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PETROLEUM AND NATURAL-GAS FIELDS IN WYOMING

By
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Prepared in cooperation with the Geological Survey
United States Department of the Interior
and the University of Wyoming

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By RALPH H. ESPACH [2] and H. DALE NICHOLS [3]

INTRODUCTION

Wyoming contains many petroleum and natural-gas fields, and more than 250 geological structures have been mapped; however, only about 85 have been found (July 1938) to contain petroleum or natural gas, or both, in commercial quantities. To January 1938 approximately 434 million barrels of oil and 915 billion cubic feet of gas have been produced, and it was estimated that proved oil reserves in Wyoming amounted to 300 million barrels.[4]

The Salt Creek field, the largest in the Rocky Mountain area, alone has produced 64 percent of the State's oil and 46 percent of its gas. This field ranked thirteenth among the producing fields of the United States in total cumulative production as of January 1, 1938. On this basis it ranks with the Kern River and Huntington Beach fields of California and the Butler County fields of Kansas. The Salt Creek field has declined in relative importance; in 1937, while still the largest oil-producing field in the State, it produced 31 percent of the oil and 11 percent of the gas extracted from all wells in Wyoming.

Wyoming has never ranked very high in volume of oil produced, but in 1923, at the peak of its output, it held fourth place among the petroleum-producing States of the country, supplying, however, only 6.1 percent of the total for that year. In 1937 the State produced 1.46 percent of the total and held eighth place. The total oil produced in Wyoming from 1894 to January 1, 1938, was 2.17 percent of the total produced in the entire United States since 1859. The State's oil-production record is compared with that of the country as a whole in table 1.

From 1894 to 1912 the development of Wyoming's petroleum and natural-gas resources was retarded by lack of markets and transportation facilities. In 1912 pipe lines were built from the Salt Creek field to Casper, and refineries at Casper were enlarged. Later, as fields were developed, pipe lines were built to carry crude oil to refining centers or to railroads for shipment to refineries. The prolific production of oil in the Salt Creek field started extensive prospecting and development of other structures throughout the State. Structures thought to be suitable for oil and gas accumulation were numerous and easy to find. However, many operators who enthusiastically entered the area in search of oil were unsuccessful and, after a few years, withdrew from the State. Early prospecting was confined to

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[4] Hearings before a subcommittee of the Committee on Interstate and Foreign Commerce, House of Representatives, 73d Cong., on H. Res. 441, pt. 2, 1934, p. 1081. Boyer, W. W., Rocky Mountain Crude-Oil Reserves. II: Oil Weekly, vol. 79, November 4, 1935, pp. 24–29.

those structures in which certain sands likely to carry oil could be reached at reasonable depths by cable tools.

TABLE 1.—*Petroleum produced in Wyoming and in the United States* [1]

[Barrels of 42 gallons]

Year	Wyoming	United States	Year	Wyoming	United States
1859–1909		2, 164, 307, 000	1924	39, 498, 000	713, 940, 000
1894–1909	124, 000		1925	29, 173, 000	763, 743, 000
1910	115, 000	209, 557, 000	1926	25, 776, 000	770, 874, 000
1911	187, 000	220, 449, 000	1927	21, 307, 000	901, 129, 000
1912	1, 572, 000	222, 935, 000	1928	21, 461, 000	901, 474, 000
1913	2, 407, 000	248, 446, 000	1929	19, 314, 000	1, 007, 323, 000
1914	3, 560, 000	265, 763, 000	1930	17, 868, 000	898, 011, 000
1915	4, 246, 000	281, 104, 000	1931	14, 834, 000	851, 081, 000
1916	6, 234, 000	300, 767, 000	1932	13, 418, 000	785, 159, 000
1917	8, 978, 000	335, 316, 000	1933	11, 227, 000	905, 656, 000
1918	12, 596, 000	355, 928, 000	1934	12, 556, 000	908, 065, 000
1919	13, 172, 000	378, 367, 000	1935	13, 755, 000	996, 596, 000
1920	16, 831, 000	442, 929, 000	1936	14, 455, 000	1, 098, 516, 000
1921	19, 333, 000	472, 183, 000	1937 [2]	18, 703, 000	1, 277, 653, 000
1922	26, 715, 000	557, 531, 000			
1923	44, 785, 000	732, 407, 000	Total	434, 201, 000	19, 971, 209, 000

[1] White, A. G., Hopkins, G. R., and Breakey, H. A., Crude Petroleum and Petroleum Products: Bureau of Mines Minerals Yearbook, 1937, pp. 993, 1009.
[2] 1937 figures from Bureau of Mines Monthly Petroleum Statement 167, Feb. 9, 1938, p. 4.

In 1935 the discovery of light oil in the Lance Creek oil field in appreciable quantities and in formations deeper than those that had been prospected renewed interest in the oil possibilities of the State. In 1936 prospecting activity increased noticeably and it is believed will continue for some time.

The State contains a number of large structural basins: Big Horn, Powder River, Wind River, Bridger, Great Divide, Hanna, Carbon, Shirley, Laramie, and (in the southeast corner) part of the Julesburg. Around the margins of these basins the sedimentary rocks have been deformed, resulting in many anticlines and domes—the present known structures. Large parts of the basins are covered by formations of Tertiary age, the youngest members of which lie unconformably on older beds, which in turn may be unconformable to formations older than those of Tertiary age. In these large areas geophysical methods and equipment will be used in an endeavor to find Tertiary-covered structures in the Cretaceous and older formations. The Quealy Dome oil field, discovered in 1934, is reported to be the first productive structure defined by geophysical means (seismograph survey) in the Rocky Mountain area.

Figure 1 (case) is a correlation chart of the geologic formations in Wyoming, compiled in April 1925 by M. Grace Wilmarth, then secretary of the Committee on Geologic Names, Geological Survey, United States Department of the Interior, and revised in October 1937 by Miss Wilmarth and approved by G. F. Loughlin, chief geologist, Geological Survey, to show changes in classification since the initial preparation of the chart. The chart should prove valuable as a reference in finding and placing the producing sands and formations in the various oil and gas fields discussed in this bulletin. Figure 2 (case) is a map of Wyoming, showing the oil and gas fields, some unproved structures, oil and gas pipe lines, and highways.

The early recorded petroleum history of the State begins with Capt. Benjamin Bonneville's report to the War Department, in which he states that in 1833 he was directed by Indian guides to an

oil seep or spring at what is now the Dallas Dome oil field in the south central part of Fremont County. Not until 1884 was a hole drilled at this site to a reported depth of 300 feet, resulting in the discovery of gas and oil that flowed spasmodically. From 1884 to 1886 two more wells were drilled, flowing heavy black oil intermittently from depths of 400 and 750 feet. Some of this oil was hauled in iron drums 125 miles from the wells by horses and marketed at stations along the Union Pacific Railroad. Operations were abandoned temporarily when refined oils from Pennsylvania supplanted this heavy black oil. In 1901 and 1903 other wells were drilled in the field, but intensive operations were not undertaken until 1910.

The next published account (1848) of the occurrence of oil in Wyoming related to an examination of an oil seepage (Brigham Young oil spring) near Hilliard, sec. 4, T. 13 N., R. 119 W., in southern Uinta County, by the Mormons in their pioneer journey to Great Salt Lake in 1847. From then until 1886 oil was skimmed from seepages (primarily the Brigham Young, Judge White, and Carter oil springs) and pits dug near them; it was used for lubrication and medicinal purposes. The Brigham Young and Judge White seepages each yielded daily a few gallons of oil and the Carter 8 to 10 gallons of heavy black oil. About 150 barrels of oil was recovered from these seepages during the period 1867 to 1872. In 1867 and 1868 a hole was drilled to a depth of 480 feet at the Judge White oil spring in sec. 33, T. 14 N., R. 119 W., near Spring Valley, Wyo., but neither oil nor gas was found. In 1885 brackish sulfur water, containing a little oil and gas, flowed from a well drilled to a depth of 100 feet in sec. 23, T. 21 N., R. 117 W., near Fossil, Wyo. In 1886 two of three holes drilled 225 and 300 feet at the Carter oil springs in sec. 31, T. 15 N., R. 118 W., near Spring Valley, Wyo., were reported to produce 6 barrels of oil daily. In 1900 and 1901 oil was discovered at Spring Valley, Uinta County, in a well in sec. 27, T. 15 N., R. 118 W., 1,183 feet deep, that produced from sands 424 to 463, 567 to 575, and 1,147 to 1,159 feet deep.

For many years oil seeps had been known in the vicinity of the present Salt Creek field, Natrona County, approximately 45 miles north of Casper. In 1886 an eastern oil operator inspected these seepages and became interested in the oil possibilities of the area. In the fall of 1889 oil was found in a well, at a depth of about 1,000 feet, in what is now the abandoned Shannon pool at the north end of the Salt Creek field. In 1890 and 1891 three other wells were drilled in this pool, and in 1893 about 2,300 barrels of oil was hauled to Casper by 12- and 16-horse teams. Additional wells were drilled in the Shannon pool in 1895, 1901, 1902, and 1906. In 1908 the Salt Creek field proper was discovered.

The reader is referred to a report by Hon. H. H. Schwartz,[5] United States Senator, for additional information regarding early exploration for oil in Wyoming.

More than 100,000 barrels of oil was produced in Wyoming during 1910, mainly from the Salt Creek, Shannon, Dallas, Garland, and Spring Valley fields. By 1912 Wyoming was recognized as an oil-producing State. During that year a well with an initial daily oil production of 1,200 barrels was completed at Salt Creek; this dis-

[5] Schwartz, H. H., Oil History in Wyoming: Inland Oil Index, vol. 24, November 20, 1931, pp. 1, 4, 8; November 27, 1931, pp. 1, 2, 7.

covery started a period of extensive prospecting in Wyoming, especially in Natrona County. Two pipe lines were laid from Salt Creek to Casper, and two refineries were built at Casper. The production of oil in Wyoming increased steadily from 1910 until 1923, the peak year, when more than 44,300,000 barrels was produced.

During the period 1900 to 1938 approximately 6,700 wells were drilled for oil and gas in Wyoming—about 5,100 oil wells, 370 gas wells, and 1,230 dry holes. Until 1927 virtually all drilling was done with cable tools. Since then rotary drilling has gradually increased in favor and now is used for almost all drilling to depths beyond 3,000 feet. Rotary equipment was introduced into Wyoming in the Garland field in 1906 but at that time proved unsatisfactory. In 1917 the rotary method of drilling was tried in the Big Muddy field and in 1918 in the Rock River and Lance Creek fields, still without success. About 1927 to 1929, however, it gained favor, being used in drilling wells in the Big Muddy, Lost Soldier district, and Oregon Basin fields.

The Oregon Basin field, where the wells were drilled to a depth of about 3,600 feet, probably was the first developed successfully with rotary equipment. The outstanding development in early rotary drilling in the State was the satisfactory completion in 1931 of a well 8,596 feet deep on Neiber dome in Washakie County; this definitely established rotary drilling in the Rocky Mountain area. From 1931 to 1933 few wells were drilled, but when drilling was resumed in 1934 rotary equipment was used generally. Since then the rotary method has proved satisfactory despite the difficulty of drilling straight holes through very hard sand and shale beds dipping as much as 25° to 30° from the horizontal. Casing programs used commonly in drilling and completing wells in the active fields in Wyoming are given in table 4 (Appendix, p. 115).

The deepest hole in Wyoming, in sec. 13, T. 13 N., R. 68 W., about 8 miles west of Cheyenne, Laramie County, was drilled with rotary equipment to a depth of 9,385 feet and was completed as a dry hole in March 1937 and abandoned. The deepest producing well in Wyoming, in the Badger Basin field, sec. 17, T. 57 N., R. 101 W., Park County, was drilled by cable tools to a depth of 8,723 feet and completed as a flowing oil well in 1931. In drilling this well 4,182 feet of open hole was carried from a depth of 4,044 to 8,226 feet. The largest gas well in Wyoming was completed in the Little Buffalo Basin gas field, Park County, in 1921, with an initial daily production of 90 million cubic feet of gas; the largest oil well was completed in the United States Naval Petroleum Reserve No. 3, Natrona County, in 1923, with an initial daily production of 25,000 to 30,000 barrels of oil.

SCOPE OF REPORT

As stated in the introduction, approximately 85 geological structures in Wyoming have been found to contain petroleum, natural gas, or both. At least 75 oil or gas fields on these structures have produced or are producing some oil or gas of commercial value or have been proved of commercial value and shut in temporarily owing to market conditions. This report deals with each of these 75 fields and furnishes as much pertinent information and data as are available with the view of giving a fair over-all picture of the fields; many details, however, are necessarily omitted.

Most of the field reports give the following information: Geographical position and brief description of the geologic structure; history of the field development; geologic formations drilled, their depths and initial conditions; a map of the field showing structural features and location of wells; status of the field in 1938 as regards number of wells, quantity of oil, gas, and water produced, production methods, and water and gas conditions; analyses of the oil, gas, and water from the productive formations; yearly production of oil and gas during the life of the field or to 1938 (production-decline curves are given for a few oil fields); productive acreage in each formation; and disposal of the oil or gas produced. Mention is made of those fields developed and operated under unit or cooperative plans of agreement. The bulletin also contains a bibliography and an appendix which presents other information that may be of interest to readers desiring further detail, including casing programs used in active oil fields, oil and gas production data, and analyses of oil-field waters, natural gases, and crude oils of the State.

The authors desire to call attention to certain limitations regarding the material presented in this report. Although every precaution was taken to obtain accurate data, the authors could not study each field in detail; some inaccuracies therefore may be found in the report, and some of the maps may not record the latest or the most accurate interpretation of structural conditions in these fields but they give a general idea of structural features. Consequently, care should be taken in using the maps for any purpose other than that for which they are intended. The oil, gas, and water analyses (Appendix) are representative of samples submitted for analysis, but it should be remembered that in any given field these may vary somewhat from time to time or even from well to well.

ACKNOWLEDGMENTS

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The writers appreciate the assistance rendered by the oil and gas operators of Wyoming, who gave the Bureau representatives access to their properties and supplied information concerning them. Credit and thanks are extended the companies and individuals who furnished maps, supplied data that otherwise were unobtainable, and reviewed numerous chapters of the report.

Herman Stabler, chief, Conservation Branch, and Hale B. Soyster, chief, Oil and Gas Leasing Division, Conservation Branch, Geological Survey, supported the work and contributed in many ways. Engineers of the Oil and Gas Leasing Division, at Casper, Thermopolis, and Midwest, Wyo., supplied material for the report which, as a result, contains much information that otherwise could not have been included. The authors are also much indebted to the following employees of the Geological Survey: H. J. Duncan, supervisor, Northwestern District, Oil and Gas Leasing Division; R. D. Ferguson, C. A. Hauptman, and L. G. Snow, district engineers, and F. M. Blehr and J. R. Schwabrow for their assistance, suggestions, and critical reviews; R. R. Patterson and Harry Thompson for preparation of

maps; and C. E. Dobbin, Carle H. Dane, and R. M. Larsen for review of the manuscript.

M. Grace Wilmarth, former secretary of the Committee on Geologic Names, kindly revised the chart showing tentative correlation of geologic formations in Wyoming, reproduced in this bulletin as figure 1, with permission of the Director of the Geological Survey.

Hugh D. Miser, senior scientist, Geologic Branch, Geological Survey, and chairman of the Committee on Geologic Names, rendered appreciated assistance, and Alice S. Allen, secretary, Committee on Geologic Names, carefully checked all stratigraphic names appearing in the text and tables.

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The report was prepared under the general supervision of R. A. Cattell, chief engineer, Petroleum and Natural Gas Division, Bureau of Mines, and H. P. Rue, supervising engineer, Bureau of Mines Petroleum Experiment Station, Laramie, Wyo. The writers are especially grateful to C. C. Anderson, of the Bureau staff at the Amarillo (Tex.) helium plant, who supplied most of the data for table 5 from a report he is preparing for publication on analyses of natural gases from the western part of the United States, and to those members of the staff at Amarillo who made the gas analyses reported in the table. The constructive criticism of the manuscript by H. C. Fowler, H. C. Miller, H. B. Hill, C. P. Bowie, W. B. Berwald, and R. E. Heithecker, of the Bureau of Mines, is gratefully acknowledged.

Draftsmen of the Geological Survey in Washington, D. C., under the direction of C. A. Weckerly, and John Trevorrow, Jr., and Daniel Robertson, of the Bureau of Mines, rendered valuable assistance in preparation and revision of the illustrations. The many improvements in this bulletin that resulted from editing by Estelle R. Templeton, of the Bureau of Mines, are greatly appreciated.

REVIEW OF FIELDS

ALKALI BUTTE

Alkali Butte (fig. 3, case) is a closely folded anticline in secs. 1 and 2, T. 33 N., R. 95 W., and secs. 26, 35, and 36, T. 34 N., R. 95 W., Fremont County. The Steele shale outcrops at altitudes of 5,200 to 5,400 feet. Sandstone beds outcropping around the structure dip 40° to 50° on the west side and 15° to 20° on the east side. The north end of the structure is separated by a fault from the main structure and dips more gradually.

The field was discovered in 1920 on drilling a well in the SE¼NW¼ sec. 1 that produced approximately 8 million cubic feet of gas daily from the Frontier formation at depths of 2,481 to 2,493 feet; the shut-in wellhead pressure was 600 pounds per square inch. From 1920 to 1929 a number of small oil wells were completed in the north end of the field in the Shannon sandstone member of the Steele shale at depths of 900 to 930 feet but were unimportant and soon abandoned.

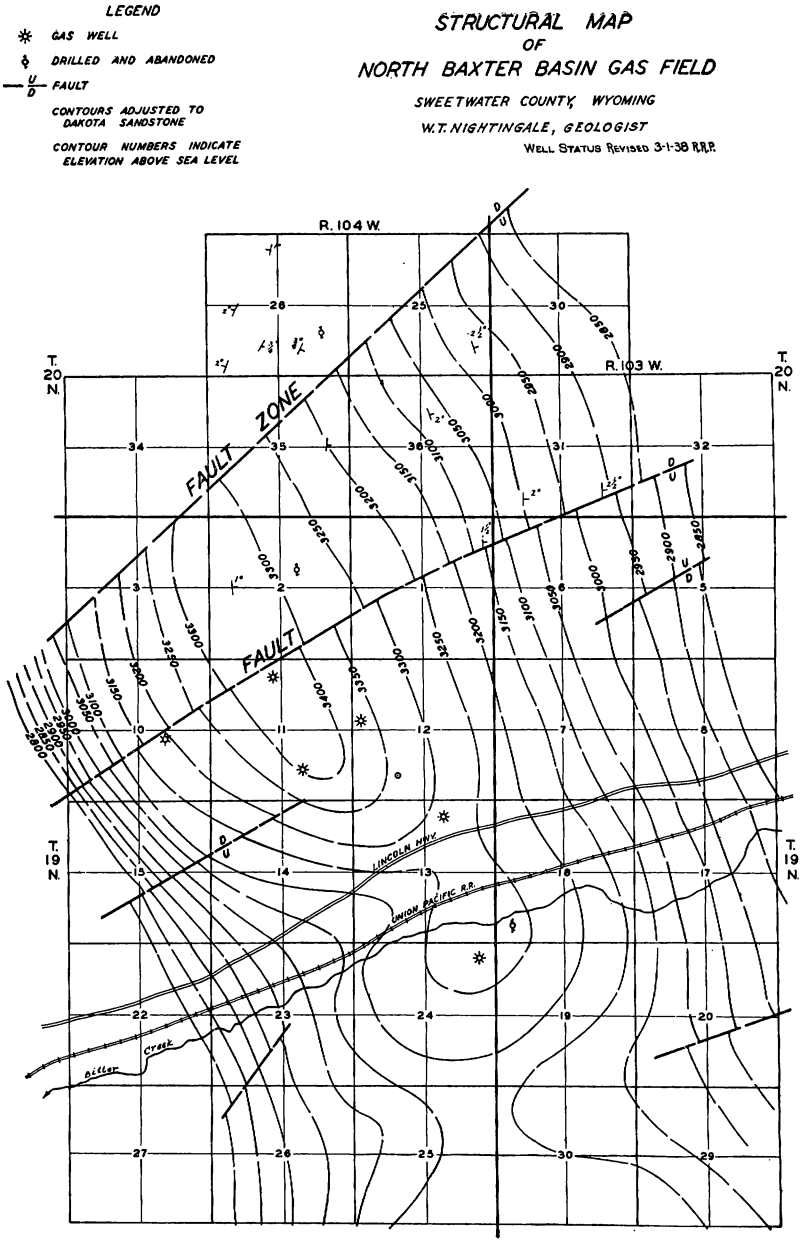

FIGURE 7.—Structural map of North Baxter Basin gas field.

In a test well to the Frontier formation in the north end of the field water was found in the sand at 3,544 to 3,560 feet. In 1928 a well was completed in the Muddy sand at a depth of 3,960 to 3,970 feet, with a reported initial daily production of 700 barrels of 33° A. P. I. gravity oil. This well also produced 1.5 million cubic feet of gas a day from the Cloverly formation at 4,151 to 4,156 feet. In 1931 a well drilled 4,482 feet and bottomed in the Morrison formation had an open-flow volume of 10 million cubic feet of gas daily from the Lakota sand at 4,381 to 4,394 feet; the shut-in wellhead pressure was 1,775 pounds per square inch. In 1933 another well was drilled 5,459 feet to the Chugwater formation. The Sundance sand at 4,920 to 4,930 feet was water bearing, and a sand in the Morrison formation at 4,571 to 4,595 feet produced at the rate of 6 million cubic feet of gas daily at a shut-in wellhead pressure of 1,850 pounds per square inch. A generalized log of the formations shows the Frontier formation at 2,600 to 3,233 feet, the top of the Dakota sand at 4,170 feet, the top of the Morrison formation at 4,250 feet, the upper Sundance sand at 4,860 to 4,960 feet, another Sundance sand at 4,995 to 5,050 feet, and the top of the Chugwater formation at 5,185 feet. About 21 wells were drilled on or near this structure, and all but 4 either were dry or produced for only a short time and were abandoned.

On January 1, 1938, there were two gas wells and one oil well in the field, with a capacity of approximately 5 barrels a day. Although the field can produce oil and gas, it has been shut in virtually since its discovery. The production of gas was 46.6 million cubic feet in 1920 and 39.7 million in 1921 and the production of oil, 7,720 barrels in 1928, 2,058 in 1930, 863 in 1931, and 553 in 1933. Analyses of the oil from the Muddy sand, gas from the Dakota sand, and water from the Frontier formation are given under Crude-oil Analyses (p. 124), in table 5 (p. 116), and in table 6 (p. 118), respectively.

A unit plan for the development and operation of the Alkali Butte field was approved by the Secretary of the Interior on October 1, 1936.

ALLEN LAKE AND EAST ALLEN LAKE

The Allen Lake gas field (fig. 4, case) in secs. 27 and 34, T. 23 N., R. 79 W., Carbon County, occupies a small dome at the northern end of the Allen Lake anticline, a structure about 7 miles long and 1 mile wide; the axis of the structure forms a reverse curve and in general trends northwest-southeast. The dome has about 900 feet of independent closure. The formations on the northeast flank dip as much as 75°, whereas those on the southwest flank range from 30° to 50°. The surface formation is Niobrara shale at an altitude of approximately 6,600 feet.

The Allen Lake field was discovered in 1919 on completion of a well in the NE¼NW¼ sec. 34 with a reported daily open-flow volume of 35 million cubic feet of gas from the Muddy sand at 1,357 to 1,397 feet. The upper Dakota sand contained water at 1,419 feet. A well drilled in 1925 disclosed gas or showings of gas in the following formations: Thermopolis (Muddy sand), from 1,324 to 1,364 feet; Cloverly, 1,400 to 1,555 feet; Morrison, 1,555 to 1,680 feet; and Sundance, 1,680 to 1,845 feet. Commercial production was developed in 1932 and 1933 when three wells were drilled and a combined open-flow

volume of approximately 75 million cubic feet of gas daily was established. The main producing formation is the Sundance; the initial shut-in wellhead pressure was 900 pounds per square inch. In July 1938 a well in the SE¼NW¼ sec. 34 was drilled 4,362 feet and abandoned. The depths to the top of the formations were: Sundance, 2,270 feet; Chugwater, 2,551 feet; and Tensleep, 3,864 feet (Tensleep sandstone was water bearing).

On January 1, 1938, there were three gas wells in the field that had been "pinched down" since early in 1937 to supply only a small quantity of gas to Medicine Bow. Analyses of gas from the Morrison and the Sundance formations are given in table 5 (p. 116). The field has produced 1.7 billion cubic feet of gas since 1933, when the gas was piped to Laramie. Since early in 1937 the gas used for domestic and industrial purposes in Laramie has come from the Medicine Bow field. The yearly production of gas is given in table 8 (p. 122). It is estimated that about 320 acres in the Sundance is productive.

