E	1915	755	Dry hole
Hart-Kilimage No. 1 Blankenship	NE NE NW 7-11-23E	1943	635	50 M cu. ft. gas well
Hart et al. No. 2 Blankenship	S¼ SE NW 7-11-23E	1944	530	Dry hole
Brewer-Lane No. 1 Burant	SW SE 7-11-23E	1943	380	200 M cu. ft. gas well
Brewer-Lane No. 2 Burant	S½ NW SE 7-11-23E	1944	315	150 M cu. ft. gas well
Hart et al. No. 1 Burant	NE SE SW 7-11-23E	1944	365	Dry hole
Brewer et al. No. 1 Dunlap	W½ NW 7-11-23E	1943	530	125 M cu. ft. gas well
Brewer et al. No. 2 Dunlap	E½ NW 7-11-23E	1943	618	450 M cu. ft. gas well
Douglas et al. No. 1 Kerns Deepened by H. E. Barker & Roxanna Oil Co.	NE SE NE(?) 7-11-23E	? 1943	527 660	Dry hole
Brewer-Lane No. 1 Poorth	S½ SE SE 7-11-23	1944	405	175 M cu. ft. gas well
Arrow Oil & Gas Co. No. 1 Dunlap	NW SW NE 8-11-23E	1930	484	238 M cu. ft. gas welll
Arrow Oil & Gas Co. No. 2 Dunlap	NW NE NE 8-11-23E	?	511	236 M cu. ft. gas well
Arrow Oil & Gas Co. No. 3 Dunlap	SW NW NW 8-11-23E	?	640	Dry hole

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
Arrow Oil & Gas Co. No. 4 Dunlap	NW NE 8-11-23E	1930	531	Dry hole
J. E. Douglas No. 1 Dunlap	NE SE NE 8-11-23E	1936	850	Dry hole
Guy Grey No. 1 Fee	NE SW NE 8-11-23E	1944	637	Dry hole
Arrow Oil & Gas Co. No. 1 McKee	SE NE NW 8-11-23E	1930	514	560 M cu. ft. gas well
Arrow Oil & Gas Co. No. 2 McKee	SW SE NW 8-11-23E	1930	511	126 M cu. ft. gas well
Arrow Oil & Gas Co. No. 3 McKee	NW SE NW 8-11-23E	1930	513	126 M cu. ft. gas well
Northcott & McLaughlin No. 1 Smith	SE NE SW 8-11-23E	1931	635	Dry hole
Patrick & Douglas et al. No. 1 Billings	SW SE SW 9-11-23E	1931	681	1,137 M cu. ft. gas well
Patrick, Douglas, Brewer No. 2 Billings	SW NE SW 9-11-23E	1931	723	Dry hole
Patrick & Douglas et al. No. 1 Einhelig	NW SW NW 9-11-23E	1931	517	540 M cu. ft. gas well
W. A. Nicholas et al. No. 1 Green	NE SE 9-11-23E	1931	582	500 M cu. ft. gas well
Bonner Springs Oil & Gas Co. No. 1 Holyfield	SW SW NE 9-11-23E	1916	588	Gas well for a few days, flooded out by water; reported to be 900 feet from a well drilled many years before
Jones et al. No. 1 Bert Lindsey	CSL NE 9-11-23E	1932	725	Dry hole
Patrick & Douglas No. 1 Thompson	SW SW SE 9-11-23E	1931	683	439 M cu. ft. gas well
Galey & Hays No. 1 Burt	SE NW 10-11-23E	1931	645	Dry hole (?)
W. A. Nicholas et al. No. 1 O'Hara	SW SW SW 10-11-23E	1931	645	Gas well
W. A. Nicholas No. 2 O'Hara	NW SW SW 10-11-23E	1931	549	118 M cu. ft. gas well
Messler et al. No. 1 Wyandotte County Farm	11-11-23E	1930	812	Small oil well, 10 bbls. per day (?)
Lindsey No. 1 Norman	NW NE NW 11-11-23E	1932	650	233 M cu. ft. gas well
Tom Galey et al. No. 1 Peterson	NE NE NE 11-11-23E	1931	585	Dry hole, 100 M cu. ft. gas 472–479 ft.
Messler et al. No. 1 Getty	SE NE NE 12-11-23E	1930	420	Gas well
Messler et al. No. 1 Barker & Getty	SE NW 12-11-23E	1930	420	Dry hole (?)
W. A. Nicholas No. 1 G. M. Grey	NW SW NE 12-11-23E	1932	595	Dry hole
Central Gas Co. No. 1 Johnson	NE SW 12-11-23E	1941	420	120 M cu. ft. gas well

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Central Gas Co. No. 2 Johnson	SE NE SW 12-11-23E	1941	471	150 M cu. ft. gas well
Messler et al. No. 1 Johnson	NE NE NE 12-11-23E	1930	600	Dry hole
Messler et al. No. 1 Alexander Johnson	NE SW 12-11-23E	1930	595	Gas well
Central Gas Co. No. 1 Parrott	SW NW NE 12-11-23E	1941	427½	190 M cu. ft. gas well
Ruf Drlg. Co. No. 1 Baker et al. Community Lease	SW SW 13-11-23E	1933	500	Dry hole
Ruf Drlg. Co. No. 1 Bennett et al. Community Lease	SW NE SW 13-11-23E	1933	490	Dry hole
Kleinsteiber et al. No. 1 Community Lease	SW NW NW 13-11-23E	1933	431	554 M cu. ft. gas well
Ruf Drlg. Co. No. 1 Jones	SE SE NW 13-11-23E	1933	509	540 M cu. ft. gas well
Ruf Drlg. Co. No. 1 Madison & Wilkens Community Lease	SW NW 13-11-23E	1933	535	500 M cu. ft. gas well
Ruf Drlg. Co. No. 1 Alfred Norman	SE NW NW 13-11-23E	1933	570	Dry hole
Ruf Drlg. Co. No. 1 Schee	SE 13-11-23E	1933	850	Dry hole
Hazlett et al. No. 1 C. W. Meyers	NW NW SW 14-11-23E	1931	817	Dry hole
Patrick et al. No. 1 O'Neil	NE NE NW 16-11-23E	1931	668	28 M cu. ft. gas
Douglas & Patrick No. 1 Shannon	SW SW NW 16-11-23E	?	650	
Douglas & Patrick No. 1 Spandle	SE SE NE 16-11-23E	1931	602	Dry hole
Bonner Springs Oil & Gas Co. No. 1 Stone	NE NW NW 16-11-23E	1918	797	
L. M. Williams & Co. No. 1 Pickering	N½ NW SW 17-11-23E	1931	835	Dry hole
Douglas et al. No. 1 Smith	NE NE NE 17-11-23E	1931	675	69 M cu. ft. gas well
Messler et al. No. 1 Stanley	SW SW NW 17-11-23E	1926?	706	Dry hole
..... No. 1 Bachnick	NE NE NW 18-11-23E	?	578	Dry hole
Jeffers et al. No..... Rhinehart	SE NE SE 18-11-23E	1931	602	10 M cu. ft. gas well
Bonner Springs Oil & Gas Co. No. 1 Kinchlow	20-11-23E	1915	550	Gas well
Allen & Knox No. 1 Landsberg	SE NW SE 20-11-23E	?	871	350 M cu. ft. gas well
Bonner Springs Oil & Gas Co. No. 1 Longfellow	20-11-23E	1904	805	
Bonner Springs Oil & Gas Co. No. 4 Longfellow	NE SW SE 20-11-23E	1916	424	Oil well, 95 bbls. daily
Bonner Springs Oil & Gas Co. No. 5 Longfellow	NE SE 20-11-23E	?	744	
Bonner Springs Oil & Gas Co. No. 7 Twist	SW SW NE 20-11-23E	1908	591	Gas well

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, continued*

Name of well	Location	Year completed	Total depth, feet	Remarks
..... No. 1 Kinahan	SE NW 21-11-23E	1904	853	200 M cu. ft. gas well
Bonner Springs Oil & Gas Co. No. 2 Longfellow	SW NE SE 21-11-23E	1908	788	Gas well
Bonner Springs Oil & Gas Co. No. 1 Slater	21-11-23E	1916	600	Light show of oil 592–600 ft.
Arrow Oil & Gas Co. No. 1 D. C. Haines	SE NE NW 23-11-23E	1930	511	125 M cu. ft. gas well
Fred Frank No. 3 Meyrick	NE NW SE 23-11-23E	1930	555	Dry hole
Frank et al. No. 3 Hall	NW SW 24-11-23E	?	572	Dry hole
Ogden Jones et al. Theressa B. Hall	SE SW NW 24-11-23E	1931	640	
Marks No. 1 Hall	SE SW NW 24-11-23E	1920?	640	Dry hole
Well at Bonner Springs	NW NW 29-11-23E	....	2,220	
C. L. Bloon No.....	(Bonner Springs) ?-11-23E	1899	2,150	
..... No. 4	(Bonner Springs) 29-11-23E	1904	567	1,300 M cu. ft. gas well
..... No. 1 Twist	SW NE 29-11-23E	1904	1,040	Top Mississippian, 990 ft.
..... No. 1 Schubert	SW SW NE 30-11-23E	1904	1,014	Top Mississippian, 996 ft.
Bonner Springs Oil & Gas Co. No. 1 Lashbrook	31-11-23E	?	479	Gas well (?)
..... No. 1 Bahner	SW SE SE 1-11-24E	1936	293	Gas well
Mid West Oil Co. No.....	NE NW NW 1-11-24E	1930	456	Small gas well
Kenosha Auto Transport Co. No. 1	SE SW SE 1-11-24E	1938	600	Dry hole (?)
Kenosha Auto Transport Co. No. 2 Port of Entry	SW SE 1-11-24E	1938	515	Dry hole (?)
Mid West Oil Co. No. 1 Ulerich	SE NW NW 1-11-24E	1930	533	Dry hole
Ruf & Sons No. 1 Conner Estate	SW NE SW 2-11-24E	1933	452	Dry hole
Mid West Oil Co. No. 1 Jasso	NE NE NE 2-11-24E	1930	397	250 M cu. ft. gas well
Mid West Oil Co. No. 1 McCabie	NE¼ 2-11-24E	?	757	75 M cu. ft. gas well
Mid West Oil Co. No. 1 Nye	NW NW NE? 2-11-24E	1930	512	Dry hole
Mid West Oil Co. No. 1 Parker	SW SW NW? 2-11-24E	1930	490	Dry hole

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Mid West Oil Co. No. 1 Shell Filling Station	NW NW NE 2-11-24E	1930	460	Oil show 380–382 ft.
Carson No. 1 Fee	Cen. SW 3-11-24E	?	524	300 M cu. ft. gas well
Western States Co. No. 1 Knoche	NW NE NE 3-11-24E	1932	736	702 M cu. ft. gas well
Ruf Drlg. Co. No. 1 McDonnell	NW NE SE 3-11-24E	1933	545	120 M cu. ft. gas well
Western States No. 1 Ulreich	SE NE NW 3-11-24E	1932	386	465 M cu. ft. gas well
Ruf & Sons No. 1 Younghans	SE NE 3-11-24E	1936	738	131 M cu. ft. gas well
Ruf et al. No. 2 Younghans	NE NE NE 3-11-24E	1937	735	260 M cu. ft. gas well
F. R. Pettijohn No. 2 Parratte	4-11-24E	1939	707	Dry hole (?)
Williams et al. No. 1 Bigham	NW NW NE 6-11-24E	1931	548	1,215 M cu. ft. gas well
L. M. Williams & Co. No. 2 Bigham	NW NE NE 6-11-24E	1931	900	Dry hole
Messler et al. No. 1 Fife	SW SW SW 6-11-24E	?	410	Dry hole
Messler et al. No. 1 Guffey	NE NE NW 6-11-24E	?	474	Gas well
Fred Debetz No. 1 Masterson	SE NW SW 7-11-24E	1939	612	Dry hole
Fred Debetz No. 2 Masterson	NW NE SW 7-11-24E	1939	670	Dry hole
W. L. Hendee No. 1 Jacks	SE SE NE 8-11-24E	1942	510	100 M cu. ft. gas well
W. L. Hendee No. 1 Lyle	SE SE SE 9-11-24E	1942	370	500 M cu. ft. gas well
Way et al. No. 1 Fee	SW SE SW 10-11-24E	1942	335	250 M cu. ft. gas well
..... No. 1 Steinegar	NE SW 10-11-24E	1933	502	Dry hole
W. L. Hendee No. 1 Countryman	NE NE 12-11-24E	1941	260	50 M cu. ft. gas well
Cullum & Brown No. 1 W. Vogel	NW NW NW 12-11-24E	1945	435	Dry hole
Fred Frank No. 3 Dreyer	SE SW NE 13-11-24E	1930	510	Very small gas well
Howard Hunt No. 1 Fee	NW SE 15-11-24E	1936	333	
Goodrich et al. No. 1 Dr. Kain	NW NW SW 15-11-24E	1946	440	Gas well
Suburban Gas Co. No. 1 Simpson	Cen. SW 15-11-24E	1941	401	20 M cu. ft. gas well
Peter Faltermeir No. 1 Meier	SW SE NE 16-11-24E	1945	398	25 M cu. ft. gas well
Suburban Gas Co. No. 1 Jester	SW SW NE 16-11-24E	?	501	10 M cu. ft. gas well
Stevenson No..... Faltimer	NE SW SE 16-11-24E	?	446	Dry hole
Suburban Gas Co. No..... Pierce	SE NW NE 16-11-24E	?	304	Gas well

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TABLE 72.—*Data on wells drilled for oil and gas in Wyandotte County, concluded*

Name of well	Location	Year completed	Total depth, feet	Remarks
Puett et al. No. 1 Puett	NE SE NE 16-11-24E	1945	415	Dry hole
Hass, Hendee & Son No. 1 Dana	SE SE SE 17-11-24E	1942	395	88 M cu. ft. gas well
Hass, Hendee & Son No. 1 Melville	NE NE SE 17-11-24E	1942	400	10 M cu. ft. gas well
Mid-West Petro. Co. No. 1 F. Shirwan	SE SE SE 18-11-24E	1940	766	Dry hole
Green No. 2 Shirwan	SE SE SE 18-11-24E	?	417	
..... No. 1 Young	NW SE 20-11-24E	?	439	
Suburban Gas Co. No..... McDonald	NW NW NW 21-11-24E	?	370	40 M cu. ft. gas well
Hass, Hendee & Son No. 1 Meanor	SW NW 21-11-24E	1942	509	50 M cu. ft. gas well
Suburban Gas Co. No. 1 Mumford	SW NW NW 21-11-24E	?	404	80 M cu. ft. gas well
Suburban Gas Co. No. 1 Ruch	NW NE NE 21-11-24E	1941	630	Dry hole
..... No. 1 Way	NE NE 21-11-24E	1911	441	
Fred Frank No. 4 Hall	NW NW SW 24-11-24E	1930	573	Dry hole
Frank et al. No. 1 Potter	NW SW 24-11-24E	?	535	Dry hole
..... No..... Turner	24-11-24E	?	88	
Haterious et al. No. 1 Beattie	(Morris, Ks.) 27-11-24E	?	530	
B. F. Hammel No. 1 Kendall	SW SE SE 28-11-24E	1941	511	30 M cu. ft. gas well
Young, Gatton & Hendee No..... Young	NE NW NE 29-11-24E	?	439	Gas well
Harbach et al. No. 1 Fee	NE SW 31-11-24E	1941	385	Dry hole
Hammel et al. No. 1 Waldo	NE NE NW 34-11-24E	1941?	590	50 M cu. ft. gas well
.....	723 T Court 3-11-25E	1931	735	
City Ice Co. No. 1	7 & NW 3-11-25E	....	570	
..... No. 1 Western Terra Cotta	12th & Franklin 3-11-25E	1929	394	
..... No. 1 Durant	12 & Garfield 4-11-25E	1932	758	
..... No. 1 Evans	4-11-25E	1932	820	

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Hugh Matthews No. 1 Cloverleaf Dairy	SW NE NE 7-11-25E	1941	280	
Douglas Oil No. 1 Kerr	NEc NW? 7-11-25E	1931	437?	Gas well
Payne Laundry Co. No. 1 City Lot Fee	SW¼ 9-11-25E	1930	727	Dry hole
..... No..... Jenson Well at Gould Hotel	8th & Minne- sota 10-11-25E	1932?	523	
..... No..... Armstrong's Addition	15-11-25E	....	851	
Swift & Co. No.....	15-11-25E	1889	....	
.....	105 S. 16th 16-11-25E	1931	724	
..... No..... Herman L. Carswell	12th & McAlpine 16-11-25	1930	610	
..... No. 1 I-H Flour Mill	SE cor. 17-11-25E	....	500	Dry hole
..... No. 2 I-H Flour Mill	17-11-25E	....	317	
..... No. 3 I-H Flour Mill	17-11-25E	1930	320	
..... No. 4 I-H Flour Mill	17-11-25E	....	358	
..... No.....Ismert-Hincke	17-11-25E	1931	733	
..... No. 5 Shawnee Blvd.	100 ft. above river valley 20-11-25E	1905	1,023?	
K. C. Structural Steel Co. No. 1 K. C. Structural Steel Co.	21st & Met- ropolitan 20-11-25E	1929	440	Dry hole
K. C. Structural Steel Co. No. 2 K. C. Structural Steel Co.	21st & Met- ropolitan 20-11-25E	1929	590	Dry hole
Earl Rand No. 1	NE SW NE 28-11-25E	1929	798	Dry hole
Erie et al. No. 1 Andrew Erie	SE NW NW 31-11-25E	1946	665	Dry & abd.
..... No. 3 Sanders	32-11-25E	1947	200	
E. Rieke et al. No. 1 Ernie Rieke	NW SW SW 32-11-25E	1946	675	Dry hole
Henderson et al. No. 2 Sanders	SW NE SW 32-11-25E	1946	640	
Henderson et al. No. 3 Sanders	SW NE SW 32-11-25E	1947	200	
Baker-Rosedale Baths No. 2 Baker & Baker	SW NE NW? 34-11-25E	1945	350	37 M cu. ft. gas well

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INDEX

Aagard, 226
Ackerland, 254, 256
Adams, 205
Allen County, 91
Allen North, 123
Allen-Robison, 123
Alloway, 302
Altamont, 248, 251
Alta Vista, 305
Altemus, 138
Altoona East, 317, 319, 354
Anadarko basin, 64
Anderson County, 96
Andover South, 123
Angola, 248, 251
Antelope, 280
Antelope North, 280
Arbuckle, 205
Arbuckle rocks, 77
Arkansas City, 170
Arkansas City West, 12, 170
Atchison County, 104
Atyeo, 31, 32, 221, 275, 277
Augusta, 120, 121
Augusta North, 120, 121

Baird, 170
Baird East, 170
Baldwin, 197, 213
Bankers Life, 237, 254
Banzet, 248
Bare, 11, 123
"Bartlesville sand," 77
Bartlett, 249
Barton arch, 62
Batesville, 359
Batesville Southwest, 14, 359
Bausinger, 124
Bayard, 93
Bazaar, 12, 139, 141
Beagle, 269
Beaumont, 221
Beaumont anticline, 66
Beaumont North, 221
Beaumont South, 221
Bellairs, 302
Benedict, 354
Benton, 124
Bergkamp, 12, 170
Bergkamp Northwest, 12, 170
Berlin, 147
Bethel, 367
Biddle, 170
"Big Lake," 69, 293
"Big Lake sand," 78
"Big lime," 78
"Big Salt sand," 78
Big Sandy, 359
"Big shale," 78
Biscuit Hill, 14, 280
Black, 294
Blackwell, 221
Blankenship, 30, 124, 220, 221
Block, 33, 295
Blue Mound, 102, 269
Bogner, 12, 170
Bolton, 299, 303
Bonaccord, 188
Bonner Springs, 242, 367
Borroum, 147
Bourbon arch, 64
Bourbon County, 107
Box, 171
Bradfield, 275, 277
Bradfield Northwest, 13, 277
Brandt-Sensenbaugh, 124
Brazilton, 184
Brewster, 301
Brickley, 11, 124
Brickley Southwest, 11, 124
Brinegar, 221
Brinegar North, 221
Bronson Southeast, 110
Bronson-Xenia, 29, 93, 110
Brown, 171
Brown County, 112
Browning, 31, 221
"Brown lime," 79
Brown-Sturgis, 147
Brownville syncline, 65
Brown West, 12, 171
Bruce, 30, 172
Buffalo, 354, 359
Bunyard, 205
"Burbank sand," 79
Burden, 172
Burden East, 12, 172
Burdick, 14, 305
"Burgess sand," 79
Buried rocks, 42
Burkett, 31, 222
Burns dome, 62
Burt, 13, 223
Bush City Shoestring, 30, 70, 102, 103
Bush-Denton, 205
"Bush-Denton sand," 80
Bushong, 13, 277
Butler County, 117
Butwick, 11, 125
Butwick Northeast, 11, 124
Buxton, 354

Cabin Valley, 12, 172
Cambrian rocks, 52
Caney, 33, 301
Caney West, 147
Canfield, 12, 172
Canville Creek, 317
Carter, 162
"Cattleman sand," 80
Cedar Creek (Anderson County), 102
Cedar Creek (Marion County), 14, 280
Centennial, 12, 172
Centerville, 30, 32, 102, 269
Central Kansas arch, 62
Central Kansas uplift, 61, 62
Chanute, 316
Chase County, 134
"Chat," 80
Chautauqua arch, 61
Chautauqua County, 143
Cherokee basin, 64
Cherokee County, 149
"Cherryvale," 299, 302
Chetopa, 249
Chetopa Townsite, 249
Churchill, 172
Clark, 172
Clay County, 152
Clear Creek, 205
"Cleveland sand," 80
Climax, 223
Clover, 172
Coffey County, 159
"Coffeyville," 71, 299, 302
Coffeyville-Cherryvale, 33, 250, 301, 302, 355
Coleman, 302
Collyer, 205
Colony, 102

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Colony-Mount Ida trend, 102
"Colony sand," 80
Colony-Welda, 30, 102, 103
Colony West, 93, 103
Combs, 124, 172
Combs Northeast, 124
Copeland, 12, 172
Couch, 172
Country Club, 250
Countryman, 172
Covert-Sellers, 280
Cowley County, 165
Coyville, 355
Craig-Monticello, 242
Crawford County, 182
Cretaceous rocks, 37, 43
Critzer, 269