The East Allen Lake gas field (fig. 4) in secs. 17 and 18, T. 22 N., R. 78 W., Carbon County, occupies a small dome at the southeastern end of the Allen Lake anticline. The surface formation is a shale of Benton age. The field was discovered December 25, 1936, when a well drilled in the NE¼SE¼ sec. 18 flowed gas at the rate of 15 million cubic feet daily from the upper sand in the Sundance formation at 2,044 to 2,085 feet. The Wall Creek sand was reached at 606 feet (contained water), the Muddy sand at 1,475 to 1,512 feet (showing of gas), the Dakota at 1,540 to 1,574 feet, the top of the Morrison at 1,589 feet, the top of the Sundance at 1,855 feet, and gas at 2,044 to 2,085 feet. The well was drilled to a depth of 2,374 feet but was plugged back to 2,186 and completed as a gas well; the initial daily production was 5 million cubic feet and the shut-in wellhead pressure, 1,020 pounds per square inch. A second well completed in August 1937 produced 45 million cubic feet of gas daily from the Sundance formation at 1,952 to 2,045 feet. Analysis of the gas is given in table 5 (p. 116).

ANT HILLS

The Ant Hills structure (fig. 5, case) in secs. 19 and 30, T. 37 N., R. 62 W., and secs. 24 and 25, T. 37 N., R. 63 W., Niobrara County, is believed to be a small circular dome with a closure of about 150 feet defining an area of about 400 acres. The flanks of the structure dip 4° to 8°. The surface formation is Pierre shale at an altitude of approximately 4,100 feet.

Oil was discovered in 1928 on drilling a well in the northeast corner of sec. 25 that produced 178 barrels of oil daily from the Muddy sand at 3,945 to 3,952 feet. The top of the Carlile shale was reached at 2,485 feet. An offset well to the east had a showing of oil in the Muddy and Lakota sands. A production test was made on the discovery well, after which the well was shut in. The production of oil in 1928 was 6,503 barrels and in 1929, 50 barrels. Analysis of oil that had been in storage for a number of years is given under Crude-oil Analyses (p. 124).

A unit plan for the development and operation of the Ant Hills dome area was approved by the Secretary of the Interior on November 15, 1937.

ARMINTO AND LOX

The Arminto and Lox structures are on a line of folding that extends northeast and southwest through T. 37 N., R. 86 W., Natrona County. The Arminto structure, an asymmetrical anticline in secs. 17 to 20, inclusive, is estimated to have 250 feet of independent closure. Formations on the southwest flank dip as much as 70° and those on the northeast flank as much as 25°. The Steele shale is exposed on the surface.

In 1917 a well drilled in the SE¼ sec. 18 through the Second Wall Creek sand produced approximately 200,000 cubic feet of gas daily. In 1923 a well in the NW¼ sec. 20 produced gas at the rate of about 5 million cubic feet daily from the Wall Creek sands at depths of 1,787 to 1,930 feet. It later was drilled to the Lakota sand to a depth of 3,535 feet but was plugged back to the Wall Creek sands and completed as a gas well. Since 1932 some gas has been produced from this well for domestic consumption in Arminto.

The Lox structure in secs. 34 and 35 appears to be a dome about 3 miles southeast of the Arminto structure. The Steele shale outcrops at an altitude of about 6,000 feet. In 1921 a well drilled in the NW¼ sec. 35 produced 3 million cubic feet of gas daily from the Second Wall Creek sand at depths of 2,068 to 2,088 feet. The well was plugged and abandoned. In 1920 a dry hole was drilled, apparently off structure, in the SW¼ sec. 35.

BADGER BASIN

The Badger Basin structure (fig. 6, case) in the west half of T. 57 N., R. 101 W., Park County, is a dome with an areal extent of about three sections within approximately 150 feet of closure. The flanks of the structure dip uniformly outward from the crest at angles of 2° to 4°. The Fort Union of Tertiary age is the surface formation at an altitude of about 4,275 feet near the crest of the structure.

In July 1931 a well in the SW¼NE¼ sec. 17, completed at a depth of 8,723 feet in the Frontier formation, produced 55 barrels of 50° A. P. I. gravity oil and ¼ million cubic feet of gas daily. The well flowed through 1¼-inch tubing. When it was shut in the wellhead pressure built up to 3,000 pounds per square inch within a week and had to be released because of inadequate wellhead equipment. The Frontier formation was logged between 8,190 and 8,690 feet and below it the Mowry shale. Gas and oil were found at 8,250 to 8,295 feet (probably Torchlight sandstone member) and a marked increase of oil at 8,490 to 8,591 (probably Peay sandstone member). This well has attracted much attention because it was drilled with cable tools to a depth of 8,723 feet, with open hole from 4,044 to 8,226, or 4,182 feet. Six strings of casing, ranging from a 20-inch conductor to a 5¾-inch oil string, were run in the hole. A second well, drilled with rotary drilling equipment, was completed in December 1936 in the Frontier formation at 8,250 to 8,463 feet; the initial daily flowing production was 200 barrels. Two more wells were drilled in 1938, but oil production was small.

On May 1, 1938, there were three flowing wells in the field, one producing about 40, another about 8, and the third about 200 barrels of oil daily. Analyses of the oil and gas are given under Crude-oil Analyses (p. 125) and in table 5 (p. 116), respectively. Production

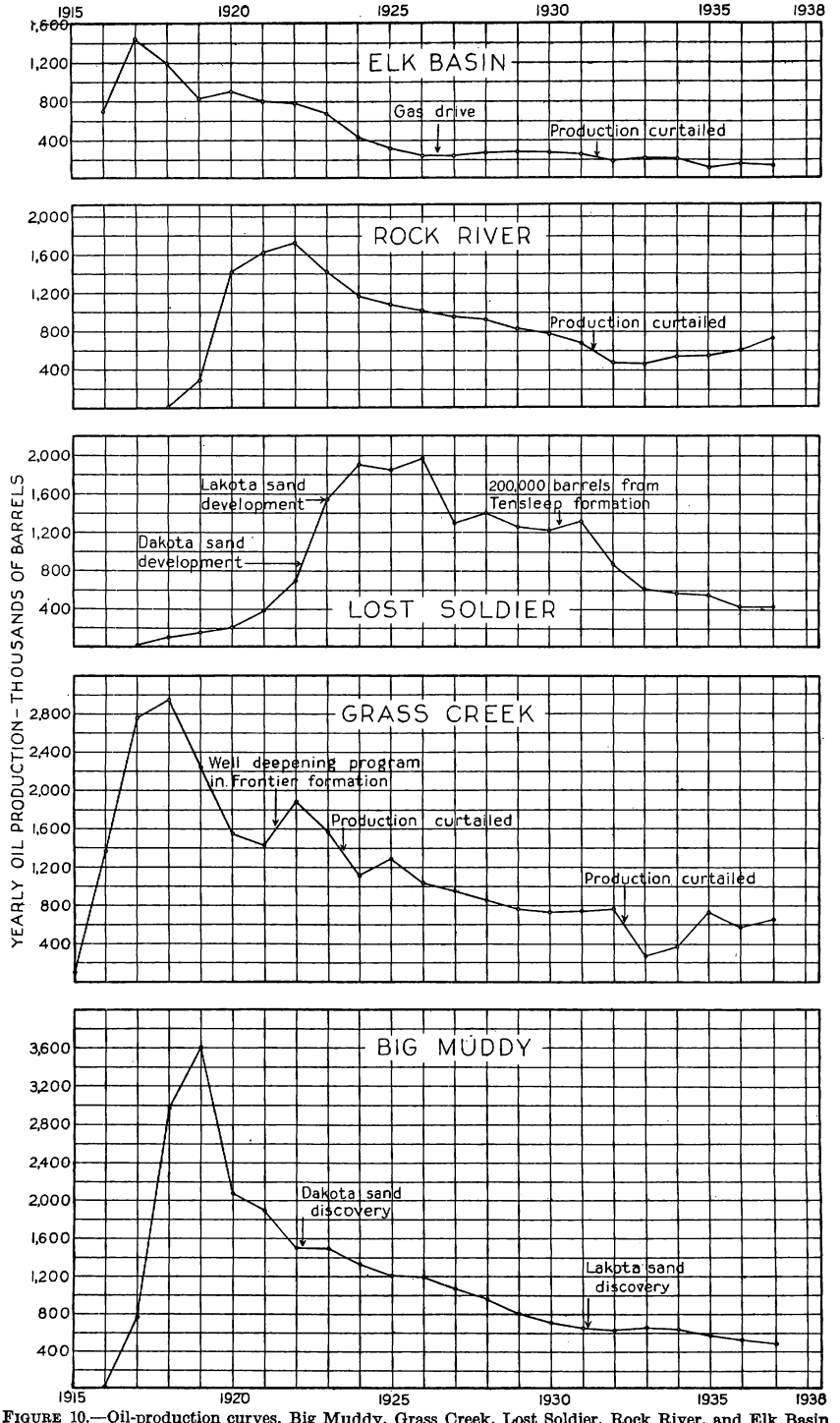

FIGURE 10.—Oil-production curves, Big Muddy, Grass Creek, Lost Soldier, Rock River, and Elk Basin fields.

figures for the years 1931 to 1937, inclusive, are given in table 7 (p. 120). Too little drilling has been done to determine the productive area of the field. The oil is processed for its gasoline and tractor-fuel content at a small plant in the field, and these products are sold locally.

BAXTER BASIN (NORTH AND SOUTH)

The North and South Baxter Basin gas fields are on the Rock Springs anticlinal uplift in Sweetwater County. The escarpments of the Mesaverde formation, which are nearly continuous on this uplift, are 10 to 12 miles apart across the structure and about 40 miles apart north and south. Baxter shale covers the central area. The North and South Baxter Basin gas fields occur at two local severely faulted structural "highs" on this large uplift. The North field is about 1,200 feet lower structurally than the South field. A generalized section of the geologic formations in the Baxter Basin gas fields based on drilling records and Geological Survey Bulletin 781 shows the following thickness in feet: Baxter shale, 3,350 to 3,600; Frontier, 85 (approximately); Aspen shale, 455; Cloverly, 125; Morrison, 360; Twin Creek limestone, 125; Nugget sandstone, 950; Ankareh shale, 200; Thaynes (?) formation and Woodside shale, 760; and Park City formation, 115. The Weber quartzite is below the Park City formation.

The North Baxter Basin gas field (fig. 7) is in T. 19 N., Rs. 103 and 104 W. One of the two main transverse faults in the structure was a factor in determining the gas-bearing area of the field. The closure is estimated to be approximately 275 feet. The Baxter shale at the surface is at an altitude of about 6,300 feet. Gas was discovered in the North Baxter Basin field in November 1926 in a well in the NE¼NW¼ sec. 11, T. 19 N., R. 104 W., that produced 14 million cubic feet daily from the Dakota sand at 2,920 to 3,068 feet; the shut-in wellhead pressure was 1,200 pounds per square inch. In August 1929 a well in the NE¼NE¼ sec. 24, T. 19 N., R. 104 W., produced 3½ million cubic feet of gas from the Sundance formation at 3,504 to 3,528 feet; the shut-in wellhead pressure was 1,450 pounds per square inch. Nine wells were drilled in the field, and six gas wells were completed. Three of these were completed in the Dakota sand at depths of 2,950 to 3,155 feet, with initial daily productions of 10 to 17 million cubic feet, a total of 40 million; the shut-in wellhead pressure was 1,210 to 1,270 pounds per square inch. The other three were Sundance wells, at a depth of 3,465 to 3,650 feet, with an initial daily production of 3½ to 7 million cubic feet each; the shut-in wellhead pressure was 1,450 pounds per square inch. One well in the SW¼NE¼ sec. 2 yielded a small quantity of oil—about 2 barrels a day—from the Sundance.

On April 1, 1938, six gas wells in the North Baxter Basin field averaged 6 million cubic feet daily, based on the total production in 1937. All wells in North Baxter Basin produce sweet gas. Analyses of gas from the Frontier, Dakota, and Sundance sands are given in table 5 (p. 116). The total volume of gas produced in the North Baxter Basin field to 1938 was 12.3 billion cubic feet; yearly production is given in table 8 (p. 122).

The South Baxter Basin gas field (fig. 8, case) is in Tps. 16, 17, and 18 N. and Rs. 103 and 104 W. Structurally the South Baxter Basin

field comprises three areas separated by faulting. The north area is comparatively free from faulting, whereas the south area is highly faulted. The Bishop conglomerate of Tertiary age covers part of the north area at an altitude of approximately 8,600 feet.

Small showings of oil and gas had been found in South Baxter Basin as early as 1916, but commercial accumulations of gas were not proved until August 1922 when a well in the NE¼SE¼ sec. 16, T. 16 N., R. 104 W., which flowed 1 million cubic feet daily from the Frontier formation at 2,050 to 2,135 feet, produced 36 million cubic feet (estimated) from the Dakota sand at 2,475 to 2,515 feet. Another well, drilled during 1923 in sec. 21, T. 16 N., R. 104 W., produced 2 million cubic feet from the Frontier formation at 2,440 to 2,460 feet and 60 million cubic feet from the Dakota sand at 2,828 to 2,900 feet. Twenty-three gas wells were completed in the field to 1938. Twelve yielded sweet gas (free from hydrogen sulfide) from the Frontier formation; initial daily production was 1¼ to 18 million cubic feet, and the combined open-flow volume was 75 million cubic feet. Initial shut-in wellhead pressure ranged from 630 to 780 pounds per square inch and averaged 730. Depth to the top of the producing formations ranged from 1,800 to 2,700 feet. Eleven wells completed in the Dakota sand produced sour gas (containing hydrogen sulfide); initial daily production was 7 to 65 million cubic feet, and the combined open-flow volume was 300 million cubic feet. Shut-in wellhead pressure ranged from 735 to 875 pounds per square inch and averaged 780 pounds. Depth to the sand ranged from 2,100 to 3,570 feet. On January 1, 1938, the 23 wells in the field averaged 10 million cubic feet of gas daily, based on the total production for 1937. Analyses of the gas from the Frontier and Dakota formations are given in table 5 (p. 116).

Early in 1938 three small gas wells were completed in what is referred to as Middle Baxter Basin, which includes the southern part of T. 19 N. and most of T. 18 N., Rs. 103 and 104 W. One well in the SE¼SE¼ sec. 12, T. 18 N., R. 104 W., produced 3.5 million cubic feet daily from the Dakota sand at a depth of 2,490 feet; and another in the NW¼NW¼ sec. 30, T. 18 N., R. 103 W., produced 2.2 million cubic feet daily from the Frontier formation at 1,690 to 1,725 feet.

The gas from the Dakota sand in North Baxter Basin contains no sulfur, whereas that in South Baxter Basin contains 32 to 77 grains of hydrogen sulfide per 100 cubic feet. The Sundance formation produces sweet gas in North Baxter Basin but is barren in South Baxter Basin, even though the latter field is much higher structurally on the same major axis of folding. The total volume of gas produced in the South Baxter Basin field to 1938 was 19 billion cubic feet; yearly production is given in table 8 (p. 122). Gas from the North and South Baxter Basin fields is piped to Salt Lake City and Ogden, Utah, and to a number of cities in southwestern Wyoming where it is used for domestic and industrial purposes. The main gas-transportation system, including the line from Clay Basin and the Hiawatha area, is one of the largest in the State; it consists of 18 miles of 8-inch, 33 miles of 10-inch, 40 miles of 14-inch, 83 miles of 16-inch, and 122 miles of 18-inch pipe.

BIG MUDDY

The Big Muddy oil field (fig. 9, case) in the north half of T. 33 N., R. 76 W., Converse County, is on a structure of the anticlinal type; the outcropping sands dip 2° to 10° on all sides, except on the north where they dip about 20°. The structure has a closure of about 500 feet. The Pierre shale is exposed on the surface at an average altitude of about 5,000 feet.

The field was discovered in 1916 on completion of a well in the NE¼NE¼ sec. 9, with an initial daily production of 26 barrels of oil from the Shannon sand. Wells completed later in the Shannon sand averaged 35 barrels of 34° A. P. I. gravity green oil daily, although a few produced 300 to 400 barrels. In 1917 a well in the NW¼SE¼ sec. 7 was completed with an initial daily production of 128 barrels of oil from the deeper Wall Creek sands at a depth of 3,147 to 3,217 feet. In 1922, 36° A. P. I. gravity brown oil was discovered in the Dakota sand, and in 1931 a well in the NE¼NE¼ sec. 9 completed in the Lakota sand, at a depth of 4,353 to 4,364 feet, produced 405 barrels of 32° A. P. I. gravity brown oil daily. The Lakota sand, however, also carried water. About 403 wells were drilled on and near the Big Muddy structure, of which 226 either were dry or by 1937 had been abandoned and 21 had been shut down permanently. Wells in the Wall Creek sands produced some gas along with the oil. The daily production of gas in 1918 and 1919 was more than 4 million cubic feet but decreased with the oil production to about half a million in 1936. In 1935 a deep test was drilled on top of the structure in which the following sands and formations were logged: Shannon sand at 945 to 993 feet, Wall Creek sands at 3,011 to 3,130 feet, Muddy sand at 4,210 to 4,215 feet, Dakota sand at 4,276 to 4,281 feet, Lakota sand at 4,362 to 4,406 feet, Sundance formation at 4,570 to 4,910 feet (the first sand member was dry, the second carried water, and the third, 45 feet thick, carried water), Chugwater formation at 4,940 to 5,704 feet, Embar lime at 5,705 to 5,933 feet, Tensleep sandstone at 5,933 to 6,247 feet (dry), Amsden formation at 6,247 to 6,553 feet, and Madison limestone (porous and crystalline) at 6,553 feet.

On June 1, 1938, the 142 wells in the field produced at the rate of about 1,200 barrels daily; 9 each produced about 3 barrels of 34° A. P. I. gravity green oil from the Shannon sand, and 114 produced about 900 barrels of 35° A. P. I. gravity green oil from the Wall Creek sands. The largest well in the Wall Creek sands at that time produced 30 barrels of oil a day, and the others ranged from 2 to 25 barrels of oil and 50 percent of water. Two wells in the Dakota, three in the Lakota, and one combination Dakota and Lakota well produced 35 to 115 barrels of oil a day, or about 310 barrels in the aggregate. Wells in the Lakota sand produced about 8 barrels of water per barrel of oil. About 13 so-called stray-sand wells in the northeast corner of the field produced a total of about 100 barrels of oil a day from the Niobrara shale at depths of 1,600 to 2,600 feet. Analyses of oils from the Shannon, Wall Creek, Dakota, and Lakota sands, gas from the Wall Creek sands, and waters from the Shannon, Wall Creek, and Sundance sands are given under Crude-oil Analyses (pp. 126 and 127), in table 5 (p. 116), and in table 6 (p. 118), respectively.

The total oil production from the Big Muddy field to 1938 was 25,683,281 barrels; yearly production is given in table 7 (p. 120) and

plotted as an oil-production curve in figure 10. The volume of gas reported for 1922 to 1932, inclusive, is shown in table 8 (p. 122); this, however, represents only a small part of the gas actually produced —probably only that sold—as virtually all of it was used in the development and production of the oil; no records are available of the total volume produced. Based on a productive area of approximately 2,640 acres, the recovery per acre in the field to 1938 has been 9,728 barrels. Most of the oil is piped about 5 miles to a refinery at Glenrock, Wyo.

BIG SAND DRAW

The Big Sand Draw gas field (fig. 11, case) in the northeast quarter of T. 32 N., R. 95 W., Fremont County, is on an anticlinal structure, the east flank of which dips about 30° and the west flank considerably more. The structure is concealed by flat-lying beds of the Wind River formation of Tertiary age, which unconformably overlie the folded rocks. The Mesaverde formation, exposed north of the field in a curved outcrop, indicated a structure and led to the discovery of the field. The average surface altitude is 6,200 feet.

The field was discovered in 1918 on completion of a well in the NE¼SW¼ sec. 10 in the first Frontier sand, at a depth of 2,427 to 2,485 feet, with an estimated daily open-flow volume of 40 million cubic feet of gas; the initial shut-in wellhead pressure was 1,350 pounds per square inch. Later 11 more gas wells were drilled to the Frontier sands and 1 to the Cloverly formation, and a combined open-flow volume of more than 200 million cubic feet of gas a day was developed. The shut-in wellhead pressure of wells in the Frontier sands ranged from 650 to 1,100 pounds per square inch. The log of a deep-test well drilled on top of the structure in the NW¼SW¼ sec. 14 showed the following: Frontier, 2,300 to 3,060 feet; Mowry and Thermopolis, 3,060 to 4,217 feet; Cloverly, 4,217 to 4,385 feet; Morrison, 4,385 to 4,979 feet; and Sundance, 4,979 to 5,345 feet. This well was drilled to a depth of 5,345 feet but was plugged back to 4,350 feet (water having been found in the base of the Sundance) and was completed in the Cloverly formation, which yielded gas at a pressure of about 2,000 pounds per square inch. The well was mudded in, and no production tests were made until the fall of 1937 when the well was reconditioned and produced at the rate of 54 million cubic feet of gas a day.

By 1938 there were 12 wells in the field—11 in the Frontier and 1 in the Cloverly. The field averaged about 9 million cubic feet of gas a day in 1936, and during the fall of 1937 it increased its production to 20 to 25 million cubic feet a day. Casper and the sugar-beet plants in Wyoming and Nebraska were supplied from the Big Sand Draw and Muskrat gas fields when the gas fields in the Lost Soldier district were shut in and the line from Lost Soldier to Casper was taken up. Analyses of the gases from the Frontier and Cloverly formations are given in table 5 (p. 116).

The total gas production reported from the field to January 1, 1938, was 45.4 billion cubic feet; yearly production is given in table 8 (p. 122). In addition, some gas was wasted in the early life of the field. From 1922 to 1928, 5 to 6 million cubic feet of gas a day was piped to Riverton, Wyo., where it was processed in an absorption gasoline plant and the residue burned in a carbon-black plant. In

1928 the manufacture of carbon black was discontinued, and the gasoline plant was moved to the field; it is now operated primarily to "dry" the gas by removing some of the heavier hydrocarbons and water. The liquid yield is about 0.1 gallon per 1,000 cubic feet of gas.

The productive area of the field has not been determined on the east and south sides, but it is believed that at least 1,200 acres in the Frontier formation has been proved productive. It appears also that an appreciable gas reserve is available in the Cloverly formation. Gas is piped from the field to Lander, Riverton, and Fort Washakie, Wyo., through a northern line and to Casper, Wyo., and points east into Nebraska through an eastern line.

A unit plan for the development and operation of the Big Sand Draw gas field was approved by the Secretary of the Interior on February 11, 1932.

BILLY CREEK

The Billy Creek gas field (fig. 12, case) in the west half of T. 48 N., R. 82 W., Johnson County, is on an anticlinal structure whose axis forms a reverse curve. The Pierre shale outcrops at altitudes of 4,930 to 5,110 feet. The east flanks of the structure dip 7° to 15° and the west flanks 10° to 15°. The structure has about 500 feet of closure.

The discovery well in the SE¼SE¼ sec. 17 was "brought in" in January 1923; it tested initially 58 million cubic feet of gas a day from the Second Wall Creek sand of the Frontier formation at 3,182 to 3,200 feet. The shut-in wellhead pressure was 1,150 pounds per square inch. Later about 10 other wells were drilled into the Frontier formation to depths of 3,135 to 3,300 feet; 6 were gas wells and 1 an oil well. Initial open-flow tests ranged from 30 to 68 million cubic feet—a combined initial open flow of over 300 million cubic feet of gas a day—and shut-in wellhead pressure from 1,000 to 1,150 pounds per square inch. Two of the gas wells also produced some oil. The oil well, the lowest (structurally) producing well in the field, was completed in 1929, yielding 100 barrels of 20° A. P. I. gravity green oil daily. Water was found in the Frontier formation in wells drilled still farther down structure. Evidently the Second Wall Creek sand contains gas on top of the structure above a thin band of oil overlying water. A deep-test well was drilled in 1937 on the crest of the structure to a total depth of 7,775 feet in the Bighorn dolomite. The Shannon sand was reached at 862 to 1,020 feet, First Wall Creek sand at 3,160 to 3,170 feet, Second Wall Creek sand at 3,665 to 3,720 feet, Lakota sand at 4,613 feet (water bearing), Morrison at 4,637 feet, Sundance at 5,047 feet (dry), Chugwater at 5,190 feet, Embar at 6,130 feet, Tensleep at 6,258 feet, Amsden at 6,570 feet, Madison at 6,848 feet, and Bighorn dolomite at 7,260 feet. No showings of oil were reported, and the well was plugged and abandoned.