"Dack," 250
Dallas, 243, 244
Daniels, 173
Darien, 173
Dartnell, 250
David, 173
David Northwest, 12, 173
David South, 173
Davis, 139
Davis-Bronson, 29, 93, 103, 110
Davis Ranch, 14, 72, 277, 344, 345
Davis Ranch East, 14, 345
Deichman, 173
DeMalorie-Souder, 31, 223
DeMoss, 124
Dennis, 250
"Dennis sand," 81
Denton, 173
Devon, 110
Devonian rocks, 52
Dexter, 173
Diamond Springs, 306
Dickinson County, 186
Dixon, 124
Doane, 173
Dodge City embayment, 64
Doles Park, 280
Doniphan County, 190
Dory, 205
Douglas County, 193
Douglass, 124
Dunaway, 162, 164, 223
Dunbar, 173
Dunkleberger, 205
Dunn's Mill, 125
Durham, 14, 280
Dutch Creek, 12, 173
"Dutcher sand," 81

Eastman, 30, 173
Eckel, 126
Edgecomb, 11, 126
Edmonds, 14, 280
Edna, 250
Edwardsville, 367
"Eight hundred-foot sand," 81
Elbing, 73, 126, 280
Elbing East, 11, 126
Elbing North, 280
El Dorado, 30, 121, 122, 123
Elgin, 147
Elk, 139, 140
Elk City, 204, 205, 299, 302
Elk County, 202
Elk Falls, 205
Ellis arch, 61, 62
Elmdale, 140
Elrod, 174
Elsmore Shoestring, 29, 93, 110
Elsmore West, 94
"Encill sand," 81
Enterprise, 174
Enterprise Northeast, 12, 174
Enterprise Southwest, 12, 174
Erie, 33, 316, 317
Estes, 174
Eudora, 201, 244
"Eudora gas sand," 81
Eudora South, 201
Eureka, 223
Eureka West, 13, 223
Evans, 162, 271, 359
Ewers, 205

Fairfax, 366
Fairmont, 256
Fair Oak, 184
Fall River, 355
Falls City, 174
Fankhauser, 31, 32, 223, 224, 277
Fanska, 280
Farmdale, 355
Ferguson East, 205
Ferguson Northwest, 13, 174
"Ferguson sand," 81
Ferguson West, 174
Ferrell, 126
Ferrell North, 223
Finnerty, 12, 162, 165
"First break," 81
"First lime," 81
Fleak, 205
Fleming, 206
Florence, 281
Fontana, 295
Fontana South, 269, 295
Forest City basin, 64
"Forty-foot lime," 82
Four Mile Creek, 11, 126
Fox-Bush, 30, 126
Franklin County, 208
Frazier, 147
Fredonia, 355
Fredonia anticline, 66
Frog Hollow, 30, 174
Frog Hollow East, 174
Fulton, 110
Fussell, 13, 174, 175

Gaffney, 223
Galesburg, 318
Garden, 126
Gardner, 244
Gardner South, 244
Garland, 111
"Garnett sand," 82
Garnett Shoestring, 30, 101, 103
Garnett West, 103
Geary County, 213
Gelwick, 126
Geuda Springs, 175
Geuda Springs West, 175
Gibson, 175
Gibson South, 13, 175
Gilroy, 223
Girard, 185
"Golden Lanes," 127, 221, 222, 225
Goodrich-Parker, 32, 102, 270
Gossard, 251
Graham, 175
Grand Summit, 175, 206
Graves, 103
Greeley, 30, 103
Greenwood County, 218
Grouse Creek, 13, 175
Guthrie, 175
Guyot, 126

Hale-Inge, 146, 147, 206
Halligan, 359
Hamilton, 31, 224
"Hancock shale," 82
Hannah, 127
Hannah North, 127

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Harris, 223
Hartenbower, 11, 127
Hartenbower South, 11, 127
Harvey, 13, 175
Harvey Northwest, 13, 175
Hatch, 162
Haverhill, 30, 127
Hazlett, 127
Hazlett North, 11, 127
Heck, 206
"Heck sand," 82
Heigle, 306, 308
Henderson, 175
Hepler, 111, 185
Hertha, 318
Hewins, 147
Hickory Creek, 127
Hillsboro, 281
Hinchman, 224
Hinderliter, 206
History, 18
Hittle, 30, 73, 74, 176
Hoagland, 360
Hollis, 224
Honey Creek, 13, 224
Hoover, 147
"Hoover sand," 82
"Houston," 185
Hower, 176
Hubbard, 224
Humboldt-Chanute, 29, 33, 94, 318, 355, 360
"Hunton" limestone, 82
Hylton, 147
Hymer, 140

Idenbro, 251
Igneous rocks, 37
Independence, 299
Iola, 94
Iola Northeast, 95
Irish Valley, 111
Irish Valley South, 111
Island district, 316

Jackson, 224
Jackson County, 230
Jarbalo, 256
Jarvis, 176
Jefferson, 299
Jefferson County, 234
Jefferson-Sycamore, 33, 303
Jobes, 224
Johnson County, 239
Jonestown, 95
Joseph, 127

Kansas City-Lansing, 83
Keighley, 127, 220
"Keowen," 360
Key, 206
"Kimbal," 224
Kimball, 318
Kincaid, 30, 102
"Kincaid," 250
King, 127
Kingston, 148
Kipfer, 206
Knobtown sandstone, 83
Knox, 128
Kramer-Stern, 30, 128
Kramer-Stern South, 128

Labette County, 245
LaCygne, 270
LaCygne-Cadmus, 32, 270
Ladore, 318
Ladore North, 318
Lafontaine, 355
Laidlow, 360
Lake Creek, 251
Lamont, 31, 224
Lamont trend, 221
Landon-Floyd, 148
"Lanier," 128
Lansing group, 83
"Lansing limestone," 83
Lavelle, 206
Lawrence, 201
Lawrence North, 256
"Layton sand," 83
Leavenworth County, 252
Lehigh, 281
Lehigh North, 14, 281
LeLoup, 213
Leniton, 148
Leon, 128
Leroy, 163, 164
Leroy North, 164
Linn County, 265
Linwood, 256
Lipps, 140
Liscoe, 206
"Little Golden Lanes," 221
Littler, 141
Livengood, 114, 115
Logsden, 206
Long, 11, 128
Longton, 31, 204, 207
Longton anticline, 66
Longton North, 207
"Longton sand," 83
Lost Creek, 111
Lost Springs, 188, 189, 281
Lost Springs East, 281
Lost Springs North, 188, 189
Lost Springs Northeast, 188, 190
Lost Springs South, 281
Lost Springs Southeast, 281
Louisburg, 293
Louisburg Northeast, 295
Love, 207
Lowe, 148
Lucas, 128
"Lush," 248
Lyon County, 271

McAllister, 147, 148
McCaig, 128
McCann, 128
McCullough, 128
McCune, 31, 185
McCune Townsite, 186
McGlasson, 148
McKay, 13, 176
McLouth, 237, 256
McLouth North, 237
McLouth sand, 83
McNoun, 148
Maddix, 13, 176
Madison, 31, 220, 224
Mahannah, 176
Malone, 148
Mansur, 13, 176
Mantanzas, 148
Mapleton, 111
Mapleton Southwest, 111
Marion County, 278
Marshall County, 285
Miami County, 288
Mill Creek, 14, 345
Millett, 176
Mills, 207
Misener sand, 84
Mississippian rocks, 40, 41, 51
"Mississippi lime," 84
Moline, 207
Moline South, 207
Monmouth, 186
Montgomery County, 295
Moran, 95
Morehead, 318

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Morris, 13, 224
Morris County, 303
"Mortimer," 250
Mound City, 270, 271
Mound Valley, 251
Mound Valley South, 251
Muddy Creek, 11, 128
Murdock, 11, 128
Murphy, 176

Neil, 225
Nelson, 306
Nemaha anticline, 63, 64
Nemaha County, 308
Neodesha, 33, 303, 355
Neodesha East, 355
Neosho County, 313
Neosho Falls, 33, 95, 359, 360, 361
Neva, 141
New Albany, 31, 207
"New Albany sand," 84
New Albany Townsite, 355
Newbury, 14, 345
New Salem, 13, 176
Nigger Creek, 13, 176
"Nine hundred-foot sand," 84
Niotaze, 148
Northcott, 104
North Kansas basin, 61, 63
Norwood, 213

Oak Valley, 207
Oak Valley South, 207
Olathe, 244
Olathe North, 244
"Old Red sand," 84
Oliver, 147, 148, 207
Olsen, 177
Ordovician rocks, 52
Osage County, 319
"Osawatomie," 292, 294
Oswego, 251
Oswego City Park, 251
"Oswego lime," 84
"Oswego limestone," 84
Other mineral resources, 16
Ott, 225
Ottawa, 213
Otter Creek, 177
Otto, 177
Outcropping rocks, 36
Ozark basin, 60
Ozark dome, 67
Ozark monocline, 61, 62, 63
Ozark uplift, 62

"Paola," 292, 294
Paola-Rantoul, 31, 33, 213, 293
Parks, 225
Parsley, 11, 128
Patterson, 224
Peabody, 281
"Peacock sand," 84
Pennsylvanian rocks, 37, 39, 40, 41, 43
Permian rocks, 37, 38, 43
Perry, 361
"Peru sand," 85
Peru-Sedan, 30, 146, 148
Petroleum geology, 35
Petterson, 225
Pettit, 128
Pierce West, 12, 129
"Pink lime," 85
Piqua, 361
Pixlee, 32, 221, 225
Polhamus, 32, 225
Polkinghorn, 102
Pomona, 213
Pontiac, 129
Porter, 207
Pottawatomie County, 326
"Pottawatomie Valley," 103
Potwin, 129
"Potwin chat," 85
Potwin South, 129
Powell, 129
Prairie Center, 244
Prairie Plains monocline, 67
Pre-Cambrian rocks, 56, 58
Prescott, 271
"Pressonville," 293, 294
Preston, 207
Price, 32, 251
"Priest," 177
Propp, 281
"Prue sand," 85
Pudden, 177

Quarry Siding, 14, 281
Quaternary deposits, 36
Quincy, 32, 221, 225, 359, 361
Quincy trend, 223, 224, 226

Rahn, 30, 177
Rahn Northeast, 13, 177
Rahn Southwest, 177
Rainbow Bend, 30, 177, 178
Rainbow Bend Northeast, 177
"Rainbow Bend sand," 85
Rainbow Bend West, 177
"Rantoul," 292
"Redd sand," 85
"Red Fork sand," 86
"Red sand," 85
Reece, 225
Reidy, 178
Rettig, 207
Reynolds-Schaffer, 129
Rice, 251
Riley County, 330
Ritchey-Moore, 277
Roberts-Maywood, 256, 367
Robinson, 282
Rock, 31, 178
Rock Creek, 277
Rock North, 178
Rombold, 12, 129
Rose, 361

Sabetha, 14, 313
St. Paul-Walnut, 186, 316, 318
Salina basin, 64, 66
Sallyards, 32, 225, 226
Sallyards trend, 220, 221, 222, 224, 226
Salter, 129
Savonburg, 95
Savonburg West, 95
Schade, 207
Schimmerhorn, 102
Schimmerhorn-Selma-Kincaid, 102
Schlegel, 112
School Creek, 178
Schrader, 207
Scipio, 104
Scott, 32, 225
Seacat, 178
Secondary recovery, 27, 28
"Second break," 86
"Second lime," 86
Sedgwick basin, 64, 66
Seeley, 226
Seeley-Wick, 32, 221, 226
Seibert, 95
Seibert North, 95
Selma, 30, 102
Semisch, 129
Severy, 226
Severy North, 226
Seward, 129
Shambaugh, 208
Shank, 14, 282

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Shawnee County, 336
Sheedy, 359
Shinn, 129
"Siliceous lime," 86
Silurian rocks, 52
Silver City, 359, 361
Silver Creek, 13, 178
Simpson rocks, 86
Six Corners, 256
"Six hundred-foot sand," 86
"Skinner sand," 86
Slick-Carson, 178
Smith, 178
Smock-Sluss, 30, 126, 129
Snowden-McSweeney, 130
Sorghum Hollow, 303
Southeast Nebraska arch, 60
Southwest Kansas basin, 61
"Squirrel sand," 86
"Stalnaker sand," 87
Stange, 362
Stanhope, 226
"Stanton," 293
"Stapleton zone," 87
Starr, 208
State, 178
Stayton, 13, 178
Stayton South, 13, 178
Steele, 14, 359, 362
Steinhoff, 130
Stephenson, 362
Stillwell, 244
"Stokes sand," 87
"Stone Bluff sand," 87
Strahm, 313
Strahm East, 14, 313
Stratigraphy, 36
Strong City, 141
Structural geology, 59
Structural provinces, 59
"Suitcase sand," 87

Teeter, 32, 141, 226
Teeter trend, 220, 221, 225, 226
Teichgraber, 226
Tertiary deposits, 36
Thayer, 319
Thayer East, 319
Theta, 221, 225
"Third lime," 87
Thompson, 130, 302
Thrall, 226
Thrall-Aagard, 226
Three Mile Creek, 14, 306
Three Mile Creek South, 14, 307
Thurlow, 178
Tichenor, 359
"Timber Hills," 250
"Tonkawa sand," 88
Tonovay, 227
Tonovay West, 13, 227
Toronto, 227, 362
Towanda, 130
"Traxon," 251, 252
Trees, 179
Trent, 319
Tucker, 227
"Tucker sand," 88
Turner, 179
Turner North, 179
Turner West, 13, 179
Tyro, 303

Udall, 179
Upola, 208
Urbana, 319
Utopia, 227

Valeda, 251, 252
Vandenberg, 130
Van Noy, 164
"Varner sand," 88
Verdigris, 13, 227
Vernon, 362
Vestal, 179
Vilas, 356
Viola limestone, 89
Virgil, 32, 75, 227
Virgil North, 32, 162, 165, 227, 362
Voshell anticline, 63

Wabaunsee County, 340
Wakefield, 157, 158
Wakefield Northeast, 12, 158
Walker, 208
Walnut Bend, 179
Walnut Southeast, 31, 186
Walnut syncline, 65
Washington County, 348
Wauneta, 148
Wayside-Havana, 33, 148, 303
"Wayside sand," 89
Weathered, 31, 179
Weaver, 130
Webb, 208
"Webb sand," 89
Weide, 362
"Weiser cap," 89
"Weiser lime," 89
"Weiser sand," 89
Welborn, 367
Wenger, 283
Werner, 179
Wheat, 14, 345
Whitewater, 12, 130
Whitewater North, 12, 130
Wick, 226
Wiggam, 148
Wiggins, 228
"Wiggins," 356
"Wilcox sand," 90
Wilde, 308
Wilde Northwest, 308
Wilkerson, 228
Willard, 228
Wilmot-Floral, 179
Wilmoth, 251
Wilsey, 306, 308
Wilson, 179
Wilson-Burns structure, 62
Wilson County, 351
Winfield, 31, 180
Winfield South, 180
Winterscheid, 162, 362
"Wiser sand," 90
Wissman, 362
Womack, 130
Woodbury, 14, 345
Woodson County, 356
Wyandotte County, 363

Yates Center, 362
Young, 30, 130
Youngmeyer, 208

Zimmerman, 13, 228
Zlab, 14, 359, 362

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Table 72--Recorded wells drilled and oil production in eastern Kansas fields, 1949 through 1952, concluded