On January 1, 1938, there were five producing gas wells in the field; two oil wells were shut in. The gas wells averaged 1.2 million cubic feet a day during 1937. Analysis of the gas is given in table 5 (p. 116). Gas production from the field was begun in 1930 when a 8-inch line was laid to Buffalo and Sheridan, Wyo.; production by years is given in table 8 (p. 122), the total production to 1938 being about 1.9 billion cubic feet. Approximately 560 acres in the field is gas bearing, but the extent of the oil-bearing area has not been determined.

A unit plan for the development and operation of the Billy Creek field was approved by the Secretary of the Interior on April 11, 1932.

BISON BASIN

Bison Basin (formerly Buffalo Basin) in the northwest part of T. 27 N., R. 95 W., Fremont County, is a faulted area (fig. 13, case). The Niobrara shale is exposed on the crest of the structural high in sec. 17, at altitudes of 7,000 to 7,250 feet. In 1923 a well drilled in the NE¼SW¼ sec. 17 through three sands in the Frontier formation at depths of 603 to 620 feet, 875 to 889 feet, and 1,040 to 1,062 feet produced about 20 million cubic feet of gas a day; the shut-in wellhead pressure was only 100 pounds per square inch. Gas from the well was used in drilling other wells. Nine wells were drilled in the area, of which seven were abandoned and two shut in. The initial daily production of one of the shut-in wells was 4 million cubic feet of gas from sands in the Frontier formation at 905 to 955 and 1,060 to 1,067 feet; the shut-in wellhead pressure was 42 pounds per square inch. The other was reported to have a capacity of about 8 barrels of oil a day from a Frontier sand at 842 to 870 feet. Since 1930 the field virtually has been abandoned. Analysis of the gas from the Frontier formation is given in table 5 (p. 116). The production of gas was reported as 38.8 million cubic feet in 1924 and 13.6 million in 1926.

BLACK MOUNTAIN AND LAKE CREEK

Black Mountain (fig. 14, case) is a sharply folded anticline extending from the northwest corner of T. 42 N., R. 90 W., into the southeast corner of T. 43 N., R. 91 W., Hot Springs County. An idea of the topography of the area may be gained from the contour map of the structure (fig. 14). The Mowry shale is exposed on the surface at an altitude of about 5,700 feet. Outcrops of the Frontier formation on the north flank of the structure dip 10° to 20° and those on the south about 60°. The structure has about 1,100 feet of closure opening on the southwest into the Lake Creek anticline.

Oil in commercial quantities was discovered on this structure in 1923 when a well in the SW¼NW¼ sec. 36 was brought in, producing 300 barrels of 24° A. P. I. gravity black oil daily from the Tensleep sandstone at 3,176 to 3,245 feet. Five other wells were completed, three in the Tensleep and two in the overlying Embar lime. The initial production of the wells ranged from 200 to 300 barrels a day. The gravity of the oil from the Tensleep sandstone was 19° to 24° A. P. I. and of that from the Embar about 26° A. P. I. A composite log of the formations on this structure, starting at the base of the Frontier formation, showed the following: 210 feet of Mowry shale, 650 feet of Thermopolis shale (including the 110-foot water-bearing Muddy sand 350 feet below the top of the Thermopolis shale), approximately 110 feet of Cloverly formation, 190 feet of Morrison formation, 280 feet of Sundance formation, 1,320 feet of Chugwater formation, 300 feet of Embar lime, about 300 feet of Tensleep sandstone (including a 73-foot oil-bearing zone at the top with water beneath), about 90 feet of Amsden formation, and at least 275 feet of Madison limestone.

On January 1, 1938, the six oil wells in the field produced at the rate of 20 to 100 barrels daily, a total of approximately 250 barrels a day for the field. Water has been the source of much trouble in the field for

a number of years—four of the wells were drilled into water and then plugged back. All wells, except the highest one structurally, produced water, the quantities ranging from 3 to 40 percent of the total fluid, or about 50 barrels a day. The wells are pumped individually. Analyses of a composite sample of the oil from the field, gas from the Embar lime, and waters from the Embar and Tensleep formations are given under Crude-oil Analyses (p. 128), in table 5 (p. 116), and in table 6 (p. 118), respectively. The Black Mountain field has produced 234,106 barrels of oil to 1938. Yearly production is given in table 7 (p. 120). The wells are produced when there is a market for the oil; the oil is processed in a refinery at Thermopolis, Wyo.

The Lake Creek structure (fig. 14) is a long, narrow anticline paralleling the Black Mountain anticline. The axis of the anticline extends from sec. 2, T. 42 N., R. 91 W., Hot Springs County, to sec. 24, T. 43 N., R. 92 W., Washakie County, the high on the axis being in secs. 28 and 29, T. 43 N., R. 91 W. The Frontier is the surface formation at an altitude of 5,079 feet at the one well on the structure. The structure has about 800 feet of closure independent of the Black Mountain anticline.

In 1925 a well drilled in the NE¼NW¼ sec. 34, T. 43 N., R. 91 W., to the Embar lime at 3,705 to 3,720 feet disclosed a 15-foot zone of oil-saturated limestone that could produce initially 238 barrels of 24° A. P. I. gravity oil a day by pumping. Four other wells were drilled on or near the structure and abandoned. The one well produces intermittently. When last pumped it yielded 20 barrels of oil and an equal quantity of water daily. Production reported was 1,078 barrels in 1925, 8,098 in 1926, 3,949 in 1927, 218 in 1932, and 375 in 1936. Analysis of Lake Creek oil that had been in storage for 3 years is given under Crude-oil Analyses (p. 145).

BOLTON CREEK

The Bolton Creek oil field (fig. 16, case) in secs. 3, 4, 9, and 10, T. 29 N., R. 81 W., Natrona County, occupies a small dome on the Bolton Creek anticline. A rim rock of the Wall Creek sandstone member of the Frontier formation encircles the field. The flanks of the dome dip 10° to 60°. The Frontier is the surface formation at an altitude of about 6,030 feet. A major east-west fault cuts across the north end of the structure. The dome has an independent closure of about 600 feet.

The field was discovered in January 1920 when a well in the SE¼SE¼ sec. 4 came in, producing initially 50 barrels of 22° A. P. I. gravity black oil daily from the Sundance formation at 1,100 to 1,135 feet. Later in 1920 a well in the NW¼NW¼ sec. 10 made an initial daily production of 300 barrels of 32° A. P. I. gravity black oil from the Embar lime at 2,070 to 2,078 feet. About 16 wells were drilled on the structure, of which 6 produced oil from the Sundance formation and 6 from the Embar lime and 4 were dry holes. The wells completed in the Sundance formation were 1,078 to 1,135 feet deep and produced initially 50 to 100 barrels daily. The wells completed in the Embar lime were 2,046 to 2,218 feet deep and produced initially as much as 500 barrels a day. The Dakota sand, at a depth of approximately 625 feet, was 50 feet thick and produced flowing water; the Tensleep sand, at a depth of 2,300 feet, also was water bearing.

By 1938 all wells in the field except three (two in the Sundance and one in the Embar formation) had been plugged and abandoned. The

three remaining wells produced 2,622 barrels of oil in 1937. Analyses of the water from the Dakota sand and the oils from the Embar and Sundance formations are given in table 6 (p. 118) and under Crude-oil Analyses (pp. 128 and 129), respectively. The wells in this field have produced over 43,000 barrels of oil; yearly production is given in table 7 (p. 120). The productive area was about 80 acres, and water soon flooded most of the wells. The oil is trucked to Casper, Wyo. At one time, however, it was transported from the field to Casper through a 6-inch oil line 29 miles long.

BOONE DOME AND NORTH BOONE DOME

The Boone Dome gas field (fig. 15) in secs. 9, 10, and 15, T. 35 N., R. 85 W., Natrona County, is on a small anticline and has about 100 feet of closure. The Steele shale forms the surface of the structure at an altitude range of 5,900 to 5,950 feet. The Parkman sandstone member of the Mesaverde formation outlines most of the structure and dips 20° to 30° on the east and west flanks.

The field was discovered in 1923 on drilling a well in the NE¼NW¼ sec. 15 that produced about 2 million cubic feet of gas daily from the Shannon sand at a depth of about 1,600 feet; the shut-in wellhead pressure was 500 pounds per square inch. When the well was deepened additional gas was found in a sand at a depth of 2,200 feet; the volume of gas from the two sands was 4 million cubic feet a day. The shut-in wellhead pressure was 760 pounds per square inch. In 1919 a well drilled in the SE¼SW¼ sec. 4 flowed approximately 2 million cubic feet of gas daily from the Shannon sand at a depth of 1,580 to 1,620 feet, but the well was plugged and abandoned. In 1923 and 1925 five gas wells were completed, initial daily production ranging from 1 to 4 million cubic feet. The structure was tested to a depth of 5,192 feet where drilling stopped in the Mowry shale. The Frontier sands were unproductive. By 1938 the field was about depleted. Three wells that formerly delivered some gas into the Big Sand Draw-Casper gas line were shut in. One well furnished low-pressure gas to Powder River, Wyo. The gas is analyzed in table 5 (p. 116). The total production of gas from the field to 1938 was 1.2 billion cubic feet; yearly production is given in table 8 (p. 122).

North Boone dome is a small anticline in secs. 28, 29, and 32, T. 36 N., R. 85 W., 3 miles northwest of the Boone Dome gas field, Natrona County. The Steele shale forms the surface at an altitude of about 6,000 feet. The Teapot sandstone member of the Mesaverde formation dips 15° on the east flank of the structure toward a synclinal axis about ½ mile east of the anticlinal axis and 50° to 65° on the west flank at a point 1 mile west of the axis.

In 1917 a well drilled in the SE¼SE¼ sec. 29 had a good showing of gas from the Shannon sand at 660 to 690 feet. Nine wells were drilled on this structure from 1917 to 1933; good showings of gas were obtained in most of these wells. One well had a showing of oil. None of the wells was large enough to be of commercial value. A well in the NE¼NE¼ sec. 32 was drilled to a depth of 3,335 feet, then plugged and abandoned.

BUNKER HILL

The Bunker Hill gas field (fig. 17, case) in secs. 29 and 32, T. 27 N., R. 89 W., Carbon County, occupies a symmetrical elongated dome

with a structural closure of 750 feet. The Bunker Hill dome is 2½ miles northeast of the Wertz gas field and 2,800 feet lower structurally. (See fig. 25, case.) The structure is defined clearly, as it is surrounded almost completely by outcrops of several Mesaverde sandstones, and the topographic form of the crest is a very slightly modified

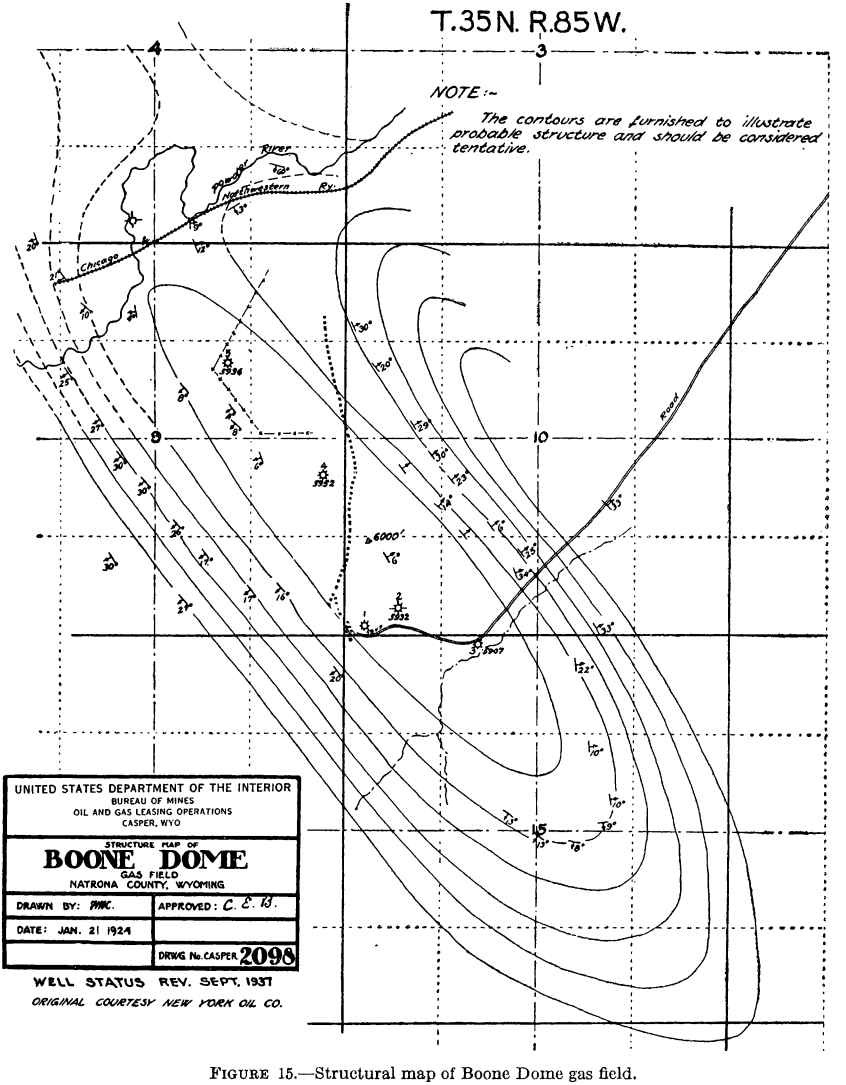

FIGURE 15.—Structural map of Boone Dome gas field.

reproduction of the structural form. The lower resistant sandstone members of the Mesaverde formation outcrop on the crest of the dome at an altitude of about 7,000 feet.

In 1932 a dry hole in the SE¼SW¼ sec. 29 was drilled to the first Sundance sand at 6,748 to 6,791 feet. The Shannon sand was logged at 1,325 to 1,455 feet, with a good showing of gas; Wall Creek sands at 4,980 to 5,170 feet, with a good showing of gas; an oil-saturated zone in

the Muddy sand, at 6,163 to 6,194 feet; Lakota at 6,311 to 6,333 feet (water bearing); the Morrison at 6,352 to 6,603 feet; and First Sundance sand at 6,748 to 6,791 feet (water bearing), total depth. In 1937 a well in the SE¼SW¼ sec. 29, 100 feet from the hole drilled in 1932, was completed, producing 5 million cubic feet of gas daily from the Shannon sand at 1,224 to 1,480 feet. As a result, two other wells were drilled, and the dry hole drilled in 1932 was recompleted as a gas well in the Shannon sand. A combined open flow of about 8 million cubic feet of gas a day was developed; the shut-in wellhead pressure was 500 pounds per square inch. A dry hole drilled in the SE¼SE¼ sec. 30 produced water from the Shannon sand at 1,691 to 1,749 feet, and a well in the NE¼NW¼ sec. 32 produced 2.3 million cubic feet of gas daily from the Shannon sand at 1,470 to 1,594 feet. On April 1, 1938, there were three shut-in gas wells in the field, potential producers from the Shannon sand.

BYRON

The Byron field (fig. 18, case) is in the center of the eastern half of T. 56 N., R. 97 W., Big Horn County, about 2 miles northeast of the Garland field. The name "Byron" was used formerly in referring to the present Garland field (p. 33). The Byron structure is a faulted anticline, the Cody shale being exposed at the crest. The outcropping Mesaverde sandstones on the sides of the structure indicate dips of 15° to 18° on the northeast flank and 8° to 10° on the southwest flank. The closure, as determined by the syncline between the Byron and Garland structures, is about 1,000 feet. The altitude along the river is about 3,920 feet; in the center of the field, 4,000 to 4,100 feet; and on the rim rocks to the northwest, 4,200 to 4,300 feet.

The field was discovered in 1918 when a gas well in the NE¼NE¼ sec. 22 was brought in from the Torchlight, or upper sand in the Frontier formation, at a depth of 2,430 to 2,460 feet. Later two other gas wells were completed in this sand. The initial open-flow volume of the gas wells ranged from 1.5 to 15 million cubic feet, and the initial shut-in wellhead pressure was about 1,000 pounds per square inch. In 1929 oil was discovered in the Sundance formation at 4,209 to 4,240 feet in a well in the NE¼ sec. 23. The initial daily production of the discovery well was about 120 barrels of 31.4° A. P. I. gravity green oil. The history of the well indicates that the Sundance was not an important producing formation. In 1930 oil was discovered in the Embar lime and Tensleep sandstone at 5,300 to 5,412 feet in a well in the NE¼NE¼ sec. 22; the initial production of the well was 567 barrels of 24.3° A. P. I. gravity black oil. Before January 1, 1938, 14 wells completed in the Embar-Tensleep zone and 2 in the Embar lime produced 250 to 550 barrels daily, each averaging about 400 barrels. The formations in the Byron field are similar to those in the Garland field but occur 1,500 to 2,000 feet deeper at Byron. Whereas the surface at the crest of the Byron structure is approximately 2,150 feet above the Frontier formation, it is only 600 feet at Garland.

On January 1, 1938, there were 20 wells in the field; 3 of these were gas wells that could flow about 8 million cubic feet daily. The Sundance oil well, which could produce 6 to 7 barrels of oil by pumping, was shut down. The 14 Embar-Tensleep wells and the 2 Embar wells had a capacity of about 4,500 barrels of oil daily. Several

wells were acidized, resulting in a material increase in yield of oil. Little or no gas accompanies the oil; the wells are pumped, although several could flow 10 to 20 barrels of oil daily because of the hydrostatic pressure in the formation. Only two wells produce water with the oil. Analyses of the oils from the Embar and Embar-Tensleep producing zones and gas from the Frontier formation are given under Crude-oil Analyses (pp. 129 and 130) and in table 5 (p. 116), respectively.

The total volume of gas produced from the field to 1938 was reported to be 2.9 billion cubic feet; yearly production is given in table 8 (p. 122). The total production of oil to 1938 was 1,281,485 barrels; yearly production since 1929 is given in table 7 (p. 120). The gas-bearing area in the Frontier formation is about 320 acres, but the oil-bearing area in the Embar-Tensleep zone has not been determined accurately. However, drilling has proved about 1,300 acres. Gas from the field is piped to Lovell and Cowley, Wyo., for domestic consumption. The oil is piped through an 8-inch line to a refinery and loading racks just north of Lovell for transportation by rail to refineries in Laurel and Billings, Mont., and through an 8-inch line to the Elk Basin-Greybull pipe-line system. An 8-inch line from the Garland field also carries some oil from the Byron field to a refinery and loading racks at Lovell. Some oil is trucked out of the field to a refinery in Billings, Mont.

CROOKS GAP

There are three anticlines in the Crooks Gap area: Crooks Gap in secs. 18 and 19, T. 28 N., R. 92 W., and secs. 13 and 24, T. 28 N., R. 93 W.; Spring Creek in sec. 7, T. 28 N., R. 92 W., and secs. 1 and 12, T. 28 N., R. 93 W; and Sheep Creek in sec. 14, T. 28 N., R. 92 W., all in Fremont County.

Crooks Gap and Spring Creek (fig. 19, case) are contiguous and are sharply folded asymmetrical anticlines separated by a narrow syncline. The axes of the anticlines, which are nearly parallel and about 2 miles apart, trend northwest and southeast. The southwest flanks of the structures dip sharply, reaching 75° at Crooks Gap and almost 90° at Spring Creek. The northeast flanks dip about 30°. The closure on the Crooks Gap structure is 3,000 feet. The surface formation of the two structures is Steele shale at an altitude of about 7,000 feet. A generalized stratigraphic section of the Crooks Gap area (at Crooks Gap and Spring Creek) gives the following formation thickness: Steele shale, 650 feet; Niobrara and Carlile shale, 2,350 feet (with 150 feet of GP sand at the top of the Niobrara); Frontier, 1,500 feet (including 300 feet of First Wall Creek sand at the top); Cloverly, 200 feet (including sandstone members equivalent to Dakota and Lakota formations); Morrison, 500 feet; Sundance, 400 feet (the Sundance sand starting 100 to 150 feet below the top); Chugwater, 1,800 feet; Embar, 300 feet; Tensleep, 400 feet; Amsden, 150 feet; and Madison, 100 feet. Cambrian quartzite is below the Madison.

Six wells were drilled on the Crooks Gap structure. In 1925 one drilled in the SE¼SE¼ sec. 13 produced 40 barrels of oil daily from the Frontier formation at 2,495 to 2,590 feet. In 1935 another drilled in the SE¼SE¼ sec. 13 to a depth of 4,725 feet showed that the Frontier at 2,720 to 2,770 feet was dry; the Mowry at 3,503 to 3,518 feet contained water; and the Dakota, topped at 4,500 feet, was

dry. The well apparently was drilled on the steep side of the structure. A unit plan for the development and operation of the Crooks Gap structure unit area was approved by the Acting Secretary of the Interior on October 15, 1937.

Three wells have been drilled on the Spring Creek anticline, but neither oil nor gas was found in commercial quantities, although showings of gas at various depths were logged in a well in the NW¼NW¼ sec. 7. A unit plan for the development and operation of the Spring Creek structure was approved by the Secretary of the Interior on June 21, 1937.

Sheep Creek anticline (fig. 20, case), about 4 miles east of Crooks Gap anticline, is a sharply folded anticline about 2 miles along and ½ mile wide. The axis is approximately parallel to the axis of the Crooks Gap anticline. In places the beds on the southwest flank are almost vertical, whereas those on the northeast dip about 35°. The closure is about 900 feet. The Sundance formation is exposed on the crest of the Sheep Creek structure. Six wells were drilled on or near the latter structure; in two of these, in the NE¼SW¼ sec. 14, oil was found in the Embar-Tensleep zone. The initial daily production of one well was 40 barrels of 23.6° A. P. I. gravity oil. On January 1, 1938, two wells in the NE¼SW¼ sec. 14 on the Sheep Creek anticline were the only wells in the Crooks Gap area that could produce oil, and only one of them produced intermittently to supply local demands for fuel oil. The oil is analyzed under Crude-oil Analyses (p. 168).

CRYSTAL CREEK

Crystal Creek anticline in the west half of T. 54 N., R. 93 W., Big Horn County, is an asymmetrical anticline with a curved axis; it includes two structural highs, one at the intersection of secs. 5, 6, 7, and 8 and the other in the NW¼ sec. 19. The Chugwater formation is exposed on the anticline at an altitude range of 4,000 to 4,300 feet. A persistent bed in the Sundance formation outlining both highs dips about 35° on the west side of the anticline and about 10° on the east side. The total closure of the structure is about 800 feet, the south high having an independent closure of about 350 feet and the north about 400 feet.

In 1919 a well drilled in the NW¼NW¼ sec. 8 to a depth of 984 feet in the Tensleep sandstone produced 5 barrels of 24° A. P. I. gravity black oil daily from a sand at 963 to 983 feet. Eight wells were drilled on the north high and two on the south, all of which were unproductive. The greatest depth reached was 1,805 feet in a well in the SW¼SW¼ sec. 5. The Tensleep, Amsden, and Madison formations were tested, but neither oil nor gas was found in commercial quantities.

DALLAS AND DERBY DOMES

The Dallas Dome (Popo Agie in early reports) oil field (fig. 22, case) in sec. 13 and the northern part of sec. 24, T. 32 N., R. 99 W., Fremont County, is on a small anticlinal structure on a major line of folding (formerly referred to as the Shoshone anticline) parallel to the Wind River Mountains. The Dallas dome structure has at least 300 feet of independent closure. The outcropping limestone near the crest of the structure dips 10° to 18°. The Chugwater formation is exposed on the surface at an altitude range of 5,380 to 5,440 feet. The field is

adjacent to the Little Popo Agie River, which cuts through the center of the structure.

The history of this field, mentioned in the introductory chapter of this report, is one of the most interesting in the State. In 1884 a well drilled 300 feet located oil in a crevice in the Chugwater formation. From 1884 to 1886 two wells drilled about 400 and 750 feet, respectively, produced oil but were abandoned owing to lack of a market for the oil. In 1901 drilling was resumed and one oil well completed; two were completed in 1902 and three in 1903, the depths ranging from 700 to 1,100 feet in the Embar lime. No data are available on quantity of oil produced in the early life of the field, although 50 barrels a day is a conservative figure for 1909. About 1910, additional wells were drilled to the Embar lime, the depths ranging from 700 to 1,100 feet. Wells completed in the upper part of the Embar were deepened to other producing zones in that formation. About 56 wells were completed by 1930, having an initial production as high as 250 barrels of oil daily, although most of the wells produced less than 100 barrels of 22° A. P. I. gravity black oil. In 1930 oil was found in the Tensleep sandstone at depths of 1,150 to 1,225 feet. Seven wells drilled in the Tensleep sandstone ranged in initial production from 50 to 180 barrels a day of oil of the same type but about a degree higher in A. P. I. gravity than that obtained from the Embar formation.

On January 1, 1938, there were 27 wells in the field, 7 of which produced from the Tensleep and 20 from the Embar lime. During 1937 the field yielded about 500 barrels of oil a day and approximately four times as much water. All wells in the field produce water and are pumped at a rate sufficient to handle large volumes of fluid to obtain the daily oil production and to reduce flooding of the oil-producing formations. Analyses of the oil from the Embar formation after dehydration and of the gas are given under Crude-oil Analyses (p. 131) and in table 5 (p. 116), respectively.

No record was kept of the quantity of oil produced during the early life of the field, but it is estimated that 25,000 barrels was produced from 1884 to 1909, inclusive. From 1910 to 1912, inclusive, it is estimated that about 100,000 barrels was produced and transported through a 6-inch pipe line, built in 1910, from the field to a railroad at Wyopo Siding. Yearly production for the field is given in table 7 (p. 120). The total oil production to 1938 has been estimated at 2,088,347 barrels; based on an estimated productive area of 160 acres, the recovery per acre has been 13,050 barrels. The oil is heated to about 180°F. and then treated in an electric dehydrator before it is marketed.

Derby dome (fig. 22) is a small, elongated structure on the same major line of folding as the Dallas dome structure but about 4½ miles southeast; the crest of the structure is in sec. 4, T. 31 N., R. 98 W., Fremont County. The west flank dips about 45° and the east flank 25°. The structure has at least 1,500 feet of independent closure. The Chugwater is the surface formation at an altitude range of 5,635 to 5,655 feet along Twin Creek and 6,000 to 6,050 feet on the uneroded southern part of the producing structure.

The first well—in the SW¼NW¼ sec. 4—was completed in 1921, with an estimated daily production of 40 barrels of a 21° A. P. I. gravity black oil from a sand in the lower part of the Embar formation

at 932 to 940 feet. The daily production of this well soon settled to 12 barrels. From 1921 to 1924, inclusive, 12 wells, with an initial daily production of 10 to 250 barrels, were completed in the Embar lime. In 1922 oil was discovered in the Tensleep sandstone about 120 feet lower than the main productive Embar zone. The discovery well in the NE¼SW¼ sec. 4 produced initially 25 barrels of 24° A. P. I. gravity oil daily from the Tensleep sandstone at 1,018 to 1,022 feet. Not until 1930 and 1931, however, were four more wells completed in the Tensleep sandstone, production ranging from 20 to 125 barrels a day. A composite log of the formations tested on this structure shows about 600 feet of Chugwater at a point of greatest surface erosion, 345 feet of Embar, and the Tensleep below. None of the productive wells has penetrated the Tensleep more than 75 feet. In a well in the NW¼NE¼ sec. 9 on the south side of the fault approximately 550 feet of Tensleep sand was drilled, and a flow of about 5,000 barrels of water a day obtained. Water conditions are much the same as in the Dallas Dome field; that is, both the Embar lime and Tensleep sandstone contain water.

On January 1, 1938, the 13 wells in the field—5 in the Tensleep and 8 in the Embar formation—produced at the rate of 90 to 100 barrels of oil daily, mainly from the Tensleep, and about four times as much water. All the wells are pumped and records kept of the water and oil produced. When it is not economical to lift the liquid because of high water-oil ratios the wells are shut in. Analyses of the oil from the Tensleep sandstone and water from the Embar lime are given under Crude-oil Analyses (p. 131) and in table 6 (p. 118), respectively. Yearly production data of the Derby Dome field are given in table 7 (p. 120). The productive area of the field is about 280 acres; based on a total oil production to 1938 of 452,180 barrels, the recovery per acre has been 1,615 barrels. The oil is heated and treated in an electric dehydrator and then piped 5 miles through a 4-inch line to the Dallas Dome field where it joins the 6-inch line to Wyopo Siding.

DOUGLAS

The Douglas field, known also as the Brenning field or Brenning Basin, is in the north half of T. 32 N., R. 73 W., Converse County. Interpretation of the structure underlying the field is difficult. The White River formation of Tertiary age overlaps unconformably the Cretaceous beds, which apparently are monoclinal, dipping 20° to 30° N. Oil and gas migrating up the dip from the Cretaceous beds probably accumulated in porous and conglomeritic material overlain by impervious clay in the base of the White River formation. Drilling began in the White River formation at altitudes of 5,200 to 5,400 feet.

In 1894 an oil-saturated sandstone (top of Cloverly formation) was uncovered in digging an irrigation ditch in the NW¼ sec. 16, T. 32 N., R. 73 W. In 1896 two wells drilled in secs. 8 and 9 and in 1899 one drilled in sec. 9 yielded a small quantity of oil along with water and some gas. In 1902 a well in sec. 4 was completed, being pumped intermittently for 1 month and producing about 20 barrels of oil during that time. From 1902 through 1907 about 60 holes were drilled in the field, most of which yielded small quantities of oil, gas, and water. About 10 were completed as gas wells at depths of 406 to 665 feet and about 16 as oil wells at depths of 215 to 810 feet; most

of the oil wells, however, were completed at approximately 400 feet. Oil and gas were found apparently in the top of the Cloverly formation, the lower part of the Benton shale, or the base of the White River formation, but the yield has been small. One company drilled 36 wells during the period 1904 to 1907 and obtained oil and gas in most of them; the quantity of oil produced to 1911 was estimated at 5,000 barrels. Presumably the largest oil well in the field, drilled in 1906 in the NE¼SW¼SE¼ sec. 8, was reported to have produced 20 to 40 barrels of 36° A. P. I. gravity olive-green oil daily from a depth of 328 feet. The largest gas well, drilled in 1904 in the NW¼SE¼ sec. 4 to a depth of 435 feet, was estimated to produce 593,000 cubic feet daily; the shut-in wellhead pressure was 50 pounds per square inch.

Much of the oil was used during the construction of the LaPrele Dam, but by 1912 only two wells were being pumped. A small topping plant was built in the field. The gas was used as fuel for drilling purposes and for domestic purposes at several ranch houses; by 1912, however, only three gas wells were producing and they supplied only enough gas for three ranches. By 1932 more than 70 wells had been drilled in the field. Since then no drilling has been done, and the field virtually has been abandoned.

DRY PINEY

The Dry Piney area is in secs. 6 and 7, T. 28 N., R. 113 W., and secs. 1 and 12, T. 28 N., R. 114 W., Sublette County. The northern part of the LaBarge anticline, which extends several miles north of the Dry Piney area, is almost coincident with the LaBarge Ridge; drilling was begun near the crest of the ridge. The Adaville formation, exposed in the center of the Dry Piney area at an altitude of about 8,300 feet, dips 25° to 30° on each side of the anticlinal axis. Immediately to the east of the axis the Knight formation of Eocene age rests unconformably on the Adaville and dips about 5° E.

In 1919 a well in the NW¼NE¼ sec. 12 produced some oil from a sandstone lens in the Hilliard formation at depths of 968 to 1,001 feet. Twenty wells have been drilled in the Dry Piney area, 2 to the north of the area, about 20 to the south (between Dry Piney and the LaBarge field), and 3 in sec. 9, T. 29 N., R. 113 W. (known as Big Piney). Neither oil nor gas was found in commercial quantities. On January 1, 1938, only one small oil well and one small gas well in the area were producing.

DUTTON CREEK AND COOPER COVE

The Dutton Creek oil and gas field (fig. 21, case) in secs. 1 and 12, T. 18 N., R. 78 W., Carbon County, is on the crest of a high on the Rock Creek anticline, which trends north and south. The Mesaverde is the surface formation at an altitude of about 7,575 feet. The Dutton Creek structure has an independent closure of about 500 feet—which separates it from the Cooper Cove high—and a total closure of about 900 feet.

The Dutton Creek high proved productive in 1927; a well in the NW¼SE¼ sec. 1 drilled 5,075 feet to the Lakota sand produced initially 60 barrels of 34° A. P. I. gravity green oil from the Muddy sand at 4,876 to 4,905 feet. Two other wells, completed in this sand (approximately 30 feet thick) at depths of 4,860 to 4,873 feet, produced

initially 50 and 90 barrels. In 1932 and 1933 six gas wells completed in the Shannon sand at depths of 1,700 to 2,100 feet produced initially 70,000 to 550,000 cubic feet of gas daily. The total initial-flow volume was about 2 million cubic feet and the shut-in wellhead pressure about 450 pounds per square inch. In 1936 water was found in a deep test to the Sundance formation at 5,334 to 5,452 feet. Analyses of the oil from the Muddy sand and gas from the Shannon sand are given under Crude-oil Analyses (p. 132) and in table 5 (p. 116), respectively. A small volume of gas has been produced since 1933 and piped into the Allen Lake-Laramie gas line. At the beginning of 1938 three oil wells produced daily about 50 barrels, which was piped 12½ miles to Rock River. The yearly oil production from the field is given in table 7 (p. 120) and the gas production in table 8 (p. 122). Approximately 320 acres on the structure may be considered productive.

The Cooper Cove high is on the Rock Creek anticline south of the Dutton Creek field in secs. 20 and 29, T. 18 N., R. 77 W., Carbon and Albany Counties. Two deep tests on this structure to depths of 4,573 and 5,400 feet to the Frontier formation were failures.

ELK BASIN

The Elk Basin oil and gas field (fig. 23, case) is in the north end of the Big Horn Basin, about 25 miles from the Beartooth Mountains to the west and the same distance from the Pryor Mountains to the east, in Tps. 57 and 58 N., Rs. 99 and 100 W., Park County, Wyo., and in secs. 35 and 36, T. 9 S., R. 23 E., Carbon County, Mont. The field is on a highly faulted anticlinal structure—one of the best in Wyoming for a study of faulting and its relation to oil and gas accumulation. Where mapped the structure has at least 800 feet of closure, defining an area of more than 4 square miles, although the total closure for the structure must be two or three times as large, with a possible drainage area of 100 square miles. Surface altitude in the north end of the field ranges from 4,500 to 4,600 feet and in the south end from 4,700 to 4,900 feet. The Cody shale is exposed along the axis on the higher part of the anticline, and the Eagle and Mesaverde sandstones form a rim rock 400 to 500 feet high around the basin. The floor of the basin is quite level, except at the south end, where it is highly faulted, severely eroded, and consequently rough. The structure is symmetrical, and the northeast and southwest flanks dip 10° to 24°.

The discovery well in the NW¼NW¼ sec. 30, T. 58 N., R. 99 W., was completed in 1915 and had an initial daily production of 50 barrels from the Torchlight (First Wall Creek) sand in the Frontier formation at 1,335 to 1,402 feet. Later oil was discovered in the Peay (Second Wall Creek) sand in the Frontier formation, approximately 135 feet below the Torchlight sand. As the Torchlight sand is shaly and relatively nonporous, oil is found only in scattered areas where porosity permits accumulation. The Peay sand, a porous, uniform sand, is the source of most of the oil at Elk Basin. The average initial daily production of the Peay wells was 175 barrels of 43° A. P. I. gravity green oil. About 162 wells were drilled to the Frontier sands. In the south end of the field three gas wells were completed in the Frontier formation on the crest of fault blocks, two of which ultimately became oil wells. The oil in this faulted area is lower in A. P. I.

gravity (39°) than in the main part of the field; it also contains about 1 percent of sulfur compared to 0.1 percent for the oil in the north part.

In 1922 gas was discovered in the Cloverly formation at 2,576 to 2,593 feet, approximately 1,000 feet below the Peay sand, in a well in the NE¼SE¼ sec. 24, T. 58 N., R. 100 W. In the northern part of the field four gas wells drilled to the Cloverly formation had a total initial daily open flow of 160 million cubic feet; the shut-in wellhead pressure was 925 pounds per square inch. One of these wells had an estimated open flow of 90 million cubic feet a day. Late in 1937 a gas well in the southern part of the field, NW¼SE¼ sec. 30, T. 58 N., R. 99 W., was completed in the Cloverly formation at 2,795 to 2,813 feet; it produced 7 million cubic feet a day and had a shut-in wellhead pressure of 530 pounds per square inch. In the northern end of the field the Torchlight sand occurs at an average depth of 1,300 feet, the Peay at 1,500 feet (thickness, 40 feet), and the Cloverly at 2,500 feet (thickness, probably exceeding 100 feet).

In 1927, after a rather rapid oil-production decline of several years, a gas drive was started in the Peay sand by returning to the formation the gas produced with the oil. As a result, the daily production of oil increased from 600 to 1,100 barrels and later declined, but more gradually than before gas was injected. From May 1927 to July 1933 an average of 1 million cubic feet of gas a day was returned to the sand, and from July 1933 to January 1937 an average of ¾ million cubic feet was returned. For a number of years also (fall of 1918 to 1923) the casinghead gas was processed for its gasoline content; approximately 2 billion cubic feet of gas processed yielded 6 million gallons of gasoline. An estimated 2.5 million gallons of drip gasoline also was produced from 1927 to 1936, inclusive.

On January 1, 1938, there were about 100 wells (virtually all Peay wells) in the field, with a daily capacity of approximately 650 barrels of 43° A. P. I. gravity green oil. These were pumped from central powers, although at first they flowed naturally. The daily production per well ranged from 2 to 60 barrels. The Peay sand carried water on the flanks of the structure, but there was little encroachment; only the edge wells were affected, producing daily about 250 barrels of water. The water and oil are separated by washing the well production through 8 feet of water maintained at about 85° F. Four Cloverly gas wells in the north part of the field and one in the south had a combined open-flow volume of about 125 million cubic feet a day. One Frontier gas well in the south part was shut in. Approximately ¾ million cubic feet of gas produced daily with the oil was compressed at the casinghead gasoline plant to 50 pounds per square inch and injected through nine gas input wells into the Peay sand. When the gas-oil ratio of a well became too high (10,000 to 15,000 cubic feet per barrel of oil; for a good producing well the ratio may be higher) the well was shut in. Analyses of the oil from wells in the north and south parts of the field and gas from the Cloverly formation are given under Crude-oil Analyses (p. 133) and in table 5 (p. 116), respectively.

To 1938 the field had produced 10.5 million barrels of oil and 20.2 billion cubic feet of Cloverly gas; yearly production statistics are given in tables 7 (p. 120) and 8 (p. 122), and a yearly oil-production curve is shown in figure 10 (p. 11). The proved area of the Peay sand in the north end of the field is about 640 acres. It is difficult to estimate

the total productive area in the faulted area at the south end. Based on a total production of 10,445,267 barrels and a productive area of 640 acres, the recovery to 1938 has been 16,336 barrels per acre. The oil is piped to a refinery at Greybull, Wyo., and the gas to Billings, Mont. (67 miles), for domestic and industrial consumption.

ENOS CREEK

The Enos Creek structure is a well-developed symmetrical fold having an almost semicircular axis. Figure 24 (case), a generalized map of the southwestern part of the Big Horn Basin, shows the Enos Creek structure in relation to other structures in the area. Most of the structure is in the southeastern part of T. 46 N., R. 100 W., Hot Springs County. The Cody shale forms the surface at altitudes of 6,200 to 6,500 feet. Outcrops along the flanks of the fold dip 10° to 20°. The structure has at least 1,000 feet of closure.

In November 1924 a well in the SE¼NE¼ sec. 26 was completed in the Frontier formation at 2,835 to 2,850 feet, with an estimated daily flow of 43 million cubic feet of gas; the shut-in wellhead pressure was 800 pounds per square inch. A log of the well showed the first Frontier or Torchlight sand at approximately 2,500 feet to be water bearing, a lower sand in the Frontier formation at 2,835 to 2,850 feet to be gas bearing, and the Cloverly formation, in which drilling stopped at a total depth of 3,992 feet, to be water bearing. The hole was plugged back to 2,850 feet and mudded in. In an earlier test of the structure, drilled in 1916, water was found in the Frontier at 2,436 feet. Analysis of the gas is given in table 5 (p. 116).

FERRIS AND MIDDLE FERRIS

The Ferris structure, known also as East Ferris, is a sharply folded, elongated dome at the east end of a major fold extending east and west along the foot of the Ferris Mountains; the axis of the structure runs northwest-southeast through the center of sec. 25, T. 26 N., R. 87 W., Carbon County. Ferris, Middle Ferris, West Ferris, Mahoney, and Wertz fields are all on this fold, as shown in figure 25 (case), a map of the Lost Soldier district. The Ferris structure, shown in more detail in figure 27 (case), has a total closure of about 2,000 feet and an independent closure of about 1,000 feet; it is separated from the Middle Ferris structure by a narrow saddle. The northeast flank of the structure has a maximum dip of 45° and the southwest flank 25°. The lower Niobrara formation is exposed in places, although most of it is covered by sand dunes at altitudes of 6,900 to 7,060 feet.

The Ferris field has been a small oil and gas field. It was discovered in 1919 on drilling a well in the SW¼NE¼ sec. 25 to the Thermopolis shale at 1,707 to 1,781 feet that produced 75 barrels of 36° A. P. I. gravity green oil daily. Later about eight other wells, drilled to the Mowry and Thermopolis shales, produced initially 15 to 250 barrels of oil daily. In 1920 a well in the NE¼SW¼ sec. 25, completed in the Dakota sand at 1,805 to 1,820 feet, produced 13 million cubic feet of gas daily. In 1922 four additional gas wells were completed in the Dakota; initial daily volumes were 3 to 20 million cubic feet, but production declined rapidly. In 1925 a well in the SE¼SE¼ sec. 25, drilled to a sand at 2,615 to 2,705 feet in the Sundance formation, produced 29 barrels of oil a day but soon was abandoned. In a

deep-test well in the NW¼SE¼ sec. 25 drilled in 1928 on top of the structure to 4,600 feet in the Tensleep sandstone, the Frontier formation was found at 430 to 635 feet, Mowry and Thermopolis shales at 635 to 1,735 feet, Dakota sand at 1,735 to 1,760 feet, Lakota sand at 1,780 to 1,810 feet, Sundance formation at 2,090 to 2,835 feet, Embar lime "saturation" at 4,520 to 4,525 feet, and Tensleep sandstone at 4,598 to 4,600 feet (flowing warm sulfur water). When the well was being plugged back a small quantity of 36° A. P. I. gravity oil was recovered from a saturated zone in the Embar lime, and an initial production of 85 barrels of 18° A. P. I. gravity black oil and 90 barrels of water was obtained from a sandy zone (Parco sand) in the Chugwater formation, but the production of oil declined rapidly. Late in 1929 the well was plugged back to the Sundance formation.

In general, the fissured zones in the Mowry and sandy zones in the Thermopolis shale of the structure contain small quantities of oil; the Dakota and Lakota sands contain gas along the crest of the structure, surrounded by a narrow rim of oil, with water beneath; the Sundance formation carries water with small quantities of oil and gas; and the Tensleep sandstone was water bearing in one well.

By January 1, 1938, the wells virtually were depleted, and the field was shut in. There were 10 shut-in wells in the field, 1 gas well in the Sundance formation, and 9 oil wells, most of them in shallow shale formations. In 1936 the oil wells produced about 20 barrels of oil and 140 barrels of water daily. Analysis of the oil from the Mowry and Thermopolis shales is given under Crude-oil Analyses (p. 134). The total quantity of oil produced to 1938 was 281,690 barrels; yearly production is given in table 7 (p. 120). A production-decline curve is plotted in figure 26 and compared with a similar curve for the GP field, producing from sandstone. The probable productive area in the Dakota sand has been estimated at 200 acres and that in the Mowry and Thermopolis shales at less than 200 acres. A 6-inch oil pipe line from Casper to Parco passes through the field, and the oil from the Ferris field formerly was pumped into this line. Before the field was depleted the gas was delivered into the 10-, 12-, and 14-inch Wertz-Mahoney-Casper gas pipe line. This gas line was taken up late in 1937.

The Middle Ferris structure (fig. 27), known also as West Ferris, in secs. 26 and 27, T. 26 N., R. 87 W., Carbon County, is a small elongated dome with a closure of not more than 200 feet independent of the West Ferris structure to the west and the Ferris structure to the east—with which it is en échelon—and a total effective closure of 1,400 feet. The Niobrara shale overlying the dome is obscured by sand dunes. The altitude of the structure ranges from 6,975 to 6,985 feet.

In 1919 a well in the SE¼NW¼ sec. 26 was completed at 2,315 to 2,342 feet in the Dakota sand, with an initial volume of 10 million cubic feet of gas daily and a shut-in wellhead pressure of 800 pounds per square inch. In 1925 a well in the SW¼NE¼ sec. 27 was completed at 3,022 to 3,067 feet in the Sundance formation, with an initial volume of 4 million cubic feet of gas daily and a shut-in wellhead pressure of 1,065 pounds per square inch. Two wells were completed in each of these sands. The Dakota sand is about 45 feet thick and the Sundance producing sand about 85 feet thick on this structure.

A well drilled 4,623 feet, penetrating the Tensleep sandstone, disclosed that it was water bearing.

By 1938 the field was about depleted. Although two of the four gas wells had not been abandoned, pressure had dropped below the gas

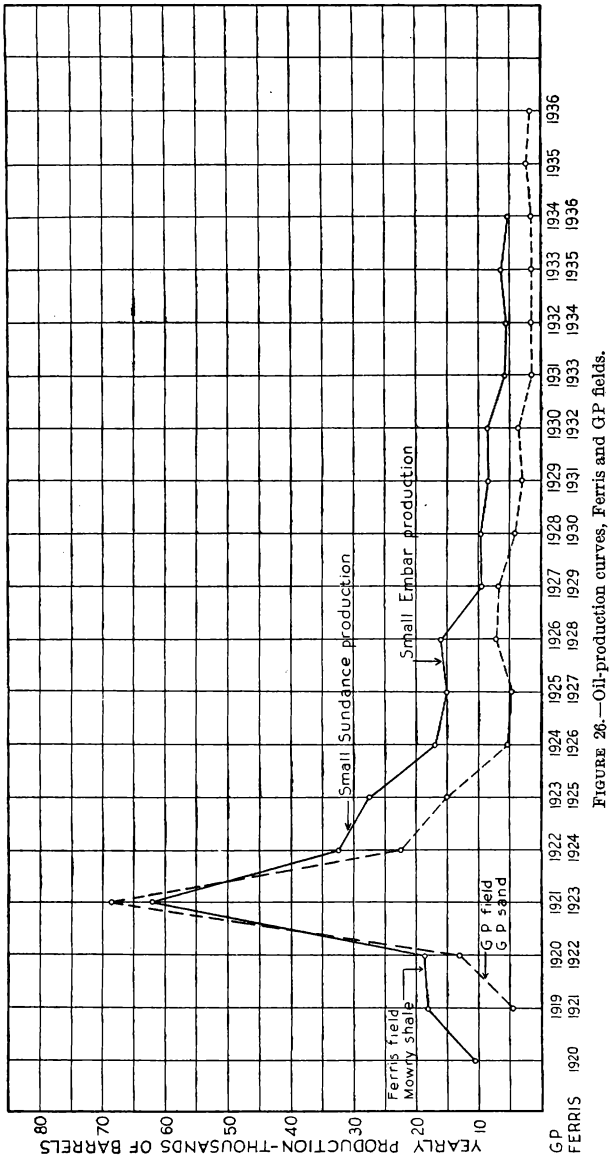

FIGURE 26.—Oil-production curves, Ferris and G P fields.

pipe-line pressure, and the wells produced only enough gas for field and camp use. The total cumulative production of gas to 1938 for Ferris and Middle Ferris fields was 6.0 billion cubic feet. Of this volume the Ferris field produced about a third, and the Dakota and Sundance sands at Middle Ferris each produced a third; yearly pro-

duction is given in table 8 (p. 122). The probable productive area in the Dakota sand was about 160 acres and in the Sundance sand 300 to 500 acres. Gas from this field formerly was delivered into the Wertz-Mahoney-Casper pipe-line system.

FOURBEAR

The Fourbear anticline (fig. 28, case) is a narrow structure about 8 miles long extending from the northwest part of T. 47 N., R. 102 W., to beyond the center of T. 48 N., R. 103 W., in Park County. Several highs occur along the axis of the anticline; the most important, in secs. 20, 28, and 29, T. 48 N., R. 103 W., has an independent closure of about 600 feet and a total closure of over 1,200 feet. The Mowry shale is exposed on the crest of this high at an altitude of 7,100 feet. The west flank dips 45° to 50° and the east flank 25° to 50°.