Field or pool	Wells drilled during 1949				Oil production during 1949, bbls.	Wells drilled during 1950				Oil production during 1950, bbls.	Wells drilled during 1951				Oil production during 1951, bbls.	Wells drilled during 1952				Oil production during 1952, bbls.	Cumulative production to end of 1952, bbls.	Producing zone	Depth to producing zone, feet
	Oil	Gas	Dry	Other		Oil	Gas	Dry	Other		Oil	Gas	Dry	Other		Oil	Gas	Dry	Other				
ELK COUNTY																							
Bush-Denton	-	-	-	-	30,809	-	-	1	-	27,784	-	-	-	-	27,029	-	-	-	-	25,075	---	"Stalnaker"	1,060
																						"Fern"	1,130
Collyer	-	-	-	-	11,136	-	-	-	-	8,933	-	-	-	-	7,329	-	-	1	-	6,969	---	"Burgess"	2,300
																						Kansas City	1,264
Dory	-	-	-	-	3,792	-	-	-	-	3,636	-	-	-	-	1,451	-	-	-	-	2,130	---	Fort Scott	1,218
Dunkelberger	-	-	-	-	29,378	-	-	2	-	29,172	-	-	1	-	31,660	-	-	6	-	32,384	---	Mississippian	1,970
																						Kansas City	1,300
																						Mississippian	1,970
Elk City	-	-	-	-	---	-	-	-	-	34	-	-	-	-	150	-	-	-	-	no report	---		
Ferguson East	-	-	-	-	999	-	-	1	-	1,050	-	-	-	-	884	-	-	1	-	1,113	---	Cherokee	2,300
Fleming	-	-	-	-	---	1	-	2	-	4,269	1	-	1	-	1,558	-	-	3	-	906	---	Arbuckle	2,666
Grand Summit*	-	-	-	-	7,490	-	-	-	-	6,774	-	-	1	-	6,393	-	-	1	-	5,118	---	Kansas City	2,000
Hale-Inge*	-	-	-	-	6,437	-	-	1	-	6,139	-	-	-	-	4,171	-	-	-	-	6,741	---	"Fern"	1,160
Hipfer	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	89	---		
Lorgsen	-	-	-	-	---	-	-	-	-	496	-	-	-	-	861	-	-	-	-	no report	---		
Longton	-	-	-	-	1,477	-	-	2	-	---	-	-	-	-	907	-	-	-	-	1,847	---		
Love	-	-	-	-	3,210	-	-	-	-	902	-	-	-	-	84	-	-	1	-	3,106	---	Mississippian	2,370
Mills	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	1	-	---	---		
Zoline	-	-	-	-	2,093	-	-	-	-	404	-	-	-	-	no runs	-	-	-	-	no report	---	"Burgess"	2,000
																						Mississippian	2,080
New Albany	-	-	-	-	13,457	-	-	-	-	9,861	1	-	-	7	16,506	-	-	-	3	18,090	---	"Wayside"	660
Oak Valley	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	141	---		
"Perkins"	-	-	-	-	471	-	-	-	-	601	-	-	-	-	166	-	-	-	-	976	---		
Porter	-	-	-	-	4,803	-	-	-	-	4,114	-	-	-	-	2,864	-	-	-	-	1,929	---	Kansas City	2,000
																						Arbuckle	3,000
Schade	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	1	-	---	---		
Schrader	-	-	-	-	28,683	-	-	1	-	27,974	1	-	-	-	34,144	-	-	-	-	31,466	---	Kansas City	1,520
Severy*	-	-	-	-	1,983	-	-	2	-	887	-	-	-	-	552	-	-	-	-	806	---	Kansas City	1,500
Starr	-	-	-	-	3,418	-	-	-	-	2,214	-	-	-	-	1,191	-	-	1	-	1,965	---	Mississippian	2,330
Walker	-	-	-	-	1,397	-	-	-	-	1,218	-	-	-	-	1,277	-	-	-	-	1,250	---	Kansas City	1,520
																						Mississippian	2,228
Webb	-	-	-	-	42,506	-	-	-	-	36,096	-	-	1	-	33,818	-	-	1	-	32,206	---	Kansas City	1,500
																						Fort Scott	1,660
																						Mississippian	1,978
Miscellaneous	---	---	---	---	357	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Arbuckle	2,500
Total	-	-	-	-	198,089	1	-	11	-	182,608	2	-	4	7	176,560	-	-	10	3	175,746	13,893,906 recorded		
FRANKLIN COUNTY																							
LeLoup	-	-	-	-	400	17	-	-	-	600	-	-	-	-	---	-	-	-	-	500	---	"Squirrel"	750
Pkola-Bantoulé*	-	-	-	-	256,507	17	-	-	9	278,204	44	-	-	39	267,807	65	-	-	25	389,556	---	Knobtown	300
																						Zepler	400
																						"Fern"	500
																						"Squirrel"	600
Miscellaneous	---	---	---	---	1,320	---	---	---	---	280,449	---	---	---	---	7,420	---	---	---	---	16,992	---	"Bartlesville"	700
Total	-	-	-	-	257,987	34	-	-	9	559,253	44	-	-	39	265,227	65	-	-	25	406,728	8,583,128 recorded		
GREENWOOD COUNTY																							
Atyeo*	-	-	-	-	13,663	-	-	-	-	12,126	-	-	1	6	14,262	1	-	-	14	102,969	---	"Bartlesville"	2,250
Beaumont	-	-	1	-	37,160	1	-	1	-	28,139	2	-	-	-	28,091	9	-	-	-	62,991	---	"Bartlesville"	1,830
																						Mississippian	2,448
																						Arbuckle	2,740
Beaumont North	-	-	-	-	518	-	-	-	-	336	-	-	-	-	401	-	-	-	-	7,805	---	Mississippian	2,477
																						Arbuckle	2,760
Beaumont South	-	-	-	-	10,695	-	-	-	-	10,339	-	-	-	-	9,726	-	-	-	-	409	---	Mississippian	2,000
Blackwell	-	-	-	-	972	1	-	-	-	1,023	-	-	-	-	1,245	-	-	-	-	2,115	---	Mississippian	2,000
Blankenship*	-	-	-	-	4,008	-	-	-	-	3,459	-	-	1	-	5,770	-	-	-	-	21,294	---	"Bartlesville"	2,650
Bringer*	-	-	-	-	6,945	-	-	-	-	6,128	-	-	-	-	4,181	-	-	-	-	8,060	---		
Browning	-	-	-	-	113,234	1	-	4	-	101,754	2	-	4	-	102,735	3	-	1	-	109,682	---	"Bartlesville"	2,314
Burkett	-	-	-	-	445,392	1	-	1	-	396,794	3	-	3	-	311,289	3	-	1	-	276,890	---	"Bartlesville"	2,200
Burt	-	-	-	-	4,995	-	-	-	-	3,660	-	-	-	-	1,945	-	-	3	-	1,609	---	Mississippian	1,945
"Bailey"	-	-	-	-	---	-	-	-	-	---	-	-	-	-	32	-	-	-	-	---	---		
Climax	-	-	-	-	10,064	1	-	-	-	10,661	-	-	-	-	6,906	1	-	1	-	14,789	---	Mississippian	1,900
Oakalosa-Souder	-	-	-	-	162,264	5	-	-	-	154,850	8	-	2	-	127,835	4	-	6	-	226,501	---	Mississippian	1,900
Dunaway*	6	-	4	-	60,977	8	-	2	-	67,139	2	-	-	-	59,580	2	-	-	-	55,262	---	Mississippian	1,800
Eaton	26	-	10	1	69,385	31	-	3	-	166,266	4	-	1	-	109,748	1	-	-	-	81,764	---	Fort Scott	1,750
																						Mississippian	2,000
Eureka West	1	-	-	-	---	1	-	2	-	---	-	-	-	-	---	-	-	-	-	---	---		
Faulkhouse*	-	-	-	-	112,875	4	-	2	6	879,606	9	-	2	1	473,110	5	-	-	-	197,687	---	"Bartlesville"	1,650
Gaffney	-	-	-	-	8,691	1	-	-	-	8,886	-	-	-	-	8,089	-	-	-	-	6,466	---	"Bartlesville"	1,850
"Oates"	-	-	-	-	---	-	-	-	-	---	-	-	-	-	335	-	-	-	-	---	---		
Gilroy	-	-	-	-	859	-	-	-	-	689	-	-	-	-	499	-	-	-	-	302	---	Mississippian	1,600
Hamilton	8	-	-	-	347,138	5	-	5	-	319,125	8	-	-	1	220,921	2	-	8	1	162,587	---	"Bartlesville"	1,650
																						Mississippian	1,800
Hinchman	1	-	-	-	5,822	2	-	1	-	4,285	-	-	-	-	3,766	-	-	-	-	5,470	---	"Bartlesville"	1,615
Hollis	-	-	-	-	2,977	-	-	-	-	1,955	-	-	-	-	1,450	-	-	-	-	1,889	---	"Bartlesville"	1,190
Honey Creek	-	-	-	-	---	1	-	2	-	526	-	-	1	-	261	-	-	-	-	no report	---	Mississippian	1,971
Hubbard	-	-	-	-	---	1	-	-	-	---	-	-	-	-	---	-	-	-	-	892	---		
Jackson	-	-	-	-	1,460	-	-	-	-	2,244	-	-	-	-	1,694	-	-	-	-	4,416	---	"Bartlesville"	
Jobes	-	-	-	-	177	-	-	1	-	---	-	-	-	-	---	-	-	-	-	2,247	---		
Kimball*	-	-	-	-	---	-	-	1	-	870	-	-	-	-	2,262	-	-	-	-	1,662	---		
Lammle	1	-	-	13	130,661	5	-	1	12	315,983	5	-	2	7	230,944	3	-	1	1	221,127	---	"Bartlesville"	1,700
Madison	-	-	-	-	74,026	1	-	1	1	65,301	2	-	3	1	145,485	8	-	2	9	350,704	---	"Bartlesville"	1,800
"Malgren"	-	-	-	-	---	-	-	-	-	---	-	-	-	-	54	1	-	-	-	no report	---		
Morris	-	-	-	-	---	1	-	2	-	no report	1	-	-	-	no report	1	-	-	-	no report	---	Mississippian	1,671
Nash	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	1	-	---	---		
Ott	-	-	-	-	---	-	-	1	-	---	-	-	-	-	---	-	-	1	-	---	---		
Parks	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Peterson	-	-	-	-	2,127	-	-	-	-	---	-	-	-	-	1,403	-	-	-	-	719	---		
Pixley	-	-	-	-	57,721	-	-	-	-	54,435	-	-	-	-	49,401	-	-	-	-	40,877	---	"Bartlesville"	2,550
Polhamus	-	-	-	-	41,299	2	-	1	-	200,721	6	-	3	-	588,685	1	-	1	-	448,104	---	Mississippian	2,150
Quincy	-	-	-	-	7,886	4	-	1	8	53,786	1	-	3	-	84,431	2	-	1	1	87,178	---	"Bartlesville"	1,800
																						Mississippian	1,978
Reece	16	-	5	-	48,461	1	-	-	-	36,776	-	-	1	-	23,468	-	-	-	-	27,633	---	Kansas City	1,280
																						"Bartlesville"	1,800
Sallyards	-	-	-	-	430,245	2	-	1	-	299,682	1	-	1	12	190,027	-	-	2	-	200,166	---	"Bartlesville"	2,200
Scott	-	-	-	-	71,798	-	-	-	-	71,589	-	-	1	-	72,786	-	-	1	-	78,145	---	"Bartlesville"	1,823
Seeley-Hick	8	-	4	2	1,134,132	4	-	3	9	947,418	1	-	13	5	734,628	5	-	11	1	1,278,091	---	"Bartlesville"	1,830
Severy*	-	-	-	-	18,049	2	-	3	-	6,162	-	-	-	-	7,307	-	-	-	-	6,972	---	Kansas City	1,200
Severy North	-	-	-	-	---	-	-	-	-	894	-	-	-	-	909	-	-	-	-	772	---		
Stachope	6	-	-	1	9,234	2	-	1	-	49,666	-	-	-	-	22,349	-	-	-	-	19,546	---	Mississippian	2,450
Tesiere	-	-	-	-	179,307	6	-	1	-	193,865	7	-	6	-	192,466	17	-	16	-	205,198	---	"Bartlesville"	2,400
Teichgraber	-	-	-	-	13,290	-	-	-	-	15,066	1	-	-	-	12,031	1	-	2	3	11,760	---	"Bartlesville"	2,750
Thrill-Hagard	-	-	-	-	480,830	-	-	-	-	451,254	16	-	-	19	1,236,650	26	-	7	1	1,064,167	---	"Bartlesville"	2,170
Tonoway	-	-	-	-	---	1	-	3	-	no report	1	-	-	-	312	1	-	3	-	2,145	---		
Tonoway West	-	-	-	-	---	1	-	1	-	787	-	-	1	-	610	-	-	-	-	716	---	Mississippian	1,948
Toronto*	-	-	-	-	4,264	-	-	-	-	3,807	-	-	-	-	2,980	-	-	2	-	2,925	---	"Peru"	1,000
																						"Bartlesville"	1,700
Tucker	-	-	-	-	---	1	-	1	-	---	-	-	-	-	---	-	-	-	-	---	---		
Utopia	-	-	-	-	---	-	-	2	-	---	-	-	-	-	---	-	-	-	-	---	---		
Virgil	7	-	4	-	162,928	15	-	8	1	189,922	20	-	6	2	169,611	5	-	3	2	160,988	---	"Bartlesville"	1,850
																						Mississippian	1,700
Virgil North*	7	-	1	-	284,285	16	-	5	-	292,138	19	-	1	-	308,904	8	-	-	-	286,743	---	"Bartlesville"	1,886
																						Mississippian	1,960
Wiggins	-	-	-	-	26,080	2	-	4	-	25,768	-	-	2	-	23,469	-	-	1	-	25,938	---	"Bartlesville"	1,850
Wilkerson	-	-	-	-	19,297	-	-	-	-	14,116	-	-	1	-	12,966	-	-	1	-	17,031	---	"Bartlesville"	1,900
Willard	6	-	-	-	24,118	4	-	-	-	37,307	2	-	1	-	30,460	-	-	-	-	29,448	---	Miss. "chat"	1,900
Miscellaneous	---	---	---	---	860	---	---	---	---	726	---	---	---	---	4,240	---	---	---	---	6,290	---		
Total	97	-	29	23	5,169,858	136	-	72	74	5,975,676	115	-	55	79	5,032,010	110	-	43	81	5,834,217	184,943,867 recorded		
JEFFERSON COUNTY																							
McLouth	-	-	-	-	73,504	-	-	-	-	48,291	-	-	-	-	11,766	-	-	-	-	---	---	McLouth	1,480
																						Mississippian	1,550
McLouth North	---	---	---	---	2,254	---	---	---	---	2,241	---	---	---	---	2,090	---	---	---	---	1,494	---	McLouth	1,480
Total	-	-	-	-	75,758	-	-	-	-	50,532	-	-	-	-	13,856	-	-	-	-	1,494	876,985 recorded		
JOHNSON COUNTY																							
Dallas	-	-	-	-	---	1	2	2	-	no report	-	-	-	-	no report	-	-	-	-	no report	---	Cherokee	
LABETTE COUNTY																							
Altamont	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	72	---		
Basset	-	-	-	-	---	-	-	-	-	148	-	-	-	-	---	-	-	-	-	---	---		
Chetopa	-	-	1	-	3,100	-	-	-	-	---	-	-	-	-	no report	-	-	-	-	no report	---		
Coffeyville-Cherryvale*	-	-	-	-	3,189	-	-	-	-	4,560	-	-	-	-	2,497	-	-	-	-	2,046	---	"Wayside"	400
																						Fort Scott	600
																						"Bartlesville"	1,000
Lake Creek	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	1,276	---		
Round Valley	-	-	-	-	370	-	-	-	-	656	-	-	-	-	273	-	-	-	-	544	---	"U. Bartlesville"	630
																						"L. Bartlesville"	700
Price	-	-	-	-	2,349	-	-	-	-	1,973	-	-	-	-	1,786	12	-	-	8	2,176	---	Mississippian	900
Miscellaneous	---	---	---	---	111	---	---	---	---	744	---	---	---	---	793	---	---	---	---	1,048	---	"Bartlesville"	600
Total	-	-	1	-	9,033	-	-	-	-	8,922	-	-	-	-	4,856	12	-	-	8	7,461	362,355 recorded		
LEAVENWORTH COUNTY																							
Askerland	-	-	-	-	2,151	-	-	-	-	1,763	-	-	-	-	3,808	-	-	-	-	---	---	McLouth	1,370
Beaver's Life	---	---	---	---	9,667	---	---	---	---	8,859	---	---	---	---	7,412	---	---	---	---	---	---	McLouth	1,460
Total	-	-	-	-	11,818	-	-	-	-	10,622	-	-	-	-	11,220	-	-	-	-	---	61,260 recorded		
LINN COUNTY																							
Blue Mound	-	-	-	-	2,524	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Centerville*	-	-	-	-	6,911	-	-	-	-	14,714	-	-	-	3	40,621	-	-	-	-	16,601	---	"Squirrel"	480
Goodrich-Pace	6	-	-	-	31,768	17	-	-	-	30,641	13	-	-	13	52,604	2	-	-	-	33,771	---	"Squirrel"	570
LaCygne-Cadmus	-	-	-	-	10,079	-	-	-	-	7,696	15	-	-	18	9,110	20	-	-	10	12,450	---	"Fern"	340
Miscellaneous	---	---	---	---	---	---	---	---	---	3,788	---	---	---	---	3,082	---	---	---	---	1,148	---		
Total	6	-	-	-	51,282	17	-	-	-	56,739	27	-	-	34	85,419	22	-	-	10	63,136	684,822 recorded		
LYON COUNTY																							
Atyeo*	-	-	-	-	391,013	-	-	-	2	296,131	-	-	-	4	239,271	-	-	1	1	192,462	---	"Bartlesville"	2,200
Bradfield	-	-	-	-	---	-	-	1	-	---	-	-	-	-	---	1	-	1	-	4,148	---		
Bushong	-	-	-	-	---	-	-	-	-	4,234	-	-	-	-	3,706	1	-	1	-	3,693	---	"Hunton"	2,990
Fankhouser*	-	-	1	-	28,226	6	-	4	-	50,580	2	-	3	-	48,585	2	-	-	-	40,638	---	"Bartlesville"	1,850
Otis*	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	1,284	---		
Ritchey-Moore	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	1	1	21,168	---		
Rock Creek	-	-	-	-	4,971	1	-	-	-	5,089	1	-	-	-	3,131	1	-	-	1	2,972	---	"Bartlesville"	1,900
Miscellaneous	---	---	---	---	---	---	---	---	---	25	---	---	---	---	---	---	---	---	---	---	---		
Total	-	-	2	-	423,608	8	-	7	2	365,259	3	-	6	4	286,790	4	-	8	2	264,965	6,126,455 recorded		
MARION COUNTY																							
Antelope	-	-	-	-	597	-	-	-	-	77	1	-	1	-	no runs	-	-	-	-	no report	---	Miss. "chat"	2,380
Antelope North	-	-	-	-	407	-	-	-	-	134	-	-	1	-	no runs	-	-	-	-	1,780	---	Kansas City	1,940
Biscuit Hill	-	-	-	-	---	-	-	-	-	---	-	-	1	-	---	1	-	-	-	no report	---	Mississippian	2,269
Blinkorn	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Cedar Creek	-	-	-	-	---	1	-	2	-	1,246	-	-	1	-	569	-	-	-	-	283	1,898	Viola	2,565
Cosmo	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Covert-Sellers	3	-	1	-	106,824	8	-	1	-	80,561	19	-	6	1	187,115	4	-	1	-	142,641	---	Viola	2,400
Coles Ferry	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Elbing*	-	-	1	-	7,601	1	-	-	-	8,859	-	-	1	-	5,602	-	-	-	-	5,232	---	Kansas City	2,120
																						Mississippian	2,400
Elbing North	1	-	1	-	22,528	-	-	3	1	15,623	-	-	-	-	10,280	-	-	-	-	7,333	57,455	Miss. "chat"	2,430
Fenske	-	-	-	-	19,547	-	-	-	-	13,964	-	-	-	-	8,247	-	-	-	-	4,826	---	Miss. "chat"	2,680
Florence	1	-	2	-	16,116	2	-	-	-	12,772	-	-	2	-	11,782	1	-	3	-	11,020	---	Viola	2,800
Hillsboro	-	-	-	-	22,054	-	-	-	-	21,402	-	-	-	-	23,193	-	-	-	-	23,189	---	Mississippian	2,470
																						Viola	2,820
Lehigh	-	-	-	-	14,121	-	-	-	-	14,898	-	-	-	-	13,009	-	-	-	-	7,711	87,963	Mississippian	2,600
Lost Springs*	2	-	3	-	254,676	5	-	5	-	234,870	4	-	2	-	207,238	1	-	1	-	198,218	---	Mississippian	2,565
Lost Springs East	-	-	-	-	7,897	-	-	1	-	5,987	1	-	-	-	2,545	1	-	1	-	1,569	---	Miss. "chat"	2,580
Lost Springs South	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Lost Springs Southeast	-	-	-	-	465	-	-	1	-	1,466	-	-	-	-	1,268	-	-	1	-	2,267	6,266	Mississippian	2,548
Peabody	2	-	1	-	33,588	4	-	1	-	34,618	-	-	3	-	32,770	-	-	1	-	31,731	---	Viola	2,800
Propp	-	-	-	-	---	-	-	-	-	7,190	-	-	-	-	8,179	1	-	-	-	7,961	52,851		
Shank	-	-	-	-	---	-	-	1	-	---	-	-	-	-	---	-	-	1	-	2,681	Mississippian	2,474
Wenger	-	-	-	-	184,766	1	-	1	-	141,133	-	-	-	-	111,699	1	-	-	-	106,472	649,184	"Hunton"	2,770
Miscellaneous	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	350	---		
Total	14	2	16	-	668,987	19	3	21	2	595,126	28	3	20	4	600,088	18	-	22	-	567,290	32,830,289 recorded		
MIAMI COUNTY																							
Block	-	-	-	-	1,700	-	-	-	-	---	-	-	-	-	none	-	-	-	-	1,449	---	"Squirrel"	480
Lostsberg	-	-	-	-	4,823	-	-	-	-	4,986	-	-	-	-	4,745	-	-	-	-	4,003	---	Knobtown	270
																						"Fern"	430
																						"Squirrel"	600
Pkola-Bantoulé*	-	-	-	-	388,899	65	-	-	107	487,186	30	-	-	22	501,424	42	-	-	1	571,965	---	Knobtown	300
																						Zepler	400
																						"Fern"	500
																						"Squirrel"	600
Miscellaneous	---	---	---	---	2,150	---	---	---	---	7,660	---	---	---	---	13,004	---	---	---	---	13,740	---	"Bartlesville"	700
Total	-	-	-	-	370,804	65	-	-	107	499,851	30	-	-	22	516,771	42	-	-	1	591,155	13,946,296 recorded		
MONTGOMERY COUNTY																							
Brewster	-	-	-	-	22,244	-	-	-	-	65,239	-	-	-	-	46,315	-	-	-	-	37,307	---	"Bartlesville"	900
																						Arbuckle	
Canny	-	-	-	-	7,441	-	-	-	-	6,516	-	-	-	-	4,889	2	-	-	1	7,623	---	"Bartlesville"	1,320
Canny West	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	1	-	---	---		
Coffeyville-Cherryvale*	-	-	-	-	64,176	6	-	-	4	60,836	-	-	-	-	57,079	-	-	-	3	53,850	---	Fort Scott	600
																						"Bartlesville"	1,000
																						Arbuckle	1,800
Coleman	-	-	-	-	5,828	-	-	-	-	1,838	-	-	-	-	810	-	-	-	-	382	---	Arbuckle	1,700
Jefferson-Sycamore	-	-	-	-	580,426	21	-	-	33	482,931	12	-	-	7	308,808	10	-	1	2	416,888	---	"Reiser"	750
																						Arbuckle	1,800
Needesha*	-	-	-	-	5,975	-	-	-	-	2,864	-	-	-	-	2,614	10	-	1	1	6,837	---	"Bartlesville"	850
Sorghum Hollow	-	-	-	-	7,688	-	-	-	-	7,688	-	-	-	-	5,006	-	-	-	-	3,881	---	"Reiser"	800
Tyro	-	-	-	-	15,215	-	-	-	-	16,048	-	-	-	-	14,726	1	-	2	1	12,373	---	"Bartlesville"	850
Wayside-Havana*	-	-	-	-	146,189	1	-	-	2	144,264	1	-	-	-	136,597	2	-	1	-	158,097	---	"Wayside"	576
																						"Reiser"	700
Miscellaneous	---	---	---	---	3,310	---	---	---	---	170	---	---	---	---	215	---	---	---	---	742	---		
Total	-	-	-	-	878,567	28	-	-	39	788,952	13	-	-	8	626,460	26	-	8	17	676,795	41,085,081 recorded		
MORRIS COUNTY																							
Alta Vista	-	-	-	-	---	-	-	1	-	---	-	-	1	-	---	-	-	-	-	---	---		
Burdick	1	-	1	-	3,216	3	-	4	-	10,905	-	-	-	-	4,765	-	-	-	-	4,765	22,188	Mississippian	2,220
Nelson	1	-	1	-	86	-	-	1	-	---	-	-	-	-	---	-	-	-	-	---	---		
Three Mile Creek	-	-	-	-	---	2	-	4	-	12,468	2	-	-	-	17,283	-	-	-	-	17,668	65,809	Mississippian	2,208
Three Mile Creek South	-	-	-	-	---	3	-	3	-	2,987	2	-	-	-	27,364	3	-	-	-	23,427	29,706	Mississippian	2,188
Wilde (gas)	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Wilsey (gas)	---	---	1	---	---	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---		
Total	1	-	4	-	1,801	8	-	14	-	26,328	4	-	1	-	49,412	3	-	1	-	45,860	141,926		
NEMAHA COUNTY																							
Sabetha	-	-	-	-	---	3	-	-	-	631	-	-	1	-	12,141	-	-	-	-	8,912