In 1928 a well drilled on the crest of this structure in the NW¼NE¼ sec. 29 disclosed oil in the Tensleep sandstone but was abandoned. In the same year a second well, drilled into the Amsden formation to a depth of 3,350 feet, produced 375 barrels of 13.5° A. P. I. gravity black oil daily from the Tensleep at 3,260 to 3,278 feet. The well has been produced only to furnish fuel for exploratory work in that area. Production of 2,606 barrels was reported in 1929 and 1,530 barrels in 1930. Analysis of the oil is given under Crude-oil Analyses (p. 134).

A unit plan for the development and operation of the Fourbear structure was approved by the Secretary of the Interior on September 19, 1934.

FRANNIE

The Frannie oil field (fig. 29, case) in secs. 23, 24, 25, and 26, T. 58 N., R. 98 W., Park County, occupies an asymmetrical elongated dome transversely cut by two faults. The surface formations are the Frontier and the Cody at an altitude range of 4,300 to 4,670 feet. The dome has about 1,000 feet of independent closure and is separated by a saddle from the Sage Creek (South Frannie) dome.

The field was discovered in August 1928 on drilling a well in the NE¼NW¼ sec. 25 to the Tensleep sandstone at 2,585 feet that flowed 125 barrels of oil a day. The well when completed at 2,612 feet produced daily 260 barrels of black oil by pumping. In September 1929 an initial daily production of 2,423 barrels was obtained in the Madison lime at 2,925 to 3,013 feet in the south end of the field, SE¼NW¼ sec. 25. The discovery of oil in the Madison lime at Frannie was the first indication that this formation was commercially productive in Wyoming. Thirteen wells were completed in the Tensleep sandstone, initial production ranging from 250 to 700 barrels daily and averaging 430 barrels per well. The oil from the Tensleep has a gravity of 28° A. P. I. and that from the Madison lime 18° A. P. I. The oil contains a small amount of gas in solution (approximately 75 cubic feet per barrel of oil), which has a hydrogen sulfide content of about 8 percent. From the standpoint of the safety engineer this concentration is highly toxic, requiring precautions—now well-known to most oil-field employees—in handling the oil and gas.[6]

[6] Sayers, R. R., Smith, N. A. C., Fieldner, A. C., Mitchell, C. W., Jones, G. W., Yant, W. P., Stark, D. D., Katz, S. H., Bloomfield, J. J., and Jacobs, W. A., Investigations of Toxic Gases from Mexican and Other High-Sulfur Petroleums and Products: Bureau of Mines Bull. 231, 1925, 108 pp.
Fowler, H. C., Prevention of Hydrogen Sulfide Poisoning in Handling and Refining High-Sulfur Petroleums: Bureau of Mines Rept. of Investigations 2847, 1927, 27 pp.

A generalized log of the field based upon drilling records gives the following approximate formation thickness in feet: Frontier, 350; Mowry, 410; Thermopolis, 370; Cloverly, 250; Morrison, 270; Sundance, 380; Chugwater, 505; and Embar, 65 (underlain by about 100 feet of white sandstone, the main producing zone of the Tensleep sandstone). The Embar lime occurs at depths of 2,500 to 2,900 feet, the top of the Tensleep sandstone at 2,550 to 3,200 feet, and the Madison lime at 3,000 feet or more, depending on the structural position of the wells and their surface elevations.

On January 1, 1938, there were 14 oil wells in the field, 13 of which produced from the Tensleep sandstone and 1 from the Madison lime; only 3 of the wells in the field produced water with the oil. The well in the Madison lime was the only flowing well in the field; it produced through a small-size choke at a rate of about 15 barrels a day. The rest of the wells were pumped. The estimated daily capacity of the field was 4,000 to 4,500 barrels of oil. Analyses of the oils from the Tensleep and Madison formations and waters from the Dakota, Tensleep (one sample from normal sandstone and one from fault zone), and Madison formations are given under Crude-oil Analyses (p. 135) and in table 6 (p. 118), respectively. To January 1938 the field produced 2,383,950 barrels of oil; yearly production is shown in table 7 (p. 120). The productive area has not been defined by drilling, but by 1938 about 500 acres had been proved. Most of the oil is shipped in tank cars and trucked to refineries in Montana; some of it is refined in Wyoming. The wells in the field have not been produced steadily or at capacity because of the fluctuating market for the oil.

GARLAND

The Garland field (fig. 18, case) is mainly in the southwest corner of T. 56 N., R. 97 W., Big Horn County. For many years while only the shallow oil and gas wells were being produced this field was called the Byron field (p. 21). However, with the development of an oil and gas structure a few miles northeast the new field was called Byron and the older was renamed Garland.

The Garland structure is an anticline along a line of folding that trends northwest and southeast in the northern part of the Big Horn Basin. The anticline extends south into the upper central part of T. 55 N., R. 97 W., Big Horn County, and northwest into the east half of T. 56 N., R. 98 W., Park County. Numerous faults are indicated by the sandstone members of the Mesaverde that outcrop on the flanks of the structure; these dip 30° to 40° on the northeast flank and 15° to 20° on the southwest flank. The structure has at least 2,600 feet of closure. The Cody shale is exposed over most of the structure at altitudes of about 3,990 feet at the southern part of the structure (eroded by the Shoshone River) and about 4,050 to 4,160 feet throughout the remainder of the field.

The first well in the Garland field, drilled in 1906 in the NE¼SE¼ sec. 33, disclosed 42° A. P. I. gravity light oil in the Peay sand of the Frontier formation at 624 feet. From then until 1921 over 30 wells 600 to 800 feet deep—most of them in lot 52 (fig. 18)—were drilled to this sand. In 1915 sweet gas was found in the Cloverly formation at 1,800 to 1,900 feet; a well in the NW¼SE¼ sec. 33 produced 28 million cubic feet of gas from the Lakota sand at 1,842 to 1,868 feet.

Fifteen gas wells were completed in the Cloverly formation; initial daily gas volume ranged from 20 to 30 million cubic feet and shut-in wellhead pressure from 500 to 650 pounds per square inch. One well with a daily open-flow volume of 1¼ million cubic feet and a shut-in wellhead pressure of 220 pounds per square inch was completed in the Morrison formation at 1,945 feet; this well later was deepened to the Madison limestone. A well was also tested in the Chugwater formation at 2,593 to 2,615 feet, and an open-flow volume of 6 million cubic feet of gas a day was obtained. In 1927 gas was discovered in the Embar lime at 3,060 to 3,165 feet in a well in the NE¼NW¼ sec. 33. The well could produce 40 million cubic feet a day; the shut-in wellhead pressure was 1,415 pounds per square inch. This was the first large gas well completed in the Embar lime in Wyoming. Deeper drilling disclosed that the Tensleep sandstone also carried gas on the crest of the structure. The gas from the Embar lime and Tensleep sandstone contains hydrogen sulfide and is a typical "sour" gas. In September 1930 oil and gas were discovered in a well in the NW¼NW¼ sec. 33 in a porous zone of the Madison limestone at 3,970 to 4,264 feet about 400 to 600 feet below the top of the lime. The discovery well produced about 2,500 barrels of 19° A. P. I. gravity black oil and 8 million cubic feet of sour gas daily; the shut-in wellhead pressure was 1,470 pounds per square inch. Eleven other wells completed in the Madison lime before April 1938 flowed initially 150 to 2,800 barrels a day after being treated with acid. Gas from an upper gas zone in the lime is utilized to "flow" the wells.

Approximately 112 wells were drilled in the field by April 1938, of which about 90 were dry or if originally productive have since been abandoned. Most of the dry or abandoned wells were completed in the shallow Frontier sand. A log of the formations in this structure shows about 600 feet of Cody shale; 590 feet of Frontier formation with the 30-foot Torchlight sandstone member at the top and the 45-foot Peay sandstone member about 440 feet below the Torchlight; 858 feet of Mowry and Thermopolis shales; 150 feet of Cloverly formation containing two sandstones each approximately 40 feet thick; 683 feet of Morrison and Sundance; 700 feet of Chugwater; 100 to 150 feet of Embar lime with three porous zones totaling 25 feet in thickness in the upper part; 122 feet of Tensleep; 190 feet of Amsden; and the Madison below.

Of the 22 wells in the field on April 1, 1938, 4 could produce some gas from the Frontier formation, 5 were Cloverly formation gas wells having an open flow of about 8 million cubic feet a day, 1 was an Embar lime gas well having an open flow of 35 million cubic feet a day and a shut-in wellhead pressure of approximately 1,400 pounds per square inch, and 12 were Madison lime oil wells. The Madison wells produce 1 to 50 percent water; this is removed by heating the oil to around 200° F. so that the water will settle out or by subjecting the oil to distillation to drive off the water along with some gasoline, which is recovered later. Analyses of oils from the Frontier, Tensleep, and Madison formations, gases from the Frontier, Cloverly, Embar and Tensleep, and Madison formations, and water from the Madison formation are given under Crude-oil Analyses (pp. 136 and 137), in table 5 (p. 116), and in table 6 (p. 118), respectively.

Yearly oil and gas production records of withdrawals from the Garland field are given in tables 7 (p. 120) and 8 (p. 122), respectively.

The total quantities produced to 1938 were 3.4 million barrels of oil and 27.4 billion cubic feet of gas.

The early oil production in the field was not recorded, but it is estimated that about 78,000 barrels was produced from 1907 to 1912, inclusive. The oil produced during 1907 and 1908 was used in development work; that produced from 1909 to 1912 was refined in a small plant at Cowley.

In addition to the gas produced (table 8), approximately 3 billion cubic feet was wasted in 1915 while a large gas well was out of control for several months, and 20 billion cubic feet was wasted while a well was out of control in 1936 and the early part of 1937. The productive area of the Peay sand was small, probably not over 40 acres; the recovery from the small producing area has been approximately 14,300 barrels per acre. It has been estimated that about 2,700 acres will prove productive in the Embar and Tensleep formations. The productive area in the Madison lime is still undetermined, as few wells have been drilled. The gas is piped to Lovell and Powell nearby for domestic and industrial uses. Some excess sour gas produced with the oil from the Madison lime is returned to the almost depleted gas sands in the Frontier and Cloverly formations. From 1918 to 1920, inclusive, over 9 billion cubic feet of gas was consumed in the manufacture of carbon black at a plant built at Cowley in the fall of 1917 and shut down in the spring of 1921. The pipe-line system that transports the oil from the Byron field also transports the oil produced in the Garland field—two 8-inch lines from the field to or near Lovell and one 8-inch line to the Elk Basin-Greybull pipe-line system. Some oil was trucked from the field to Billings, Mont.

A conditional unit-operating agreement for the southern part of the Garland field was approved by the Secretary of the Interior on July 25, 1935, and a unit plan for the development and operation of the Garland structure or northwest part of the field was approved on July 6, 1936.

GOLDEN EAGLE

The Golden Eagle gas field (fig. 24, case) in secs. 11 and 12, T. 45 N., R. 97 W., Hot Springs County, occupies a small, nearly symmetrical dome with approximately 350 feet of closure; the flanks dip about 15° on the south and west sides and 8° on the north and east. The Fort Union is the surface formation at an altitude of 5,050 feet.

The field was discovered in 1918 on drilling a well in the NW¼SW¼ sec. 12 that produced initially several million cubic feet of gas a day from a sand in the Mesaverde formation at a depth of 2,270 feet. When the well was deepened late in 1923 it was reported that the initial open-flow volume was 5.5 million cubic feet of gas a day and that the shut-in wellhead pressure was 700 pounds per square inch. In 1921 a well in the NE¼SW¼ sec. 12 was drilled to a sand in the Mesaverde formation at a depth of 2,980 to 3,000 feet; its initial open-flow volume was 20 million cubic feet a day and the shut-in wellhead pressure 1,200 pounds per square inch. Five wells were drilled in the field, three of which were dry. The discovery well penetrated a narrow section of the Fort Union formation before being drilled into the Mesaverde formation, where it was completed. The Golden Eagle structure and its relation to other structures in the southwest part of the Big Horn Basin are shown in figure 24 (case).

By 1937 the field was considered depleted and was abandoned. The last production of gas was obtained in 1933 when the one remaining well was shut in; in 1936 the well was abandoned. The lower formations in the field have not been tested, but the productive area, if any, is likely to be small. Analysis of the gas from the Mesaverde formation is given in table 5 (p. 116). During the life of the field (1921 to 1933) over 2.5 billion cubic feet of gas was produced, about half of which was burned in a carbon-black plant operated in the field during 1923 and 1924. The remainder of the gas was transported through 20 miles of 4-inch line to Thermopolis for domestic consumption. Yearly gas production is given in table 8 (p. 122). The productive area of the field was estimated at approximately 300 acres.

GOOSEBERRY

The Gooseberry anticline (fig. 30, case), mainly in T. 47 N., R. 100 W., Park County, includes two structural highs; the north one is a quaquaversal dome whose crest is in the NE¼ sec. 21, and the south one is an elongated, almost symmetrical dome whose crest is in the northeast corner of sec. 32. The elongated south dome has an independent closure of 1,000 feet opening into the north dome and a total closure of 1,600 feet opening into the Little Buffalo Basin. The west flank of the south dome dips 20° to 30° and the east flank 15° to 27°. The lowest exposed formation is Cody shale at an altitude of 6,289 feet at the discovery well.

Two dry holes were drilled on the south Gooseberry dome before oil was discovered in 1937. One drilled in 1917 in the SW¼SW¼ sec. 28 to a depth of 2,550 feet tested the Frontier formation; the other, drilled in 1926 in the NE¼NE¼ sec. 32 to a depth of 3,802 feet, disclosed water in sands in the Frontier, Cloverly, and Morrison formations. In September 1937 a well in the NW¼NW¼ sec. 33 produced by swabbing at the rate of 300 barrels a day of 22° A. P. I. gravity black oil from the Embar-Tensleep oil zone at 5,668 to 5,993 feet. The Chugwater formation was logged in the well at 4,432 to 5,601 feet and the Embar lime at 5,601 to 5,892; the Tensleep sandstone was drilled to a depth of 6,076 feet, water being found in the formation below 6,055 feet. After the well was tested it was shut in. Analysis of the oil from the Embar and Tensleep formations is given under Crude-oil Analyses (p. 137).

A unit plan for the development and operation of the Gooseberry unit area was approved by the Acting Secretary of the Interior on April 28, 1937.

GP

The GP oil field is in secs. 9 and 16, T. 25 N., R. 86 W., Carbon County. As shown in figure 25 (case), structural conditions in that area do not favor oil accumulation. The GP sand that carries the oil is a sand and sandy shale between the Steele and Niobrara formations. Lenticularity, variable porosity, and some small structural closure probably have resulted in the formation of the reservoir. The surface formation is Steele shale at an altitude of approximately 7,000 feet. Oil was discovered in the GP sand in 1919. In 1920 a well in the NW¼NW¼ sec. 16 drilled into the same sand at 3,116 to 3,131 feet produced 450 barrels of 36.5° A. P. I. gravity green oil daily. Another well drilled that year in the SW¼SW¼ sec. 9 pro-

duced 100 barrels of oil a day from the GP sand at 2,865 to 2,880 feet. The Frontier formation was tested to a depth of 5,465 feet, but the sands in this formation were water bearing. From 1919 to 1925, 10 wells had been drilled, only 2 of which produced oil. The 2 wells, producing intermittently by 1938, averaged 5 barrels a day; yearly production is given in table 7 (p. 120), and a production-decline curve is shown in figure 26 (p. 31). The production-decline curves of the GP and Ferris fields were compared because the producing zone in the GP field was a sandstone and in the Ferris field a shale. Analysis of the oil from the GP sand is given under Crude-oil Analyses (p. 138). The productive area is considered to be about 40 acres. The oil is piped to the Ferris pumping station on the Casper-Parco oil line.

GRASS CREEK AND LITTLE GRASS CREEK

The Grass Creek oil field (fig. 31, case) in T. 46 N., Rs. 98. and 99 W., Hot Springs County, occupies an asymmetrical elongated dome with a closure of approximately 1,800 feet. The east flank of the structure dips about 12° and the west flank as much as 30°. The surface formation is Cody shale at an average altitude of 5,600 feet. Sandstone members of the Mesaverde formation form escarpments that surround the field.

The field was discovered in June 1914 on completion of a well in the NW¼SE¼ sec. 18, with an estimated initial daily production of 50 barrels of oil at 900 to 1,152 feet in the Frontier formation. At least 332 wells were drilled in the Grass Creek field, most of them in 1916, 1917, and 1918, and oil was obtained in 9 sands in the Frontier formation at depths of 700 to 1,200 feet—the best production coming from about 1,000 feet. Some wells were finished with as much as 400 feet of open hole in the Frontier producing zone. The initial daily production of 300 oil wells ranged from 10 to 400 barrels of green oil with a gravity of 42° to 46° A. P. I. In the early life of the field the initial daily production ranged from 150 to 400 barrels, some wells flowing at this rate for several days to several weeks. Most of them produced some gas with the oil. One well in the NE¼NW¼ sec. 19, drilled to the Muddy sand in 1915, yielded a large flow of gas for several years. A compression casinghead-gasoline plant, which started operating in 1918, processed about 1 million cubic feet of gas a day. Until operations were suspended in the fall of 1936, 4,865 million cubic feet of gas was processed and about 12.75 million gallons of gasoline extracted. From August 1930 to August 1932, 85 million cubic feet of residue gas from the gasoline plant was returned to the Frontier sand for gas-drive purposes.

In 1922 a well in the SW¼NW¼ sec. 19 produced black oil from the Embar lime and Tensleep sandstone; later 14 wells were completed in the Embar or Embar and Tensleep at an average depth of about 3,900 feet. The Embar lime ranged from 250 to 280 feet in thickness, and the Tensleep sandstone was at least 200 feet thick in the wells drilled through it; 5 of the 14 wells produced from the Embar lime, each averaging initially 480 barrels of 24° to 25° A. P. I. gravity oil daily, while 9 yielded initially 100 to 600 barrels of 24° to 25° A. P. I. gravity oil daily from the Embar lime and Tensleep sandstone. One well in the field produced some oil from a sand in the Morrison formation and another from a sand in the Chugwater formation. A deep well in the NE¼ sec. 19, about 200 feet structurally lower than the

crest of the structure, reached the top of the Muddy sand at 1,512 feet, the Dakota sand at 1,775 feet, the Morrison formation at 2,005 feet, the Chugwater at 2,573 feet with a sand at 2,900 feet, the Embar at 3,758 feet, and the Tensleep at 4,084 feet. The well was drilled a total depth of 4,205 feet and stopped in the Tensleep.

On January 1, 1938, the wells in the Grass Creek field were shut in. There were approximately 300 wells in the Frontier sands; 280 could produce about 2,000 barrels a day by pumping, and 20 were shut in permanently. The wells are produced when there is a demand for the oil. Individual wells yield ¼ to 80 barrels a day. All of the wells in the Frontier formation produced water, ranging from 2 to 98 percent of the total liquid pumped. On the west side of the structure the Frontier formation is being flooded gradually, whereas on top of the structure it is becoming depleted. One small gas well in the field could deliver about 50,000 cubic feet a day. Each of the 14 black-oil wells in the Embar and Tensleep could average, by pumping, 400 barrels of oil a day. They were pumped at intervals to supply the demand for this type of oil. Wells in the Embar lime produced clean oil, while most of the wells in the Embar lime and Tensleep sandstone produced water with the oil, which settled out readily by using Tretolite and heating to 200°F. Analyses of the oils from the Frontier, Embar, and Embar and Tensleep formations and the water from the Frontier, Chugwater, and Embar formations are given under Crude-oil Analyses (pp. 138 and 139) and in table 6 (p. 118), respectively.

The Grass Creek field produced 26.5 million barrels of oil to January 1938, of which 1.6 million barrels was black oil; yearly oil production is given in table 7 (p. 120), and a production-decline curve is shown in figure 10 (p. 11). Approximately 3⅜ billion cubic feet of gas was reported, although probably twice this volume was produced. Yearly gas production is given in table 8 (p. 122). No records are available on volume of gas produced from 1914 to 1917, inclusive. The figures given for 1918 to 1927, inclusive, represent only a small part of the gas produced. The figures for 1928 to 1936, inclusive, approximate the volume processed in the gasoline plant.

The productive area of the Frontier sands was estimated to be 1,480 acres, but the area of the Embar and Tensleep has not been defined. Based on 1,480 productive acres, the oil recovery per acre from the Frontier sands to 1938 has been 17,500 barrels. The oil was transported 79 miles through an 8- and 6-inch pipe line to a refinery at Greybull. In the early life of the field a 3-inch pipe line 28 miles long was used to transport casinghead gasoline from the field to the railroad at Winchester.

The Little Grass Creek gas field (fig. 24, case) in secs. 10 and 11, T. 46 N., R. 99 W., Hot Springs County, is on a small symmetrical structure almost quaquaversal, which joins the Grass Creek structure from which it is separated by a narrow syncline. The Little Grass Creek structure has an independent closure of about 500 feet. The Cody shale forms the surface.

The field was discovered in April 1917 on completion of a well in the NW¼SW¼ sec. 11 in the Frontier formation at 2,562 to 2,901 feet, with an initial open-flow volume of 30 million cubic feet of gas a day and a shut-in wellhead pressure of 710 pounds per square inch. The upper Frontier sand was water bearing, whereas the lower sands contained gas. This well was shut in until 1925, when it was pro-

duced to supply gas for domestic consumption in Thermopolis. In 1919 another gas well was completed with an initial open-flow volume of 10 million cubic feet a day and in 1934 was deepened and reconditioned. The position of the Little Grass Creek structure in relation to others in the area is shown in figure 24 (case). On January 1, 1938, there was one producing gas well in the field, the other well having been shut in. The gas is analyzed in table 5 (p. 116). The field produced 1.4 billion cubic feet of gas to 1938; yearly production is given in table 8 (p. 122). The productive area of the field is probably about 160 acres. The gas is transported through approximately 35 miles of 4- and 6-inch pipe line to Thermopolis.

GREYBULL

The Greybull field, originally known as Peay Hill (fig. 34, case), occupies a faulted dome in the center of the west half of T. 52 N., R. 93 W., Big Horn County. The Peay sandstone member at the base of the Frontier formation and the upper part of the Mowry shale form the surface at an altitude range of 3,770 to 3,870 feet. The flanks of the dome dip about 4° on the north, east, and south; on the west, however, they increase to 35°. The structure has about 200 feet of closure.

Gas was discovered in July 1907 on drilling a well in the NW¼NW¼ sec. 21 on top of the dome that produced initially 6 million cubic feet of gas daily from the Greybull sand at a depth of about 825 feet. In October 1908 oil was discovered on the north flank of the structure in a well in the SE¼SE¼ sec. 17. A number of small oil wells were completed in 1909 to 1914, inclusive, but not until 1915 did the real development of the field begin. The oil-producing zone is the Greybull sandstone member in the top of the Cloverly formation at a depth of 800 to 1,300 feet, depending on the structural position of the well. The sand is approximately 20 feet thick. The oil is green and has a gravity of 49° A. P. I. Gas in the first well was blown to the air for almost 2 years, and by 1909 and 1910 when other wells were drilled the rock pressure had dropped to 120 pounds per square inch and the initial daily open-flow volume was only about 1 million cubic feet. The initial daily oil production of the early wells was about 20 barrels. During 1915 the larger oil wells completed were reported to have produced as high as 500 barrels a day, which soon dropped to about 100 barrels. Approximately 125 wells were drilled on the structure, 18 of which were gas wells. In the north end of the field in lot 72 well logs show the Muddy sand (in Thermopolis shale) at 735 to 765 feet, the Greybull sand at about 1,075 feet, and the Sundance sand at 1,496 to 1,541 feet. In a well drilled to 2,950 feet in the north end of the field in 1920 the Greybull sand was found at 950 to 990 feet and the Tensleep at 2,860 feet. All sands deeper than the Greybull were water bearing.

By January 1, 1938, at least 112 of the approximately 125 wells drilled had been abandoned; about 8 wells could produce oil, 3 or 4 having a daily combined capacity of about 10 barrels of oil. The oil and gas are analyzed under Crude-oil Analyses (p. 140) and in table 5 (p. 116), respectively. Yearly oil production is given in table 7 (p. 120). No information is available on early oil production (1909 to 1914), but the output was not large; the volume of gas produced is also unknown. Approximately 500 acres on top of the structure was gas bearing, and about 900 acres to the north and west and on the sides

of the structure was oil bearing. Based on an accumulated oil production to 1938 of 269,750 barrels, the recovery has been about 300 barrels per acre. The oil is processed at small topping plants in the field.

HAMILTON DOME

The Hamilton Dome (formerly the Cottonwood Anticline) oil field (fig. 32, case) is in secs. 13, 14, and 24, T. 44 N., R. 98 W., Hot Springs County. The field is on a highly faulted asymmetrical anticline having about 1,400 feet of closure. The northeast flank dips 10° to 15° and the southwest flank 35° to 40°. The Thermopolis shale covers the crest of the structure at an altitude of 5,550 to 5,615 feet. The Torchlight sandstone member of the Frontier formation and intervening lower beds of the Frontier and Mowry formations encircle the structure.

The field was discovered in September 1918 on completion of a well in the SW¼SW¼ sec. 13, with an estimated initial daily production of at least 20 barrels of 23° A. P. I. gravity oil from a sand in the Chugwater formation at 1,445 to 1,500 feet. This was the first commercial production of oil from the Chugwater formation in Wyoming. The well later was deepened to the Embar lime after the discovery of oil in that formation. In October 1919 oil was discovered in a well in the NE¼SE¼ sec. 14 in the Embar lime at a total depth of 2,410 feet. Most of the wells in the field were drilled in 1920, 1921, and the first month or two of 1922—17 were completed. Some drilling was done during the period 1923 to 1925 and in 1934 and 1935. Well depth ranged from 2,300 to 2,700 feet and initial production from 20 to 450 barrels. In August 1920 a good producing well in the NE¼SW¼ sec. 14 was completed in the Curtis sand of the Chugwater formation at 1,745 to 1,760 feet; in 1924 it was deepened to the Embar and in 1929 to the Tensleep sandstone at 2,733 to 2,801 feet, which yielded 300 barrels of 17° A. P. I. gravity oil daily. The well was plugged back to the Embar formation but early in 1938 recompleted in the Tensleep. The fault block in the northwest part of the field proved productive in 1923; a well in the NW¼NW¼ sec. 14, drilled 2,863 to 2,889 feet to the Embar lime, yielded 15° A. P. I. gravity oil. In January 1938 a well in the NW¼SW¼ sec. 11, drilled 3,214 to 3,246 feet to the base of the Embar lime, produced 20 barrels of 15° A. P. I. gravity oil daily. The well was deepened to 3,343 feet and acidized; it then produced 260 barrels of oil daily. The oil from this field is typical Wyoming black oil. That in the Curtis sand has a gravity of 23° A. P. I.; that in the Embar lime in the main part of the field, 25° to 26° A. P. I.; that in the Embar lime in the northwest fault block, 15° to 23° A. P. I.; and that in the Tensleep sandstone, 17° A. P. I.

A generalized log of the formations drilled shows the following formation thickness in feet: Mowry, 460; Thermopolis, 360; Cloverly, 250; Morrison, 170; Sundance, 275 (water in the top); Chugwater, 1,280 (Curtis sand, 20 to 80 feet thick, about 430 feet below the top of the formation); and Embar, 380. The Tensleep is below the Embar. The changes in the gravity of the oil in two wells in the NW¼ sec. 14 near the fault are of interest. Beyond the fault the structure is about 150 feet lower than the adjacent main part of the field. In August 1934 a well near the fault line and southeast of it came in, producing 450 barrels of 23° A. P. I. gravity oil; the gravity, however, dropped

to 18.6° A. P. I. in 5 months. A well 900 feet northwest of this well and on the other side of the fault produced initially 15° A. P. I. gravity oil, but the gravity increased during the 5-month interval to 18.5° A. P. I.

Of the 32 wells in the field on February 1, 1938, all except one in the Tensleep sandstone produced from the Embar lime. Most of the wells pumped 7 to 35 barrels, some 60 to 75 barrels, and several 300 to 400 barrels of oil daily. The well in the Tensleep sandstone produced 300 barrels daily. The output of the field has been prorated because of market conditions. The yearly average daily production was about 1,100 barrels, although the field could produce 2,000 barrels or more a day. Analyses of the oils from the Curtis sand and from the Embar lime in the main part of the field and in the fault block and of the water from the Embar are given under Crude-oil Analyses (pp. 140 and 141) and in table 6 (p. 118), respectively. The field has produced to 1938 about 4.6 million barrels of oil; yearly oil production is given in table 7 (p. 120). Approximately 600 acres is productive in the Embar lime. The oil recovery per acre to 1938 has been 7,650 barrels. The oil is transported through a 6-inch pipe line to a tank farm at Winchester and thence to a refinery at Greybull.

HATFIELD DOME

The Hatfield Dome field, known also as Eight Mile Lake, Lake Valley Dome, and Hatfield gas structure (fig. 33), is a small structural high on the north end of the Miller Hill-Lake Valley anticline; the crest of the high is in sec. 35, T. 20 N., R. 88 W., and sec. 2, T. 19 N., R. 88 W., Carbon County. The dome is elliptical and is faulted at the south end; it has about 250 feet of independent closure and is separated by a saddle from the Miller Hill dome. The Steele shale forms the surface at an altitude range of 7,140 to 7,290 feet.

The first commercial production was obtained in 1923; a well in the NE¼NW¼ sec. 2 produced an initial daily volume of 21 million cubic feet of gas from the Dakota sand at 3,954 to 3,967 feet; the shut-in wellhead pressure was 1,710 pounds per square inch. Another well produced 20 million cubic feet daily from the Frontier formation at 3,460 feet but was flooded with water, and one completed in the Muddy sand at 3,730 to 3,741 feet produced 15 million cubic feet daily and had a shut-in wellhead pressure of 1,340 pounds per square inch. A fourth well produced about 2 million cubic feet of gas daily from the Dakota sand and was shut in. Wells drilled in the north part of the field in secs. 14 and 26 yielded water from the Frontier and Dakota sands. The log of the discovery well showed First Wall Creek sand at 2,910 to 3,095 feet, Second Wall Creek sand at 3,135 to 3,300 feet, Muddy sand (with a potential yield of 6 million cubic feet of gas a day) at 3,846 to 3,858 feet, and Dakota sand at 3,954 to 3,967 feet. By 1936 the pressure on the Muddy sand had declined markedly; and in 1936 the well in this sand was deepened to the Dakota sand, which was found to be virtually depleted. The hole was plugged back to the Muddy sand, and the recompleted well produced 800,000 cubic feet of gas daily and had a shut-in wellhead pressure of 350 pounds per square inch. The small Dakota well, which had been shut in, was deepened, and lower sands were tested to a depth of 4,676 feet in the Chugwater formation but without success.

The hole was plugged back to the Dakota sand at 3,933 to 3,950 feet, and the completed well produced 1.5 million cubic feet of gas.

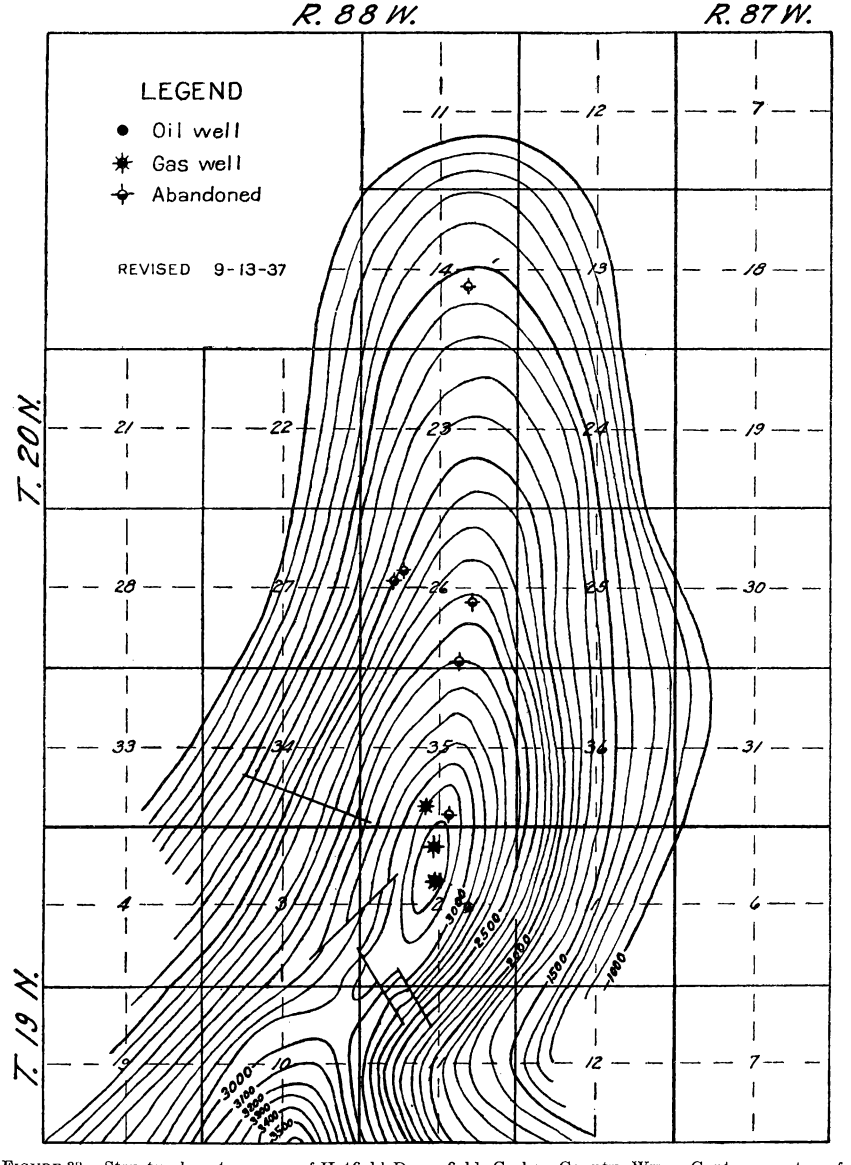

FIGURE 33.—Structural contour map of Hatfield Dome field, Carbon County, Wyo. Contours on top of Dakota sand by E. W. Krampert.

At the beginning of 1938 there were two gas wells in the field that could produce about half a million cubic feet a day. The discovery well in the Dakota sand had been abandoned. Analyses of the gases from the Muddy and Dakota sands are given in table 5 (p. 116). The

field has produced 4.9 billion cubic feet of gas to 1938; yearly gas production is given in table 8 (p. 122). The proved gas area is small, probably not over 320 acres. The gas is piped through 10 miles of 6-inch line to Rawlins, Wyo., for domestic use.

HIAWATHA

The Hiawatha gas fields (fig. 35, case) are in the Vermillion Creek Basin in T. 12 N., Rs. 99 and 100 W., Sweetwater County, Wyo., and T. 12 N., Rs. 100 and 101 W., Moffat County, Colo. Two domes—Hiawatha and West Hiawatha—are formed on the major line of folding in the Vermillion Creek area. The same outside closing contour of the Vermillion Creek anticline includes both Hiawatha and West Hiawatha domes; as the saddle between them is shallow both may form a single gas reservoir. The total closure along the axis of the fold is about 600 feet. The Hiawatha dome is virtually a quaquaversal structure with an independent closure of 235 feet defining an area of 4,400 acres—3,700 in Colorado and 700 in Wyoming. West of the Hiawatha dome and about 125 feet lower structurally is the West Hiawatha dome, with an independent closure of about 60 feet and an effective closure of about 425 feet. The surface formation on these domes is Wasatch at an altitude range of 6,500 to 7,200 feet.

Gas was discovered on the Hiawatha dome in October 1926 on drilling a well in the SW¼NE¼ sec. 22, T. 12 N., R. 100 W., Moffat County, Colo., that produced an initial open-flow volume of 45 million cubic feet of gas daily from the Wasatch formation at 2,215 to 2,238 feet; the shut-in wellhead pressure was 840 pounds per square inch. Seven other wells were drilled, and a total initial open-flow volume for the field of about 194 million cubic feet of gas was obtained from at least three producing sands in the Hiawatha member of the Wasatch formation (as per Nightingale) at depths of 2,000 to 3,719 feet. The initial open-flow volume of the wells ranged from 3 to 45 million cubic feet (averaging 23 million) and pressure from 661 to 1,315 pounds per square inch. After one well had produced gas for 3 years it started to produce 35° A. P. I. gravity green oil at the rate of about 8 barrels daily. Other wells produced "drip" gasoline.

One deep test on the Hiawatha dome was drilled 7,577 feet, almost to the base of the Williams Fork formation of the Mesaverde group, but gas in commercial quantities was not found below the Hiawatha member of the Wasatch formation (as per Nightingale). In this hole the base of the Wasatch formation (as per Nightingale) was found at approximately 3,550 feet and the top of the Lewis shale at 5,424 feet. A columnar section, starting below the Green River formation, compiled from field information and well logs shows the following formation thickness in feet: Cathedral Bluffs tongue of the Wasatch formation, 1,750; Tipton tongue of Green River formation, 370; and Hiawatha member of lower Wasatch formation (as per Nightingale), 4,000. The wells at Hiawatha start in the lower Wasatch formation 300 to 900 feet below the top of the Hiawatha member.

On January 1, 1938, there were seven gas wells on the Hiawatha dome with a total open-flow volume of about 65 million cubic feet of gas a day. The yearly average production of gas was about 6 million cubic feet a day. Analyses of the oil and gas are given under Crude-

oil Analyses (p. 142) and in table 5 (p. 116), respectively. No estimate of the productive area has been made.

The West Hiawatha dome proved productive of gas in August 1930; a well in the SW¼NE¼ sec. 19, T. 12 N., R. 100 W., Moffat County, produced 60 million cubic feet daily from four separate sands in the Wasatch; pressure in the sands ranged from 610 to 940 pounds per square inch. Three of the sands were cemented off because of mechanical difficulties; the well then produced 8 million cubic feet of gas daily from a sand at 1,992 to 2,050 feet and had a shut-in wellhead pressure of 850 pounds per square inch. Three additional wells were drilled to a depth of about 2,000 feet with an initial daily production of 5 to 16 million cubic feet, totaling about 28 million; the shut-in wellhead pressure was 850 to 900 pounds per square inch.

On January 1, 1938, there were four gas wells on West Hiawatha dome that could produce a total daily open-flow volume of about 20 million cubic feet. The yearly average production of gas was about 2 million cubic feet a day. The productive acreage has not been defined. The total volume of gas produced to 1938 from both the Hiawatha and West Hiawatha gas fields was 23 billion cubic feet; yearly production is given in table 8 (p. 122). Gas from the field is delivered into a main pipe-line system that transports gas from the North and South Baxter Basin, Clay Basin, Hiawatha, and West Hiawatha fields to Salt Lake City and Ogden, Utah, and towns in southwestern Wyoming.

HIDDEN DOME

Hidden dome (fig. 36) is a narrow, elongated, symmetrical dome in the southwest corner of T. 48 N., R. 90 W., the southeast corner of T. 48 N., R. 91 W., and the northwest corner of T. 47 N., R. 90 W., Washakie County. It is unfaulted and has about 300 feet of closure. The Cody shale forms the surface at an altitude range of 4,425 to 4,530 feet.

Gas was discovered in September 1917 in an upper Frontier sand on completion of a well in the SE¼SE¼ sec. 31, T. 48 N., R. 91 W., with an initial daily open-flow volume of 4 million cubic feet of gas. Some years later the well was deepened, and the daily production increased to 50 million cubic feet from the Frontier formation at 1,390 to 1,492 feet. Five additional gas wells were completed, yielding initially about 160 million cubic feet of gas daily from the Frontier formation at depths of 1,200 to 1,500 feet; the shut-in wellhead pressure was 725 pounds per square inch.

In August 1932 a well completed in the NE¼NW¼ sec. 31 in the north end of the dome, at least 300 feet structurally lower than the crest, produced initially 35 barrels of 41.4° A. P. I. gravity light oil from the Frontier formation at a depth of 1,436 to 1,446 feet. By 1938, 32 other wells had been drilled; 18 were commercial producers, each yielding 10 to 140 barrels of oil a day. Some of the wells flowed when completed but soon had to be pumped. All were drilled into the Frontier formation, the depth ranging from 1,435 to 1,675 feet; the average thickness of the saturated zone was 10 feet. Well logs show about 1,100 feet of Cody shale over the crest of the structure, the main gas sand in the Frontier formation at 1,400 to 1,500 feet, and the Dakota sand at about 2,400 feet. The wells in the productive area—the north end of the structure—produce oil from what appears

to be a soft sand interbedded with shale and bentonite 90 to 100 feet below the top of the Frontier formation.

By January 1938 the gas sand in this reservoir virtually was depleted. The field has produced only a small volume of gas since 1932. The potential daily production in 1937 was about 1 million cubic feet, but the pressure had declined to about 60 pounds per square inch. On January 1, 1938, the 17 oil wells in the field pumped at the

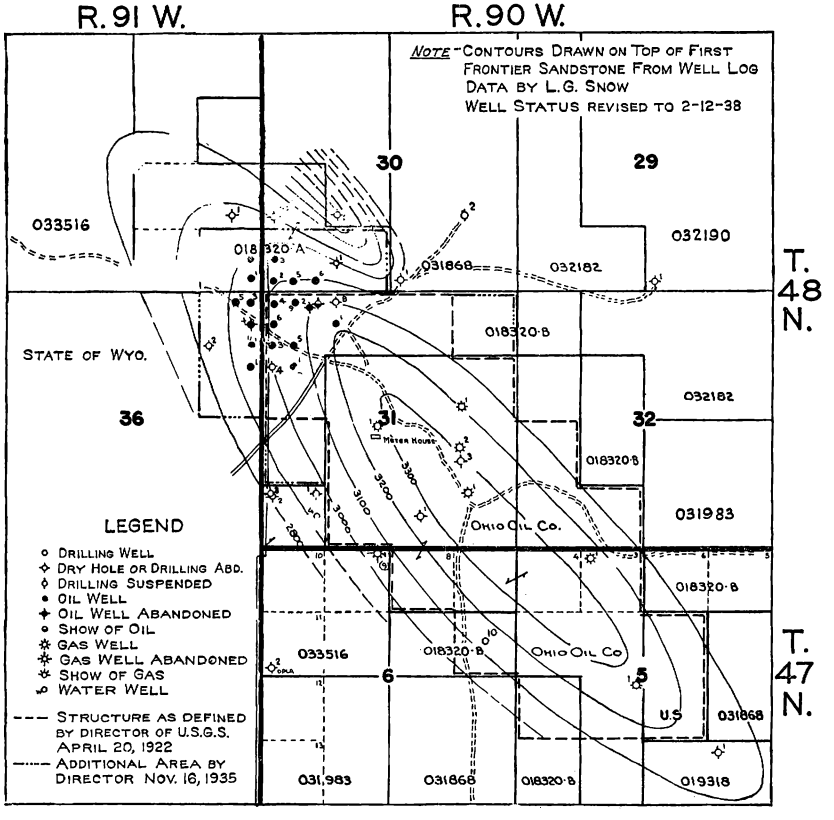

FIGURE 36.—Map of Hidden dome, Washakie County, Wyo. (U. S. Department of Interior, Geological Survey, Conservation Branch, Oil and Gas Leasing Division).

rate of approximately 170 barrels of oil a day. Analyses of the oil and gas are given under Crude-oil Analyses (p. 142) and in table 5 (p. 116), respectively. The field produced 22.1 billion cubic feet of gas and 185,837 barrels of oil to 1938. Yearly production of oil and gas is given in tables 7 (p. 120) and 8 (p. 122), respectively. The gas-bearing area is estimated to be approximately 640 acres; the oil-bearing area probably is not much over 100 acres. The gas formerly was piped through 35 miles of 8-inch line to Basin and Greybull where it served domestic consumers; the excess was used at the refinery at Greybull. The oil was piped 19 miles through a 2-inch line to a refinery at Worland.

IRON CREEK

The Iron Creek field (fig. 37) in secs. 10 and 11, T. 32 N., R. 82 W., Natrona County, is on a small anticline which is en échelon with and southwest of the southern end of the Pine Mountain-Oil Mountain fold. The Frontier is the surface formation at an altitude of 5,480 feet, and the Wall Creek sandstone member forms an escarpment that surrounds the field. One major transverse fault crosses the south end of the structure. The strata on the north end dip 42°, those on the south 11°, those on the east 20° to 60°, and those on the west 30° to 60°. The closure is about 500 feet.

The field was discovered in 1917 on completion of a well in the SW¼NW¼ sec. 11 in the Dakota sand, with a daily open-flow volume of 18 million cubic feet of gas; the shut-in wellhead pressure was 300 pounds per square inch. Ten holes were drilled on the structure; and four gas wells and one oil and gas well were completed in the Dakota sand, topped at 653 to 783 feet. The initial daily open-flow volume of the gas wells drilled in 1917 and 1918 was 15 to 20 million cubic feet, and the initial daily production of the oil-gas well was 200 barrels of 28° A. P. I. gravity oil and about 15 million cubic feet of gas. Gas from the field was piped to Casper from 1921 to September 1923, when the field pressure no longer was adequate to deliver gas into the line. About this time three of the gas wells started to produce small quantities of oil, which had moved up structure because of the decline in gas pressure. The Dakota sand contained gas at the top and, lower down, a ring of oil underlain by water. A test drilled to the Sundance formation at 1,480 feet showed that it was water bearing. The Embar lime and Tensleep sandstone have not been tested.

On January 1, 1938, four wells in the field were pumped from a central power, producing a total of about 20 barrels of oil and a large volume of water, which settled out readily. A small gas well furnished lease fuel. Analyses of the oil from the Dakota sand, gas, and water are given under Crude-oil Analyses (p. 143), in table 5 (p. 116), and in table 6 (p. 118), respectively. The field produced over 314 million cubic feet of gas, of which 74 million cubic feet was produced in 1921, 127 million in 1922, and 113 million in 1923. It also was reported to have produced to 1938 a total of 21,233 barrels of oil (table 7, p. 120). The productive area is about 60 acres. The oil is "topped" at a small plant in the field.

KIRBY CREEK

Kirby Creek oil field (fig. 38, case) is in secs. 21 and 22, T. 43 N., R. 92 W., Hot Springs County. Little is known about the structural features of the field, as no accurate logs of most of the holes drilled in the area are available. Apparantly there is some closure, although small, along the axis of a major fold, the Zimmerman Butte anticline. The Cody shale forms the surface at an altitude of about 4,800 feet.

In 1918 a well drilled in the SE¼NE¼ sec. 21 to the Second Frontier sand at 380 to 388 feet produced 60 barrels a day of 40° A. P. I. gravity amber oil. In 1919 another oil well and two gas wells were completed. The gas wells had a combined initial daily production of over 1 million cubic feet. Later about 25 other wells were drilled in the area, but none of them produced oil or gas in commercial quantities. By 1938 there were only four small pumping oil wells in the field, with a total daily production of about 7 barrels of oil and 35 barrels of water.

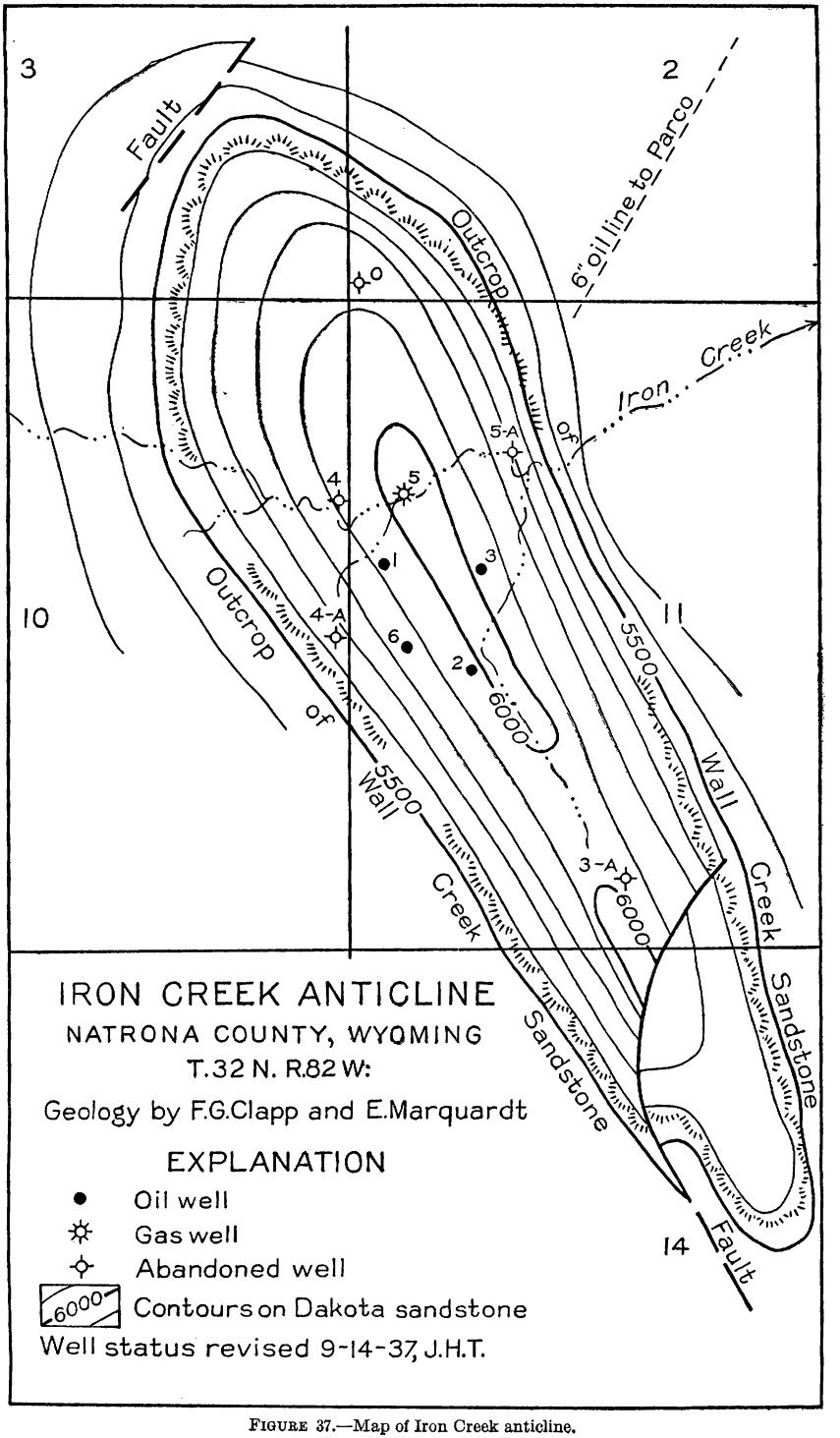

FIGURE 37.—Map of Iron Creek anticline.