TABLE IX—Recorded wells drilled and oil production in eastern Kansas fields, 1949 through 1952

Field or pool	Wells drilled during 1949				Oil production during 1949, bbls.	Wells drilled during 1950				Oil production during 1950, bbls.	Wells drilled during 1951				Oil production during 1951, bbls.	Wells drilled during 1952				Oil production during 1952, bbls.	Cumulative production to end of 1952,bbls.	Producing sone	Depth to producing sone,feet
	Oil	Gas	Dry	Other		Oil	Gas	Dry	Other		Oil	Gas	Dry	Other		Oil	Gas	Dry	Other				
ALLEN COUNTY																							
Bronson-Xenia*	-	-	-	-	12,181	5	-	-	1	12,867	15	-	-	11	10,672	2	-	-	11	82,126	---	"Bartlesville"	725
Colony West*	-	-	-	-	6,806	-	-	-	-	8,028	-	-	-	-	7,563	-	-	-	-	89,566	---	"Squirrel"	620
Davis-Bronson*	-	-	-	-	12,186	-	-	-	-	15,554	-	-	-	-	15,768	-	-	-	-	7,665	---	"Bartlesville"	720
Elsmore Shoestring	-	-	-	-	47,986	7	-	-	7	53,893	12	-	-	8	49,717	2	-	8	-	43,717	---	"Bartlesville"	700
Elsmore West	-	-	-	-	6,760	-	-	-	-	7,648	-	-	-	-	10,199	-	-	-	-	8,080	---	"Bartlesville"	695
Humboldt-Chanute*	-	-	-	-	123,927	26	-	-	26	141,855	25	-	-	17	139,434	56	-	-	45	117,160	---	"Bartlesville"	660
Iola	-	-	-	-	34,402	-	-	-	-	40,288	-	-	-	-	36,239	6	-	-	-	33,173	---	"Bartlesville"	660
Moran	-	-	-	-	6,601	-	-	-	-	13,807	-	-	-	-	8,987	4	-	1	-	9,216	---	"Bartlesville"	520
Neosho Falls*	-	-	-	-	10,869	-	-	-	-	8,756	-	-	-	-	7,053	-	-	-	-	4,063	---	"Bartlesville"	520
																						Mississippian	1,200
Seibert	-	-	-	-	665	-	-	-	-	671	-	-	-	-	819	-	-	-	-	802	---	"Bartlesville"	680
Miscellaneous	-	-	-	-	5,688	-	-	-	-	890	-	-	-	-	7,050	-	-	-	-	10,878	---		
Total	-	-	-	-	279,586	55	-	-	54	318,586	47	-	-	56	305,657	69	-	6	67	409,877	15,415,828 recorded		
ANDERSON COUNTY																							
Bush City Shoestring	-	-	-	-	356,687	50	-	-	47	361,642	23	-	-	47	341,898	2	-	-	-	339,236	---	"Squirrel"	620
Centerville*	-	-	-	-	1,804	3	-	-	-	43,280	10	-	-	2	78,065	17	-	-	18	115,215	---	"Squirrel"	680
																						"Bartlesville"	715
Colony-Welda	-	-	-	-	23,290	8	-	-	3	28,908	3	-	-	8	40,469	7	-	-	16	42,162	---	"Weiser"	600
																						"Squirrel"	620
Colony-West*	-	-	-	-	21,442	-	-	-	-	18,906	-	-	-	-	15,569	-	-	-	-	13,837	---	"Squirrel"	625
Garnett Shoestring	-	-	-	-	49,747	-	-	-	-	47,171	-	-	-	-	39,874	3	-	2	-	29,550	---	"Squirrel"	650
																						"Garnett"	800
Kincaid	-	-	-	-	59,001	2	-	-	1	58,760	-	-	-	-	52,646	-	-	-	-	37,716	---	"Bartlesville"	700
Selma	-	-	-	-	10,949	12	-	-	1	13,828	-	-	-	-	11,027	-	-	-	-	2,918	---	"Bartlesville"	700
Miscellaneous	-	-	-	-	---	---	---	---	---	---	---	---	---	---	5,000	---	---	---	---	5,000	---		
Total	-	-	-	-	402,420	75	-	-	52	543,975	37	-	-	57	583,950	27	-	-	33	976,882	14,910,963 recorded		
BOURBON COUNTY																							
Bronson-Xenia*	-	-	-	-	300	-	-	-	-	5,117	-	-	-	-	10,095	-	-	-	-	37,443	---	"Bartlesville"	665
Davis-Bronson*	-	-	-	-	13,112	-	-	-	-	8,231	-	-	-	-	2,562	-	-	-	-	564	---	"Bartlesville"	660
Hepler	-	-	-	-	868	-	-	-	-	1,200	-	-	-	-	24,357	-	-	-	-	18,977	---	"Bartlesville"	650
Savonburg	-	-	-	-	1,274	-	-	-	-	25	-	-	-	-	---	-	-	-	-	---	---		
Total	-	-	-	-	15,554	-	-	-	-	24,573	-	-	-	-	39,792	-	-	-	-	56,984	697,937 recorded		
BROWN COUNTY																							
Livingood	-	-	-	-	5,540	-	-	-	1	5,579	1	-	-	-	10,886	1	-	-	-	5,001	84,124 recorded	"Hunton"	2,880
BUTLER COUNTY																							
Allen-Robison	5	-	1	-	24,420	6	-	7	-	22,086	3	-	8	-	19,407	-	-	4	-	49,328	---	Mississippian	2,700
Allen North	1	-	-	-	59,213	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Andover South	-	-	-	-	---	-	1	1	-	---	-	-	-	-	---	-	-	-	-	---	---		
Augusta	22	-	9	67	671,015	18	1	9	-	427,886	9	1	-	-	378,326	14	-	1	-	339,088	37,225,161	Lansing	1,700
																						Kansas City	2,000
																						Marmaton	2,200
																						Ordovician	2,445
Augusta North	4	-	-	-	108,411	4	-	3	-	107,274	-	-	3	-	97,895	1	-	-	-	107,818	14,540,469	Arbuckle	2,450
																						Lansing	1,690
																						Kansas City	1,930
																						Ordovician	2,380
																						Arbuckle	2,410
Bare	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	2	-	8	-	1,332	---	"Bartlesville"	2,778
Bassinger	-	-	2	-	6,805	-	-	1	-	5,710	-	-	1	-	5,995	-	-	-	-	---	---	"Wilcox"	3,000
Beaton	-	-	2	-	2,198	-	-	1	-	1,766	-	-	1	-	1,720	---	---	---	---	2,460	---	Miss. "chat"	2,965
Blankenship*	-	-	-	-	68,820	2	2	2	8	198,166	6	-	1	6	209,011	11	-	6	9	187,246	1,760,308	"Bartlesville"	2,750
Brandt-Dannenbaugh	-	-	2	-	54,219	-	-	-	-	56,115	4	-	1	-	60,891	4	-	1	1	53,872	1,791,977	Miss. "chat"	2,960
Brinkley	-	-	-	-	---	-	-	-	-	---	1	-	-	-	6,839	2	-	1	-	12,355	46,716	"Bartlesville"	2,704
Brinkley Southwest	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	5	-	1,708	---	"Bartlesville"	2,689
Butwick*	-	-	1	-	---	5	-	-	-	24,697	-	-	-	-	22,791	-	-	-	-	5,708	67,105		
Butwick Northeast	3	1	-	-	2,037	-	-	-	-	1,266	-	-	-	-	660	-	-	1	-	858	4,289	Miss. "chat"	2,960
Combes	-	-	-	-	19,765	-	-	-	-	23,961	-	-	-	-	19,753	-	-	-	-	17,406	---	"Bartlesville"	2,820
																						"Bartlesville"	2,810
Combs Northeast	1	-	3	-	8,149	-	-	-	-	6,297	-	-	-	-	6,228	-	-	-	-	4,149	24,823	"Bartlesville"	2,810
Dekoss	-	-	-	-	28,489	-	-	2	-	29,166	-	-	-	-	25,946	---	---	1	---	21,822	---	"Bartlesville"	2,800
																						"Burgess"	2,680
Dixon	-	-	-	-	1,662	-	-	-	-	1,633	-	-	-	-	1,336	-	-	-	-	1,312	11,279	"Bartlesville"	2,800
																						Mississippian	2,900
Douglass	-	-	-	-	7,747	2	5	5	-	5,500	2	-	4	-	6,418	-	-	2	-	6,464	---	Lans.-K.C.	1,790
																						Ordovician	3,000
Edel	-	-	-	-	2,839	-	-	-	-	2,474	-	-	1	-	1,504	---	-	1	-	1,158	59,288	Lans.-K.C.	1,790
Edgecomb	-	-	-	-	---	-	-	-	-	---	2	-	-	-	975	---	-	1	-	4,603	5,478	Mississippian	2,739
Elinger	1	-	4	-	227,585	21	2	-	-	220,028	3	-	3	2	729,828	7	2	3	-	566,444	4,582,514	Mississippian	2,730
																						Kansas City	2,400
																						Viola	2,950
Elving East	-	-	-	-	---	4	-	3	-	2,205	-	-	-	-	10,309	-	-	2	-	8,876	25,389	Lans.-K.C.	1,799
El Dorado	64	-	9	8	3,074,891	62	-	18	8	3,083,823	72	-	9	30	3,249,484	92	4	71	3	3,437,824	211,533,902	Lansing	1,700
																						Kansas City	2,000
																						Viola	2,900
																						Simpson	2,910
																						Arbuckle	2,950
Farrell	2	-	-	-	72,856	2	-	-	-	100,762	2	-	-	-	103,822	2	-	-	-	130,081	1,119,020	"Bartlesville"	2,647
Four Mile Creek	-	-	-	-	---	-	-	-	-	---	6	-	10	-	11,271	2	-	-	-	33,540	73,269	Simpson	3,069
Fox-Bush	2	-	-	-	328,021	1	-	2	-	281,270	8	-	7	41	192,624	13	-	16	22	287,082	2,700,229	"Bartlesville"	2,730
Gerden	2	-	-	-	37,378	-	-	1	-	36,260	3	-	2	-	41,661	2	-	-	-	46,605	---	"Bartlesville"	2,760
Geletek	-	-	-	-	---	-	-	1	-	---	-	-	-	-	---	-	-	-	-	---	---	"Bartlesville"	2,710
Gopet	-	-	-	-	6,800	-	-	-	-	5,728	-	-	-	-	5,739	-	-	-	-	603	11,980	"Bartlesville"	2,800
Hannah	-	-	-	-	1,746	-	-	-	-	2,480	-	-	1	-	2,818	---	---	---	---	2,814	14,162	Kansas City	1,962
Hartenbower	-	-	-	-	---	-	-	-	-	2,247	1	-	1	-	1,900	1	-	-	-	2,414	5,314	"Fern"	2,604
Hartenbower South	-	-	-	-	---	-	-	-	-	---	-	-	1	-	64	-	-	1	-	64	---	Lans.-K.C.	2,060
Haverhill	11	-	2	-	72,247	11	-	2	-	66,289	15	-	2	-	67,808	6	-	3	-	49,731	4,566,207	"Bartlesville"	2,700
Hazlett	-	-	-	-	---	2	-	-	-	1,016	23	-	11	1	306,480	7	-	6	3	304,014	875,560	Mississippian	2,480
Hazlett North	11	-	2	-	23,877	51	-	12	-	231,005	Combined with Hazlett												
Hickory Creek	6	-	2	-	125,229	5	-	2	-	111,800	1	-	2	-	90,440	1	-	-	-	69,245	833,252	"Bartlesville"	2,666
																						Mississippian	
Joseph	-	-	-	-	1,236	-	-	-	-	869	-	-	-	-	716	-	-	1	-	---	4,089	Miss. "chat"	
Keighley	-	-	-	-	24,998	-	-	-	-	23,766	1	-	5	-	21,760	-	-	2	-	23,084	---	"Bartlesville"	2,650
																						Simpson	3,148
Knox	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Kramer-Stern	4	-	3	-	226,986	-	-	-	-	200,894	8	-	2	-	206,999	11	-	7	-	304,884	---	Simpson	3,000
																						Arbuckle	3,040
Kramer-Stern South	-	-	1	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
"Lanie"*	-	-	1	-	---	-	-	-	-	---	-	-	-	-	1,478	-	-	-	-	6,666	---		
Leon	2	-	1	-	28,672	-	1	1	-	23,442	1	-	-	-	24,211	-	-	12	2	26,859	2,463,610	Miss. "chat"	2,660
																						Viola	3,090
Long	1	-	1	-	548	2	-	1	-	5,600	-	-	1	-	4,088	---	-	---	---	2,859	11,833	"Bartlesville"	2,670
Lorraine	1	-	1	-	2,216	-	-	-	-	1,940	3	-	1	-	6,284	---	-	---	---	5,231	23,086	"Bartlesville"	2,690
McKean	-	-	-	-	---	-	-	-	-	---	-	-	2	-	---	---	-	---	---	---	---		
McCaig	-	-	2	-	---	-	-	-	-	---	-	-	1	-	---	-	-	2	-	---	---		
McCullough	-	-	-	-	---	3	-	-	-	2,632	-	-	1	-	1,088	-	-	1	-	1,158	491,486	"Wilcox"	3,169
Mahannah	-	-	-	-	---	-	-	-	-	---	-	-	1	-	---	-	-	1	-	---	---		
Minnoa	-	-	-	-	---	-	-	-	-	---	-	-	1	-	---	-	-	1	-	---	---		