Analyses of the oil and water are given under Crude-oil Analyses (p. 143) and in table 6 (p. 118), respectively. A total of 20,255 barrels of oil was reported to have been produced to 1938. Yearly oil production is given in table 7 (p. 120). Probably less than 40 acres can be considered productive. The oil is refined in a small plant at Thermopolis.

LABARGE

The LaBarge oil field (fig. 39, case) in Tps. 26 and 27 N., R. 113 W., Lincoln and Sublette Counties, is on a long, narrow, asymmetrical anticline with two distinct highs. The folded Wasatch sandstones of Eocene age unconformably overlie more sharply folded Cretaceous marine shales. About 2 miles west of and parallel to the anticline is the Darby fault, which has a vertical displacement of 20,000 feet; along the west flank of the structure is the LaBarge overthrust fault; and east of the LaBarge anticline is the Green River syncline. The strata dip about 22° on the west flank and 26° on the east flank. The closure is at least 300 feet and may be as great as 450 to 600 feet. The surface formations are the Knight and Almy of the Wasatch group of Lower Tertiary age at an altitude of 6,800 to 7,200 feet.

The field was discovered in 1924 when a well in the NW lot 7, sec. 3, T. 26 N., R. 113 W., was brought in, producing initially 10 barrels of oil a day from a sand in the Almy formation at 560 to 572 feet. Later about 116 commercial oil wells and 7 gas wells were completed in the field. The principal producing zone, at depths of 650 to 1,100 feet, may be divided into two distinct divisions. The upper part is a persistent sand that averages 20 feet in thickness, and the lower is a series of sands that vary greatly in thickness and persistence and are separated by infingering shale beds. The initial daily production of the wells ranged from 5 to 300 barrels of 17° to 24° A. P. I. gravity oil in the upper sand and 24° to 45° A. P. I. gravity in the lower zone. The gas wells on top of the structure produced initially as much as 52 million cubic feet daily and the maximum shut-in wellhead pressure was 360 pounds per square inch. This field is of interest because it probably was the first field in the Rocky Mountain region to produce oil commercially from formations of Tertiary age. Moreover, the oil in the same producing zone has a gravity of 45° A. P. I. on the north edge of the pool, decreases to 25° to 30° A. P. I. in the center, and declines progressively from the center to the south end, where it reaches 18° to 20° A. P. I.

On January 1, 1938, there were approximately 85 oil wells in the field that could produce 1,100 barrels of oil daily. Most of the wells are pumped and individually produce 2 to 50 barrels of oil daily. Six gas wells were shut in, with a combined open flow of 35 million cubic feet daily; the individual wells had a potential volume of 0.2 to 14 million cubic feet daily. Since 1932 gas produced with the oil has been compressed and returned to the producing sands for gas-drive purposes. The effect of the gas drive is indicated by the sustained production of oil in 1934, 1935, and 1936. The input volume between 1932 and 1938 was 200,000 to 300,000 cubic feet of gas a day. The input pressure ranged from 170 pounds per square inch in the south end of the field to 350 pounds per square inch in the north end, depending on the permeability of the sands. When gas-oil ratios in oil wells became too high the wells were shut in. There was evidence of edge-water encroachment in some sections of the field, but most

of the wells produced pipe-line oil. Analyses of three oils from the LaBarge field—one each from the north, central, and south parts of the field—are given under Crude-oil Analyses (pp. 144 and 145); analysis of the gas is included in table 5 (p. 116).

The field produced 5,284,741 barrels of oil to 1938; yearly production is stated in table 7 (p. 120). The gas figures in table 8 (p. 122) represent gas produced from one of the gas wells. No records of the quantity of gas produced with the oil are available. The productive area of the field is about 600 acres, 560 producing oil and 40 gas. The recovery of oil per acre has been about 9,440 barrels. Oil from the field is transported through 39 miles of 4-inch line to Opal on the Union Pacific Railroad.

LANCE CREEK

The Lance Creek oil field (fig. 40, case) in the northern part of T. 35 N., R. 65 W., and the southern part of T. 36 N., R. 65 W., Niobrara County, is on the Lance Creek anticline; the axis of the anticline in general trends east and west, but at the east end it bends northward and at the west end southward. The structure has an estimated closure of about 650 feet; the flanks dip 15° to 35° on the north and west sides of the axis and 2° to 5° on the south and east sides. The oldest formation exposed is Pierre shale. Escarpments of Fox Hills and Lance sandstones are north and west of the crest of the anticline and beds of the White River formation south of it. The altitude of the field ranges from 4,350 to 4,490 feet.

The field was discovered in March 1918 on drilling a well in the northwest corner of sec. 36, T. 36 N., R. 65 W., that produced 80 barrels of oil daily from the Wall Creek sand at 2,689 feet. This well was deepened and in October 1918 produced 1,500 barrels of oil from the Second Dakota sand at 3,663 feet. The drilling campaign during the period 1919 to 1923 disclosed that the main oil- and gas-producing zone of the Lance Creek field was the Second Dakota sandstone. Oil, however, was found also in the Muddy, First Dakota, Third Dakota, and the Lakota sands and gas in the Dakota and Lakota sands. The Muddy sand at depths of 2,840 to 3,070 feet (average thickness, 16.7 feet) was productive only over a small area on the crest of the structure—the south half of sec. 32 and the north half of sec. 5. Ten or twelve wells were completed in this sand (most of them in 1921 to 1923), initial flowing production ranging from 12 to 165 barrels and averaging 50 barrels of 38° A. P. I. gravity oil daily.

The First Dakota sand at depths of 3,000 to 3,700 feet (average thickness, 20 feet) was primarily a gas sand, although a few wells in the First Dakota sand produced oil with the gas. The open-flow volume of the wells ranged from 4 to 20 million cubic feet of gas a day and the shut-in wellhead pressure from 900 to 1,200 pounds per square inch. The Second Dakota sand, separated from the First Dakota sand by about 18 feet of shale, averaged 14 feet in thickness. This sand produced gas in the upper part of the structure and oil on the flanks. No distinction of wells in the Dakota sands can be made because most of the wells were completed in two or more sands. About 90 wells were drilled into the Dakota sands, producing 40° to 44° A. P. I. gravity oil. Of the first 75 wells initial results were as follows: 6 wells produced over 1,000 barrels, 2 wells 500 to 1,000 barrels, 11

wells 100 to 500 barrels, and 18 wells up to 100 barrels of oil a day; 15 were gas wells, and 23 were dry holes. The largest oil well produced initially 2,926 barrels a day; the largest gas well had an open-flow capacity of 45 million cubic feet and a shut-in wellhead pressure of 1,100 pounds per square inch. The Third Dakota sand, about 10½ feet thick, was essentially a water-bearing sand. A shale break about 16 feet thick separates the Second from the Third Dakota sand. The Lakota sand ranges from one distinct sand body 50 feet thick to several thin sand beds varying in thickness. The Lakota sand is about 104 feet below the top of the First Dakota sand and, where productive, yielded gas; one well produced initially 35 million cubic feet daily.

In the fall of 1930 a well in the SW¼SE¼ sec. 32 was completed in the upper zone of the Sundance formation at a depth of 3,653 feet, with an initial daily production of 600 barrels of 43° A. P. I. gravity oil. Later two other oil wells were completed in this zone, with an initial daily production, by pumping, of 140 and 307 barrels. In 1937 one of the wells was deepened to the basal Sundance. In March 1935 this sand had proved productive when an oil well in the NE¼SE¼ sec. 32 produced initially at a rate of about 3,000 barrels of 49° A. P. I. gravity green oil a day from depths of 3,844 to 3,884 feet. After this discovery those companies holding the greater part of the acreage started active drilling campaigns. By June 1938, 52 wells had been completed in the basal Sundance sand, with an initial daily production of 15 to 5,233 barrels, a total of approximately 70,000 barrels.

In May 1936 oil was discovered in the Minnelusa sandstone in a well in the SE¼SW¼ sec. 32, which flowed 900 barrels of 42° A. P. I. gravity oil daily from a sand at 4,394 to 4,434 feet. This sand in the upper part of the Minnelusa is the "Converse" sand. In June 1937 oil was discovered in the "Leo" sand in the lower part of the Minnelusa sandstone at 5,515 to 5,537 feet in a well in the NW¼SW¼ sec. 35, which flowed 77 barrels of 40° to 42° A. P. I. gravity oil an hour; the shut-in wellhead pressure was 435 pounds per square inch. By June 1938, 21 wells had been completed in the Minnelusa sandstone, 1 in the Converse sand and 20 in the Leo sand. One well in the Leo sand in the SE¼SW¼ sec. 32 was a gas well, with an initial flow of ¾ million cubic feet of gas daily. The oil wells in the Leo sand produced initially 25 to 2,400 barrels a day and averaged about 1,000 barrels. The Leo sand occurs at depths of 5,142 to 5,615 feet, depending on the position on the structure. Several wells in the Minnelusa sandstone have been acidized, with apparently beneficial effect.

Before 1926 a large volume of gas was blown to the air in the Lance Creek field. In 1926, however, a gasoline plant and a carbon-black plant were built in the field. The gasoline plant was the absorption type, with a daily capacity of 4½ million cubic feet of gas. Initially (1920 to 1923), the pressure of the gas was 900 to 1,200 pounds per square inch but by 1927 had dropped to 450 pounds. The gasoline content of the gas (based on plant recoveries) ranged from 0.4 to 1.6 gallons per 1,000 cubic feet and averaged 0.81 gallon. In April 1936 this plant was abandoned. Another absorption gasoline plant was built and put in operation in April 1936 to process the gas produced with the oil from the basal Sundance sand; 8 to 10 million cubic feet of gas was processed daily, yielding nearly 1 gallon of gasoline per thousand cubic feet. The residue gas was burned in a carbon-black plant which operated from January 1927 to March 1938. This plant

used 2,372 to 3,000 million cubic feet of gas annually, or a total of 29.4 billion cubic feet to March 1938. The yield of carbon black from 1927 to 1932, inclusive, was approximately 1.8 pounds per 1,000 cubic feet of gas and from 1933 to 1938, 2¼ to 2½ pounds per 1,000 cubic feet.

On March 1, 1938, a program for arresting the pressure decline in the basal Sundance sand was initiated. By June 1938 approximately 6 million cubic feet of gas was returned daily to the sand through five wells on top of the structure. The original bottom-hole pressure on the crest was about 1,560 pounds per square inch, but by March 1938 it had dropped to 800 pounds and on June 1, 1938, was 820 pounds per square inch. In March 1938 bottom-hole pressure in flank wells was about 850 pounds per square inch but by June 1938 had dropped to 810 pounds per square inch.

On June 1, 1938, there were 11 oil wells in the Dakota and Lakota sands in the field; 2 of these pumped a total of about 110 barrels of oil daily, and 9 were shut down. Two gas wells produced daily about 1 million cubic feet of gas for fuel in the field. In addition, eight gas wells were shut in but before being shut in in 1936 produced about 3 million cubic feet of gas from these sands daily; the shut-in wellhead pressure was about 150 pounds per square inch. The two wells in the upper Sundance sand were shut in. Of the 50 wells in the basal Sundance 3 were shut down, 5 were gas-injection wells, and 42 produced a total of about 9,500 barrels of oil daily. All of the wells in the basal Sundance sand flowed except several edge wells, which were being pumped. Several wells on top of the structure that had high gas-oil ratios were used as gas-injection wells. Some water trouble was experienced in a few edge wells in the north and west parts of the field. The 21 wells in the Minnelusa sandstone flowed about 4,000 barrels of oil daily, although they could have produced much more. Analyses of the oils from the Dakota, upper and basal Sundance sands, and Converse and Leo sands of the Minnelusa sandstone are given under Crude-oil Analyses (pp. 146 and 147). The oil from the Dakota sand was from a well that always produced oil of 4° to 6° A. P. I. higher gravity than the average oil from the Dakota sand. Analyses of gas from the Dakota and Lakota sands and waters from the First Dakota and basal Sundance sands are given in tables 5 (p. 116) and 6 (p. 118), respectively.

The oil in the basal Sundance sand was saturated with gas at reservoir pressure, as a gas cap apparently existed in the sand. Analysis of an oil sample taken in a well at a depth of 3,850 feet (30 feet above the top of the basal Sundance sand) showed that 557 cubic feet of gas (calculated at 60° F. and 14.4 pounds per square inch absolute) was in solution at 152° F. (reservoir temperature) and 1,038 pounds per square inch absolute (reservoir pressure) for each barrel of residual or produced oil (measured at atmospheric pressure and 60° F.); 1.37 barrels of oil in the reservoir at 1,038 pounds per square inch absolute and 152° F. was required to produce 1 barrel of oil at atmospheric pressure and 60° F.

To 1938 the Lance Creek field produced 11,209,771 barrels of oil, of which about 4,250,000 barrels came from the Muddy, Dakota, and Lakota sands, and about 50.8 billion cubic feet of gas, all but about 6 billion cubic feet coming from the Dakota and Lakota sands. About 10 billion of the 50.8 billion cubic feet of gas produced was wasted. This figure is based on an unpublished report by F. B. Tough, dated

March 24, 1920, in which he estimated that 7.45 billion cubic feet of gas had been wasted in the field and on additional evidence that between 1920 and 1926 while there was no market for the gas some wastage continued. About 11.5 billion cubic feet of gas produced from the Dakota and Lakota sands was processed in the former gasoline plant and 9.3 million gallons of gasoline recovered. By January 1, 1938, about 5.4 billion cubic feet of gas produced from the Sundance sand had been processed in the present gasoline plant and 5.1 million gallons of gasoline recovered. The productive area of the Muddy sand was about 320 acres and of the Dakota and Lakota sands about 3,600 acres, of which approximately 800 acres was oil bearing. The productive area of the Sundance was estimated at about 1,700 acres and of the Leo sand of the Minnelusa sandstone about 3,500 acres.

In June 1938 the oil produced in the Lance Creek field was being transported through a 4-inch line to a loading rack at Manville, Wyo., and through a 6-inch oil line (via Lusk where large quantities of oil also are loaded in tank cars) to Fort Laramie. Here the oil was pumped into the pipe line from the Clayton tank farm near Glenrock, Wyo., which is connected with a Mid-Continent pipe-line system at Freeman, Mo. The ultimate destination of the oil was the Chicago refining district. Some oil also was trucked from the field to refineries in eastern Wyoming and western Nebraska. The natural gasoline was transported through a 2-inch line to a loading rack at Manville.

A cooperative plan for the development and operation of the Lance Creek field was approved by the Acting Secretary of the Interior on December 23, 1937.

LANDER AND PLUNKETT

The Lander oil field, known also as Hudson (fig. 41), is on a narrow anticline in secs. 13, 24, and 25, T. 2 S., R. 1 E., secs. 19 and 30, T. 2 S., R. 2 E., Wind River Indian Reservation, and sec. 4, T. 33 N., R. 99 W., Fremont County. The Lander anticline is on the same major line of folding as that of the Dallas and Derby domes. The Chugwater is the surface formation at an altitude of 5,500 feet on the south end of the field and 5,780 feet on the north end. The east flank of the anticline dips about 30° and the west flank about 50°; the closure is at least 1,500 feet.

A small well was drilled near the river as early as 1909 in sec. 3, T. 33 N., R. 99 W., but the important discovery was not made until January 1912, when a well in lot 2, sec. 30, was completed at 1,010 to 1,050 feet in the Embar lime. About 46 wells were drilled, most of them from 1914 to 1920; 35 were productive, yielding initially 15 to 100 barrels of 24° A. P. I. gravity black oil daily. In 1926 and 1927, when the production from a number of wells had dropped considerably, the wells were deepened, and oil was found in lower zones in the Embar lime and in the Tensleep sandstone. Five wells were completed in the Tensleep sandstone along the axis of the structure at a depth of 1,780 to 1,790 feet. Initial daily production ranged from 75 to 300 barrels of 22° A. P. I. gravity black oil. A log of the formations on the crest of the anticline showed the top of the Embar lime at 900 to 1,100 feet (about 665 feet thick) and then the Tensleep. The abnormal thickness of the Embar is due to the steep inclination of the beds. Of the three porous zones or "sands" containing black oil in the Embar lime the upper zone was the largest producer. The

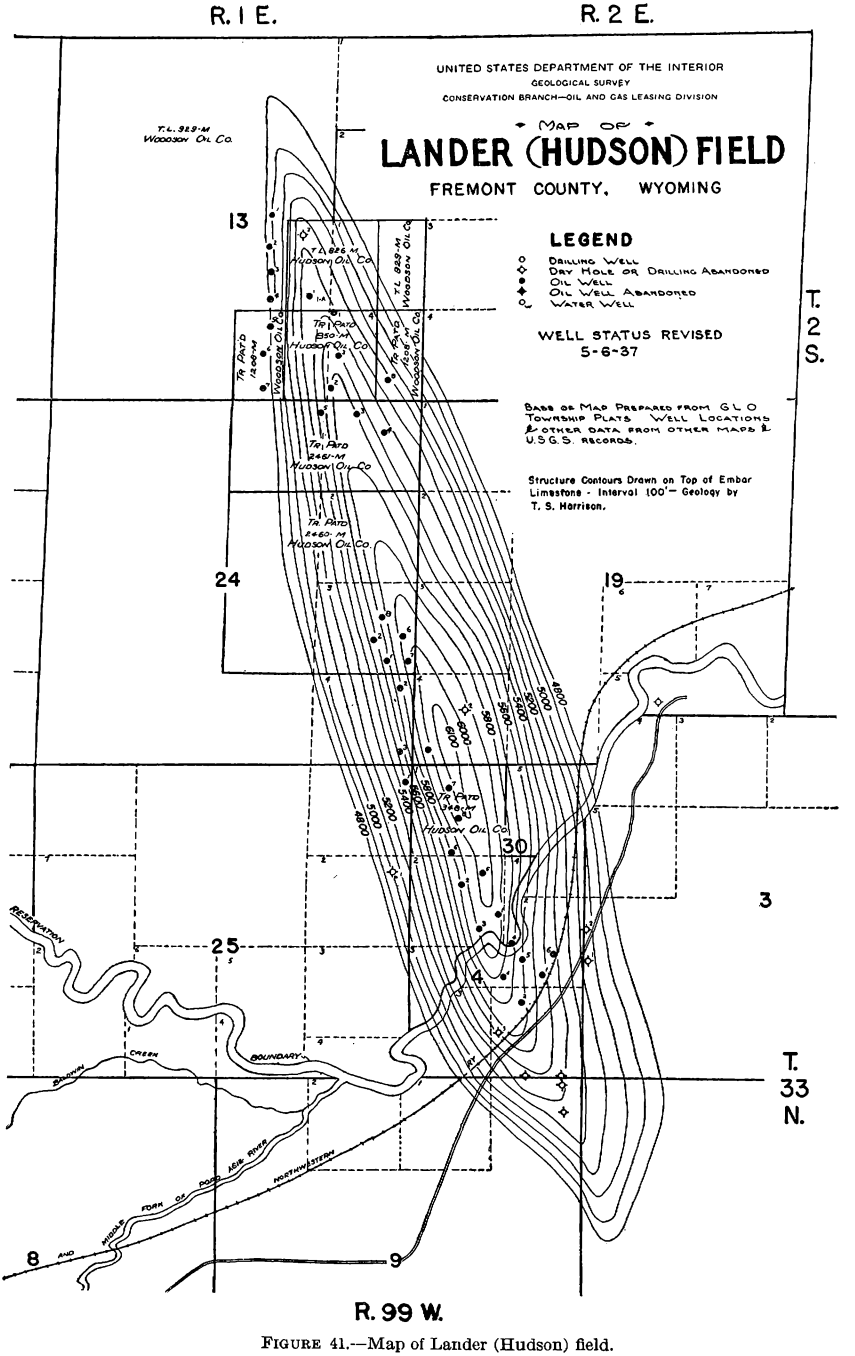

FIGURE 41.—Map of Lander (Hudson) field.

saturated portions of the upper and the lower zones totaled approximately 65 feet in thickness. All three zones contained some water, but the middle zone had the most. The upper part of the Tensleep sandstone contained oil only; the remainder of the sand contained water and oil.

By January 1, 1938, most of the wells in the Embar lime in the Lander field had been shut in because production had dropped to 2 or 3 barrels of oil per day per well. Daily oil production from the field was curtailed to about 250 barrels owing to the limited market; although this quantity could have been supplied from several wells in the Tensleep sandstone, five Embar and four Tensleep wells were being produced. Almost all of the wells produced water with the oil; the water was separated by using Tretolite and heating the oil to 160° F. Analyses of the oil and waters from the Embar lime and Tensleep sandstone are given under Crude-oil Analyses (pp. 148 and 149) and in table 6 (p. 118), respectively. The total oil production from the field to 1938 was 1,865,244 barrels; yearly production is listed in table 7 (p. 120). Approximately 360 acres in the Embar and 160 acres in the Tensleep sandstone were oil bearing. Based on 360 productive acres, the recovery to January 1938 has been 5,180 barrels per acre. Some of the oil was shipped by rail to a refinery at Casper, and some was used as fuel by the railroad.

The Plunkett oil field in secs. 23 and 26, T. 1 S., R. 1 E., Wind River Indian Reservation, Fremont County, is on the north pitching nose of the Lander anticline about 4 miles northwest of the Lander field. Sandy zones in the Mowry shale afforded means for the accumulation of oil. The Mowry shale forms the surface at an altitude range of 5,400 to 5,450 feet.

The discovery well in the NW¼NE¼ sec. 26 was drilled in 1909 near an oil seep, and oil was found in the Mowry shale at a depth of 400 feet. Additional wells drilled about 1915 produced a light, green oil of 42° A. P. I. gravity from saturated zones in the Mowry shale at an average depth of 450 feet. Eight wells had been drilled by 1921 and fifteen in 1921 and 1922. The largest well probably never produced over 8 to 10 barrels of oil daily. In one well drilled to 1,916 feet the Dakota sand contained water at 1,492 feet. By 1938 all wells had been abandoned. In August 1938 a well in the SW¼SE¼ sec. 23 drilled to 220 feet produced initially 10 barrels of oil a day. Production reported from the Plunkett field was: 3,500 barrels in 1917, 908 in 1919, 385 in 1920, 5,084 in 1921, 4,920 in 1922, and 1,686 in 1923.

LITTLE BUFFALO BASIN

The Little Buffalo Basin gas field (fig. 42, case) occupies two elliptical domes (often called East and West Buffalo anticlines or domes) mainly in the northeast corner of T. 47 N., R. 100 W., and in the southeast corner of T. 48 N., R. 100 W., Park County. The crests of the two domes coincide with one of the most impressive surface basins on the west side of the Big Horn Basin. Little Buffalo Basin is a flat oval area, 4 miles wide and 7 miles long, almost surrounded by a rugged escarpment of massive Mesaverde sandstones 400 to 700 feet high. The Cody shale covers the surface of the basin at an altitude range of 5,425 to 5,925 feet. The two domes are nearly symmetrical and apparently unfaulted. The East dome has an inde-

pendent closure of about 500 feet and the West dome about 400 feet; the total closure of the structure is about 2,000 feet. The flanks of the structure dip 15° to 30°, the steepest dips being on the west side.