Muddy Creek	-	-	-	-	---	3	2	-	-	16,216	3	-	2	-	45,001	4	-	4	-	74,605	131,722	"Bartlesville"	2,813
Murdock	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	2	-	2,105	2,105	Mississippian	2,806
Parsley	1	-	3	-	19,540	2	-	1	-	22,727	1	-	1	-	26,226	1	-	2	-	17,583	81,816	Mississippian	2,716
Pattit	1	-	1	-	2,284	-	-	1	-	1,084	-	-	-	-	1,089	---	-	---	---	---	---	"Wilcox"	3,140
Pierce	2	-	3	-	112,566	-	-	1	-	90,181	-	-	3	-	92,988	2	-	1	-	94,866	---	Miss. "chat"	2,950
Pierce West	-	-	-	-	---	-	-	-	-	---	-	-	2	-	2,296	1	-	1	-	1,261	15,846	Mississippian	2,915
Pontiac	1	-	1	-	---	-	-	-	-	---	-	-	-	-	---	---	-	---	---	---	---		
Potwin	9	-	9	-	142,444	18	9	-	-	175,806	10	-	7	-	197,983	3	-	3	-	193,797	7,713,199	Kansas City	2,550
																						Mississippian	2,660
Potwin South	1	-	1	-	5,006	-	1	-	-	---	-	-	1	-	---	---	-	---	---	---	---		
Reynolds-Schaffer	1	-	-	-	73,141	3	-	1	-	72,708	4	-	2	1	79,900	8	-	3	1	107,960	---	Kansas City	2,378
																						Mississippian	2,750
																						Viola	3,141
Rumbold	1	-	1	-	2,249	1	-	2	-	8,095	2	-	1	-	6,966	---	-	---	---	6,405	23,318	Mississippian	2,772
Salem	10	-	2	-	281,270	3	-	2	-	213,860	6	-	2	-	170,864	1	-	1	-	123,211	1,071,115	Simpson	3,000
Semisch	1	-	1	-	29,621	2	-	2	-	25,628	7	-	2	-	140,212	26	-	4	-	229,227	605,289	"Bartlesville"	2,810
Semisch-Gemmell	-	-	-	-	7,261	-	-	-	-	6,881	7	-	2	-	37,288	4	-	2	-	21,283	1,089,276	"Bartlesville"	2,806
Shinn	-	-	-	-	56,880	-	-	-	-	70,563	-	-	-	-	60,953	-	-	-	-	48,063	490,867	Mississippian	2,788
Smith-Sluss	-	-	-	-	103,139	-	-	6	-	89,901	1	-	-	-	90,645	1	-	-	-	84,413	---	"Bartlesville"	2,700
																						Viola	3,000
Snowden-McSweesy	1	-	-	-	14,797	-	-	-	-	8,437	-	-	-	-	5,387	17	-	4	-	105,112	---	Simpson	2,850
Stanhope	1	-	-	-	2,287	-	-	-	-	---	-	-	-	-	---	---	-	---	---	---	---		
Steinhoff	1	-	2	-	2,680	-	-	-	-	2,490	-	-	-	-	2,411	---	-	---	---	2,247	---	Mississippian	2,808
Thompson	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---	-	---	---	---	---		
Towanda	7	-	6	1	141,841	9	-	1	-	268,809	9	-	2	-	356,686	---	-	---	---	289,395	1,060,784	Mississippian	2,400
																						Viola	2,440
Weaver	1	-	-	-	---	-	-	-	-	---	-	-	-	-	---	-	-	3	-	---	---		
Whitewater	6	-	4	-	28,878	3	-	1	1	70,821	2	-	2	1	71,458	---	-	---	---	53,255	224,660	Viola	2,665
Whitewater North	1	-	1	-	3,469	-	-	-	-	---	2	-	2	-	6,146	---	-	---	---	1,974	8,080	Viola	2,700
Womack	1	-	2	-	6,944	1	-	4	-	8,649	-	-	1	-	5,976	---	-	---	---	1,966	---	Mississippian	2,680
																						Kansas City	2,380
Young	1	-	-	-	104,844	1	-	3	1	95,454	---	-	---	---	82,946	---	-	---	---	76,898	---	Mississippian	2,680
Miscellaneous	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---	-	---	---	612	---		
Total	136	-	60	6	6,822,785	195	2	80	12	6,862,468	191	-	119	82	7,867,788	209	-	105	104	9,186,206	379,851,867 recorded		
CHASE COUNTY																							
Altemus	-	-	1	-	---	-	-	-	-	9,283	-	-	-	-	---	-	-	-	-	---	---		
Alyea	-	-	1	-	---	-	-	-	-	---	1	-	1	-	5,648	-	-	1	-	1,344	---	"Bartlesville"	2,250
Bazaar	-	-	-	-	---	-	-	-	-	---	1	-	1	-	205	-	-	1	-	257	---	Lans.-K.C.	1,823
Elmdale	-	-	2	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Strong City	-	-	2	-	---	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---		
Textore	-	-	1	-	31,139	-	-	-	-	25,211	1	-	2	-	25,273	1	-	2	-	29,423	---	"Bartlesville"	2,500
Total	-	-	7	-	36,938	-	-	-	-	37,804	2	-	5	-	31,430	1	-	2	-	30,629	174,256 recorded		
CHAUTAUQUA COUNTY																							
Berlin	-	-	-	-	1,043	-	-	-	-	---	-	-	1	-	---	---	-	---	---	---	---		
Sorrosm	-	-	-	-	4,810	-	-	-	-	4,269	-	-	1	-	3,665	---	-	---	---	3,665	---	Marmaton	1,780
Bronco-Burgis	-	-	-	-	---	-	-	-	-	321	-	-	-	-	---	---	-	---	---	---	---		
Elgin	-	-	-	-	40,214	-	-	-	-	37,078	-	-	-	-	34,660	-	-	1	-	30,350	---	"Peru"	1,520
Frazier	-	-	-	-	572	-	-	-	-	618	-	-	-	-	832	-	-	1	-	1,079	---	"Peru"	1,520
Hale-Inge*	-	-	-	-	14,623	-	-	-	-	13,927	-	-	-	-	12,130	-	-	1	-	9,600	---	"Peru"	1,180
Hewins	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---	-	---	---	---	---		
Kingston	-	-	-	-	2,485	-	-	-	-	1,946	-	-	-	-	1,468	-	-	-	-	1,784	---	Miss. "chat"	1,960
																						Arbuckle	2,176
Landon-Floyd	-	-	-	-	31,661	-	-	-	-	29,855	-	-	-	-	24,928	-	-	-	-	22,856	---	Mississippian	2,000
Middlitter	-	-	-	-	9,001	-	-	-	-	7,304	-	-	-	-	---	---	-	---	---	---	---		
McClascon	-	-	-	-	3,969	-	-	-	-	1,798	-	-	-	-	---	---	-	---	---	---	---		
Malone	-	-	-	-	615	-	-	-	-	1,961	-	-	-	-	983	---	-	---	---	562	---	Ordovician	2,540
Niotaze	-	-	-	-	7,686	-	-	-	-	8,170	-	-	-	-	6,287	---	-	---	---	4,887	---	"Sand"	990
																						"Peru"	825
Oliver	-	-	-	-	11,207	-	-	-	-	10,423	-	-	-	-	8,140	-	-	-	-	14,275	---		
Peru-Cedar*	1	-	-	-	673,610	-	-	-	-	695,656	1	-	1	-	695,817	2	-	4	-	684,220	---	"Peru"	1,180
Sauzeta	-	-	-	-	412	-	-	-	-	1,339	-	-	-	-	2,130	-	-	1	-	2,282	---	"Peru"	1,220
																						Mississippian	2,100
Sayrick-Havana*	-	-	-	-	3,745	-	-	-	-	5,804	-	-	-	-	5,081	---	-	1	-	2,527	---	"Wayside"	875
																						"Weiser"	700
																						"Bartlesville"	1,200
Wigzan	-	-	-	-	1,574	-	-	-	-	1,493	-	-	-	-	1,659	---	-	---	---	3,401	---	"Weiser"	1,600
Miscellaneous	-	-	-	1	1,274	-	-	-	-	1,423	-	-	-	-	316	---	-	---	---	1,888	---		
Total	-	-	-	1	808,839	-	-	-	-	812,186	1	-	4	-	793,876	-	-	8	4	798,706	45,115,477 recorded		
COFFEY COUNTY																							
Dunaway*	-	-	-	-	32,066	-	-	-	-	31,972	-	-	1	-	17,584	1	-	-	-	15,839	---	"Burgess"	1,850
																						Mississippian	1,878
																						Ordovician	2,200
"George"	-	-	-	-	2,641	-	-	-	-	1,450	-	-	-	-	---	---	-	---	---	---	---		
Leroy	-	-	-	-	---	-	-	-	-	---	-	-	-	-	1,188	---	-	---	---	1,168	---		
Van Hoy	-	-	-	-	6,824	-	-	-	-	7,100	9	-	3	-	11,302	4	-	6	-	10,015	---	"Peru"	1,170
																						Mississippian	1,540
Virgil North*	-	-	-	-	36,741	-	-	-	-	59,267	3	-	2	-	48,592	3	-	-	-	44,791	---	"Bartlesville"	1,588
																						Mississippian	1,838
Winterscheid*	-	-	-	-	7,079	-	-	-	-	7,605	-	-	-	-	11,237	---	-	1	-	14,096	---	"Bartlesville"	1,630
																						Mississippian	1,760
Miscellaneous	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---	-	---	---	2,163	---		
Total	-	-	-	-	88,281	-	-	-	-	107,994	12	-	6	-	90,088	8	-	7	-	86,851	1,876,062 recorded		
COMAN COUNTY																							
Arkansas City	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	3	-	---	---		
Arkansas City West	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	6	-	5,660	5,660		
Baird	-	-	-	-	11,684	-	-	-	-	11,473	1	-	1	-	9,282	3	-	4	-	12,431	---	"Bartlesville"	3,288
																						Mississippian	3,560
Baird East	-	-	1	-	2,364	-	1	-	1	2,348	1	-	1	-	2,982	2	-	3	-	4,101	---	"Bartlesville"	3,300
Bergkamp	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	13	-	5	-	90,832	90,832	"Bartlesville"	3,202
Bergkamp Northwest	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	1	-	823	823	"Bartlesville"	3,208
Biddle	-	-	1	-	24,187	-	-	-	-	19,663	-	-	-	-	16,874	---	-	---	---	15,083	---	Kansas City	2,000
																						"Stalnaker"	2,800
Bogner	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	1	-	1,650	1,650	Mississippian	2,999
Bon	1	-	1	-	56,601	1	-	-	-	55,287	3	-	1	-	52,006	1	-	1	-	37,320	139,348	Mississippian	2,840
Brown	1	-	-	-	3,975	-	-	-	-	1,744	3	-	1	-	1,011	1	-	1	-	1,474	246,000	Kansas City	2,100
Brown West	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	---	-	---	---	---	---		
Bruce	-	-	-	-	---	1	-	-	-	2,284	1	-	-	-	10,076	---	-	1	1	11,859	24,196	Arbuckle	3,306
Burden	2	-	5	-	27,645	-	-	-	-	29,734	5	-	3	-	31,860	1	-	1	-	22,816	---	"Bartlesville"	2,900
Cabin Valley	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	3	-	1	-	2,725	2,725	"Layton"	2,725
Canfield	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	3	-	2	-	3,197	3,197	"Bartlesville"	2,976
Clark	-	-	-	-	10,303	-	-	-	-	10,070	3	-	1	-	9,021	---	-	---	---	7,807	---	"Bartlesville"	2,860
Clover	-	-	-	-	656	-	-	-	-	823	-	-	-	-	59	---	-	---	---	---	19,355	Kansas City	2,000
																						Mississippian	2,600
Combs*	-	-	-	-	51,944	-	1	-	-	48,577	-	-	-	-	40,631	---	-	---	---	38,164	326,977	"Bartlesville"	2,823
																						Mississippian	2,880
Copeland	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	3	-	137	137	Mississippian	2,811
Couch	1	-	-	-	118,387	-	1	1	-	90,337	1	-	1	-	74,416	4	-	3	-	77,186	1,873,221	"Bartlesville"	2,800
Countryman	-	-	-	-	15,468	-	-	-	-	13,265	1	-	1	-	10,189	1	-	1	-	10,259	---	"Layton"	2,800
																						Mississippian	2,970
Daniels	-	-	-	-	---	-	-	-	-	---	-	-	-	-	---	1	-	2	-	---	---		
David	1	-	-	-	38,610	-	-	-	-	35,166	3	-	1	-	66,982	8	-	2	-	149,104	1,288,818	"Bartlesville"	2,800
David South	1	-	-	-	16,291	-	-	-	-	14,272	1	-	1	-	15,462	4	-	1	-	17,351	130,000	"Bartlesville"	2,760