Gas was discovered in Little Buffalo Basin in November 1914 on drilling a well in the SE¼NW¼ sec. 2 that produced 3 million cubic feet of gas daily from the Frontier formation at 1,750 to 1,792 feet; the shut-in wellhead pressure was 350 pounds per square inch. After being deepened in 1923 the well produced from this same formation at 1,814 to 1,860 feet. Nineteen wells were drilled in the field; six on the East dome and four on the West dome produced gas. The initial open-flow volume of the wells ranged from 3 to 90 million cubic feet of gas daily and the initial shut-in wellhead pressure from 350 to 450 pounds per square inch. All the gas from this field has come from the several sands of the Frontier formation. The Cloverly and Frontier formations contained water in an edge well. A generalized log of the field based on drilling records gives the following formation thickness in feet: Cody shale, 880 to 1,920; Frontier, 480; Mowry, 365; Thermopolis, 600; and Cloverly (thickness has not been determined by drilling). Only three wells were drilled through the Mowry shale, one of which was drilled through the Thermopolis shale to the Cloverly formation. The Frontier formation comprises an upper, middle, and lower group of sandstones. The upper group is 150 feet thick and contains one to three sandstones, which frequently carry water. The middle group is about 150 feet thick and is the main gas-producing zone. The lower group is 192 feet thick and produces gas in some wells and water in others and in some wells is "dry."

Of the nine gas wells in the field on January 1, 1938, only five were in production; these had a potential daily open flow of about 100 million cubic feet of gas but produced during 1937 at an average rate of 4.5 million cubic feet. Analyses of the gas and water in the Frontier formation are given in tables 5 (p. 116) and 6 (p. 118), respectively. To 1938 the field has produced 16.2 billion cubic feet of gas; yearly production is given in table 8 (p. 122). The productive area of the field was approximately 4,800 acres. Gas from the field was transported through a 74-mile pipe-line system (8-, 12,- and 14-inch) to Greybull, Basin, Worland, Meeteetse, and occasionally to Thermopolis, where it was sold for domestic and industrial use.

A unit plan for the development and operation of Little Buffalo Basin was approved by the Secretary of the Interior on January 6, 1931.

LOST SOLDIER

The Lost Soldier field, known also as Little Lost Soldier (fig. 25, case, and fig. 43), in secs. 2, 3, 10, and 11, T. 26 N., R. 90 W., Sweetwater County, occupies a highly faulted, slighly elliptical dome adjacent to and en échelon with the west end of the Wertz-Mahoney-Ferris anticline. The Mesaverde formation forms hogback escarpments which surround part of the field. The Niobrara shale is exposed on the crest of the structure at an average altitude of 6,900 feet. The dips on the southwest or basinward flank reach a maximum of 45° and on the northeast or mountainward flank a maximum of 35°. The dome has about 3,500 feet of independent closure.

The Lost Soldier field was discovered in June 1916 on drilling a well in the southwest corner of the NW¼ sec. 11 that produced ini-

tially 200 barrels of oil a day from the Wall Creek sand at 265 to 340 feet. Later oil was found in 11 sands at depths ranging from 195 to over 4,000 feet. There are nine Wall Creek sands in the Frontier formation, five of which are oil bearing. On the crest of the structure the First Wall Creek sand proved productive at a depth of 195 feet.

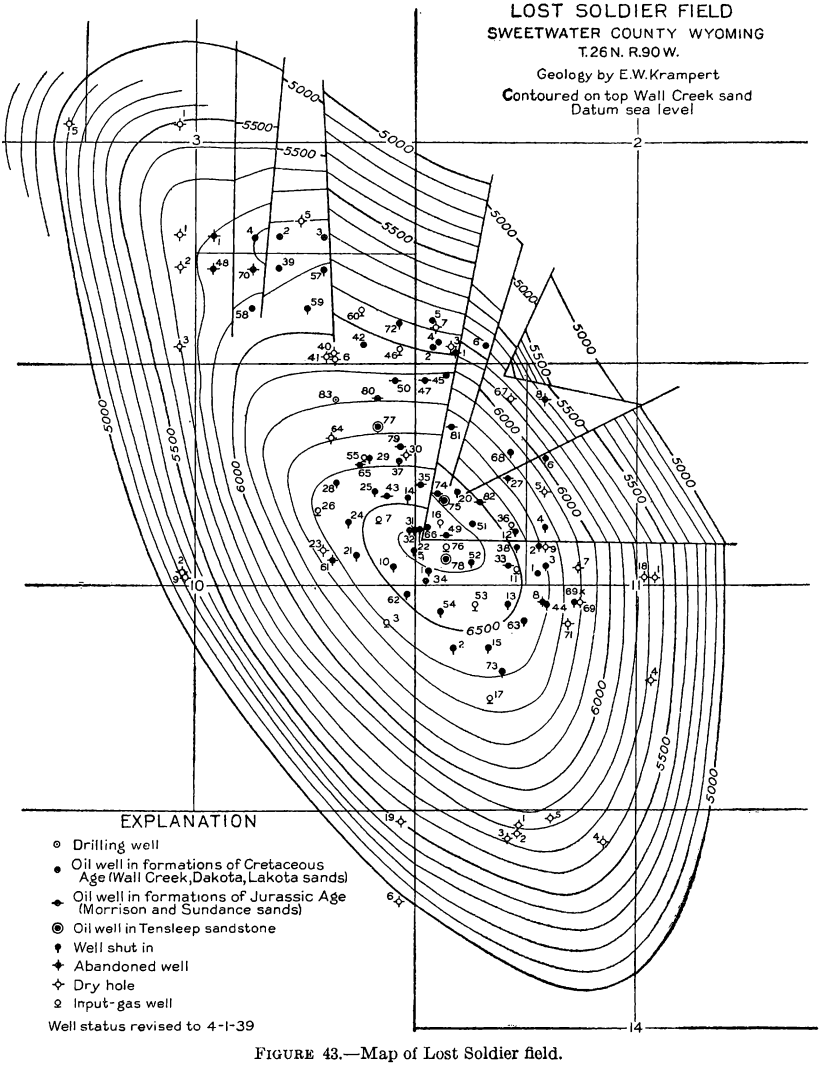

FIGURE 43.—Map of Lost Soldier field.

The Third and Fourth Wall Creek sands, the most important oil producers, occur at 400 and 600 feet, respectively. Each sand is about 90 feet thick. Over 30 oil wells produced from the Wall Creek sands, initial daily production ranging from 15 to 180 barrels of dark-green 32° A. P. I. gravity oil. Several wells produced oil from the Mowry shale at 1,100 feet; two of the wells produced initially 500 and 700 barrels of oil a day. The Mowry shale, however, was cased off in

most of the wells drilled through it, because the deeper sands were the largest producers.

In 1921 oil was found in the Dakota sand in a well in the southwest corner of the NW¼ sec. 11; most of the wells were drilled during the period 1922 to 1924. The Dakota sand was reached at 1,400 feet and averages 45 feet in thickness. Twenty-two wells were completed in this sand, initial daily production ranging from 70 to 3,900 barrels of brownish-green 32° A. P. I. gravity oil; the average initial daily production per well was around 1,500 barrels. The Lakota sand, discovered late in 1923, occurs at an average depth of 1,530 feet and averages 40 feet in thickness. Twelve wells were completed in this sand, the initial daily production per well ranging from 75 to 375 barrels of oil similar to that from the Dakota sand. In 1926 a well in the SW¼NW¼ sec. 11 produced 200 barrels of oil daily from a sand in the Sundance formation at 2,015 to 2,040 feet. Five wells were completed in the Sundance formation, initial daily production ranging from 117 to 1,498 barrels of a brownish-black 30° A. P. I. gravity oil. The productive zone—at depths of 1,890 to 2,092 feet—is a sandstone 300 feet thick. A sand just above the main Sundance sand (often referred to as a sand in the base of the Morrison formation) produced 29° A. P. I. gravity oil. Two wells were completed in this sand, with an average initial daily production of about 125 barrels of oil. A well in the SW¼NW¼ sec. 11 was completed in 1930 in the Tensleep sandstone at 3,942 to 4,009 feet; its initial daily flowing production was 1,800 barrels of 34° A. P. I. gravity brownish-black oil containing 1.2 percent of sulfur. By June 1938 two other wells had been completed in the Tensleep sandstone, with initial daily flowing production of 150 and 300 barrels of oil.

The wells in the Dakota, Lakota, and Sundance sands produced some gas when these sands were first developed. One well in the Dakota sand on top of the structure was essentially a gas well before it produced oil. The gas figures in table 8 (p. 122) for 1922 to 1931, inclusive, are estimates of the volume produced. Since 1926 the wells in the Sundance formation were produced by gas lift; on July 1, 1937, about 800,000 cubic feet of gas was being recycled daily for gas-lift purposes. For the past 10 years a small volume of excess gas has been injected into a Frontier sand.

A log of a deep well on the crest of the Lost Soldier structure gives the following formation depths in feet: Niobrara, to 295; Frontier, to 895; Mowry and Thermopolis shales, to 1,344; Dakota, to 1,395; Fuson, to 1,514; Lakota, to 1,550; Morrison, to 1,755; Sundance, to 2,187; Chugwater, to 3,715; and Embar, to 3,942. The Tensleep is immediately below the Embar.

About 90 wells were drilled on or near the Lost Soldier structure. Of the 61 wells in the field on June 1, 1938, about 19 were pumped, 2 in the Sundance sand were produced by gas lift, and 3 in the Tensleep sandstone flowed. The average daily production for 1937 was 1,200 barrels. The daily production by zones on June 1, 1938, was approximately as follows: Frontier sands, 17 barrels of oil and 47 barrels of water; Dakota, 60 barrels of oil and 200 barrels of water; Lakota, 42 barrels of oil and 2 barrels of water; Morrison, 20 barrels of oil and 50 barrels of water; Sundance, 645 barrels of oil and 2,180 barrels of water; and Tensleep, 715 barrels of oil. The discovery well in the Tensleep sandstone produced about 200,000 barrels of oil in 1930

and 1931, flowing at daily rates as high as 2,300 barrels of oil. The well was not in production from 1931 to July 1937. Analyses of the oil from the Wall Creek, Dakota, Lakota, Morrison, Sundance, and Tensleep sands; of the gas from the Frontier and Thermopolis formations and the Lakota sand; and of the water from the Dakota, Lakota, and Sundance sands are given under Crude-oil Analyses (pp. 149–152), in table 5 (p. 116), and in table 6 (p. 118), respectively.

To 1938 the Lost Soldier field produced 18.8 million barrels of oil and about 14.5 billion cubic feet (estimated) of gas. Yearly production of oil is stated in table 7 (p. 120) and of gas in table 8 (p. 122). An oil-production curve is shown in figure 10 (p. 11). The productive area in the Frontier sands is about 160 acres and in the Dakota and Sundance sands about 320 acres. The recovery per acre for this field is the largest of any in the Rocky Mountain area, probably because of the number of producing sands. Based on a productive area of 320 acres, the recovery of oil to 1938 has been 58,765 barrels per acre. The first pipe line from the field, built in 1919, was a 4-inch line to Fort Steele on the Union Pacific Railroad. This line was abandoned in 1924, when a 6-inch line 52.4 miles long was laid to a refinery at Parco, Wyo.

MAHONEY DOME AND WEST FERRIS

The Mahoney Dome gas field (figs. 25, case, and 27, case) in the southern part of T. 26 N., R. 88 W., and the northern part of T. 25 N., R. 88 W., Carbon County, is on a broad oval anticline, having about 300 feet of independent closure, which separates it from the West Ferris structure to the east, and about 1,300 feet of effective closure. The GP sand (top of Niobrara formation), exposed on the south flank of the structure, dips 5° to 10°. Most of the structure is covered by sand dunes at an altitude of 6,750 to 6,950 feet.

In 1919 a well in the SW¼NE¼ sec. 34 was completed in the Dakota sand at 2,160 to 2,185 feet, with an initial daily open-flow volume of 30 million cubic feet of gas and a shut-in wellhead pressure of 800 pounds per square inch. About 9 gas wells, with initial daily production up to 30 million cubic feet of gas, were completed in the Dakota sand at depths to the top of the sand of 2,126 to 2,647 feet; the average depth was 2,490 feet, and the sand was 25 to 32 feet thick. In 1925 a well drilled into the Sundance sand at 2,788 to 2,900 feet produced 20 million cubic feet of gas daily; the shut-in wellhead pressure was 1,190 pounds per square inch. By 1925 the wells in the Dakota sand, which had been drawn upon heavily for gas, were being flooded by water. After the discovery of gas in the Sundance sand most of the wells in the Dakota sand were deepened to the Sundance. No wells were drilled in the field after 1928; at that time there were 2 wells in the Dakota sand and 10 in the Sundance. The open-flow volume of the wells in the Sundance sand ranged from 2 to 20 million cubic feet of gas daily and the depths from 2,646 to 2,990 feet; the sand averaged 100 feet in thickness. In 1930 a well drilled in the SE¼NW¼ sec. 34 into the Tensleep sandstone at 4,670 to 4,685 feet produced 65 barrels of black 32° A. P. I. gravity oil daily. The well was produced only to determine its productive capacity. The Embar formation was logged at 4,317 to 4,600 feet and the Tensleep from 4,600 to 4,760 feet.

On June 1, 1938, the field contained one shut-in oil well in the Tensleep sandstone and nine gas wells in the Sundance formation, seven of which were capable of producing. Daily open-flow capacity of the wells ranged from 0.3 to 2 million cubic feet of gas. Analyses of the oil from the Tensleep sand and gases from the Cloverly and Sundance sands are given under Crude-oil Analyses (p. 152) and in table 5 (p. 116), respectively.

To January 1938 the Mahoney Dome field produced 50.6 billion cubic feet of gas; yearly gas production since 1922, when a gas line to Parco was completed, is given in table 8 (p. 122). The production of oil reported from the well in the Tensleep sandstone was 1,706 barrels in 1930 and 1,474 barrels in 1931. In addition, several wells produced some oil from a sand in the Frontier formation at a depth of about 1,300 feet. The production reported was 368 barrels in 1922, 191 barrels in 1923, and 142 barrels in 1924. The original productive area in both the Dakota and Sundance sands was estimated as 1,600 acres. Until the fall of 1937 the gas was transported through the 89-mile Wertz-Mahoney-Casper pipe-line system (10-, 12-, and 14-inch) to Casper. The gas now is piped through a 33-mile line (8- and 10-inch) to a refinery at Parco and through a 29-mile line to Rawlins.

The West Ferris gas field, known also as East Mahoney and sometimes included in Mahoney Dome field (figs. 25, case, and 27, case), in the southwest corner of T. 26 N., R. 87 W., and the southeast corner of T. 26 N., R. 88 W., Carbon County, occupies an elliptical dome with about 400 feet of closure independent of Mahoney dome to the west and Middle Ferris structure to the east and a total closure of about 1,500 feet. The Niobrara formation, obscured by soil and sand dunes, covers the structure at an altitude range of 6,920 to 7,075 feet. The discovery well in the SE¼SW¼ sec. 29 was completed in 1923 in the Dakota sand at 2,126 to 2,156 feet, with an initial daily open-flow volume of 37 million cubic feet of gas and a shut-in wellhead pressure of 650 pounds per square inch. About eight wells were completed in the Dakota sand (25 to 65 feet thick) at a depth of 2,085 to 2,660 feet, initial daily open-flow volume ranging from 7 to 37 million cubic feet of gas.

After the discovery of gas in the Sundance formation on Mahoney dome in 1925 a number of wells were drilled to the Sundance formation in West Ferris, and some of the wells in the Dakota sand, which up to that time had been drawn upon heavily, were deepened to the Sundance. Late in 1925 the first well in the Sundance formation, SW¼SW¼ sec. 29, produced gas at the rate of 9 million cubic feet a day in an open-flow test. Eight more wells were completed in the Sundance at depths of 2,570 to 3,164 feet, initial open-flow volume ranging from 2 to 58 million cubic feet of gas daily; the initial shut-in wellhead pressure was 1,140 pounds per square inch.

On June 1, 1938, five gas wells in the Dakota sand and six in the Sundance sand were still producing or were potential producers in the West Ferris field. Some wells in the Sundance sand are equipped also to produce gas from the Dakota sand. To 1938 the field produced 27 billion cubic feet of gas; yearly production is given in table 8 (p. 122). About 2,400 acres in the Sundance sand has been estimated to contain gas. Before the fall of 1937 most of the gas from

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this field was delivered into the Wertz-Mahoney-Casper pipe-line system, but since then the gas has been transported through pipe lines to Parco and Rawlins, Wyo.

MAVERICK SPRINGS

Four structures in the Maverick Springs area (fig. 44, case) have been drilled for oil or gas—Maverick Springs, Circle Ridge, Little, and Sheldon domes. The Maverick Springs oil field in T. 6 N., R. 2 W., Wind River Indian Reservation, Fremont County, occupies an elongated dome on the Maverick Springs anticline. The Lakota sandstone, which outcrops around the structure, dips about 30° on the southwest flank and 10° to 15° on the northeast flank. The closure of the dome is 600 feet. The Chugwater formation is exposed on the south end of the field and the Sundance formation on the north end. The altitude ranges from 6,700 to 7,200 feet.

The field was discovered in June 1918 on drilling a well in the SW¼NE¼ sec. 22 on top of the structure that produced 22° A. P. I. gravity black oil from the Embar lime at 1,105 to 1,125 feet. When completed this well flowed 146 barrels of oil a day but a year later produced 435 barrels. Because of the hydrostatic pressure in the Embar lime, the first wells flowed 20 to 146 barrels of oil daily. Oil production from some of the wells increased fivefold when they were pumped. In August 1918 oil was found in the Tensleep sandstone at 1,363 to 1,410 feet in a well in the SW¼SW¼ sec. 23. Ten wells were completed in 1918 and 1919 in the Embar and Embar-Tensleep zones at depths of 1,100 to 1,400 feet, depending on the surface elevation and position of the well on the structure; initial daily pumping production ranged from 100 to 600 barrels of oil. By 1928, when drilling was suspended, 38 wells had been drilled in the field, 32 of which were oil wells; 19 of these, in the north end of the field, had initial daily production ranging from 75 to 750 barrels of oil. The Embar lime in which most of the wells were completed is about 365 feet thick and contains an oil-bearing zone of porous or sandy lime 125 to 250 feet below the top of the formation. The Tensleep sandstone contains a 200- to 600-foot zone of water-bearing sand and a relatively thin oil-saturated zone in the upper part of the formation.

On June 1, 1938, there were 32 wells in the field, all of which were shut in; the potential daily production was about 6,500 barrels of oil. The inactivity of the field was due to its remoteness from a market and to the low market value of black oils. The field represents a sizable reserve of black oil. Analyses of the oil from the Embar lime and water from the Tensleep sandstone are given under Crude-oil Analyses (p. 153) and in table 6 (p. 118), respectively. During the years 1918 to 1928, inclusive, about 45,000 barrels of oil was produced in bringing in and testing wells. The oil either was used for development purposes or was placed in storage. In 1937, 5,500 barrels of oil was produced to supply a demand for fuel oil; yearly production is stated in table 7 (p. 120). The productive area of the Maverick Springs field is estimated as 1,800 acres.

Circle Ridge dome (fig. 44) at the intersection of Tps. 6 and 7 N., Rs. 2 and 3 W., Fremont County, is a small dome with sharply dipping flanks on the Maverick Springs anticline, northwest of the Maverick Springs oil field. It has about 2,000 feet of closure. The Embar lime forms the surface at an altitude of about 7,200 feet. In 1923 a well

drilled to 655 feet in the NE¼SE¼ sec. 1 produced approximately 132 barrels of 24° A. P. I. gravity black oil daily from the Tensleep sandstone at 592 to 655 feet. The production of oil reported for 1923 was 1,464 barrels. Since that time the well has been shut in. Analysis of the oil is given under Crude-oil Analyses (p. 130).

Little dome in secs. 9, 10, 14, 15, and 16, T. 5 N., R. 1 W., Fremont County, is on the Maverick Springs anticline southeast of the Maverick Springs oil field. It has about 1,200 feet of closure. The Morrison is the surface formation. Two wells were drilled on Little dome in the NE¼ sec. 15, neither of which reached the Embar lime, although one was drilled to a depth of 4,365 feet but was still in the Chugwater formation. Some gas and showings of oil were found but not in commercial quantities, and the wells were abandoned.

Sheldon dome is about 5 miles southwest of Maverick Springs oil field in secs. 8, 9, 10, 15, and 16, T. 5 N., R. 2 W., Fremont County. Gas was discovered in Sheldon dome in 1925; a well in the NW¼NW¼ sec. 15, starting in the Wind River formation, was drilled to a depth of 3,009 feet into the Frontier formation, flowing about 8 million cubic feet of gas daily at depths of 2,622 to 2,995 feet. The shut-in wellhead pressure was 800 pounds per square inch. The field has been abandoned.

MEDICINE BOW

The Medicine Bow oil field, known also as Big Medicine Bow (fig. 45, case), in the southeast part of T. 21 N., R. 79 W., Carbon County, is on the Medicine Bow anticline, a pronounced asymmetrical fold surrounded entirely by escarpments of the Mesaverde formation. The length of the fold within the rim is about 7 miles and the maximum width about 3 miles. Dips on the west side of the anticline range from 10° to 20°, and those on the east are 50°. The north plunge of the fold ranges from 10° to 34° and the south plunge from 1° to 5°, increasing rapidly at the extreme south end. The structure has a total closure of about 2,900 feet; more than 10 square miles is included within the lowest closing contour. The surface formation on the crest is Steele shale. The altitude ranges from 6,700 feet at the Medicine Bow River to 7,330 feet on the crest of the fold.

In June 1935 a well in the SE¼NE¼ sec. 26 came in with an initial daily production of 81 million cubic feet of wet gas from the First Sundance sand at 5,150 to 5,206 feet and 6,300 barrels of 63° A. P. I. gravity oil and 3 million cubic feet of gas from the basal or Second Sundance sand at 5,299 to 5,397 feet. The shut-in wellhead pressure of the First Sundance sand was 1,900 pounds per square inch and that of the Second sand 1,100 pounds per square inch.

Before the discovery of oil and gas in the Sundance formation seven wells were drilled on the Medicine Bow anticline, one of which flowed a small quantity of oil, probably from the Wall Creek sand, at 4,033 feet. The well was deepened and "struck" water. Water was found also in the Muddy sand and in the Cloverly formation. From the date of discovery to June 1, 1938, 10 more wells were drilled to the Sundance formation: 2 were oil wells in the Second Sundance sand, which produced initially 2,040 and 3,960 barrels of oil daily with several million cubic feet of gas; 6 were oil wells in the First Sundance sand, of which 5 produced initially 1,700 to 4,224 barrels and 1 produced 240 barrels a day; 1 was a gas well in the First Sundance sand; and 1 was

a dry hole. The oil wells in the Second Sundance sand were completed so as to produce gas also from the First sand. The following formations at the depths given were penetrated by the discovery well: Steele shale, from the surface to 2,864 feet; Niobrara shale, 2,864 to 3,587 feet; Carlile shale, 3,587 to 4,006 feet; Frontier formation, 4,006 to 4,596 feet; Mowry shale, 4,596 to 4,818 feet; Cloverly formation, 4,818 to 4,902 feet; Morrison formation, 4,902 to 5,153 feet; First Sundance sand, 5,154 to 5,206 feet; and Second Sundance sand, 5,299 to 5,397 feet (total depth; reported "still in sand").

On June 1, 1938, the field contained two shut-in gas wells in the First Sundance sand and eight producing oil wells. Two of the oil wells were in the Second Sundance sand (one was shut in but could produce gas from the First sand), and six were in the First Sundance sand. The average daily production from the field during 1937 was about 3,300 barrels. The oil in the First Sundance sand was saturated with gas at reservoir pressure, as a gas cap existed in the sand. Analysis of an oil sample taken in a well at a depth of 5,526 feet opposite the top of the First sand showed that 2,995 cubic feet of gas (calculated at 60° F. and 14.4 pounds per square inch absolute) was in solution at 142° F. (reservoir temperature) and 2,370 pounds per square inch gage (reservoir pressure) for each barrel of residual or produced oil (measured at atmospheric pressure and 60° F.). Because the gas was composed of the heavier gaseous hydrocarbons (under normal conditions of pressure and temperature), the oil had a surprisingly high shrinkage factor; 2.77 barrels of oil in the reservoir at 2,370 pounds gage and 142° F. was required to produce 1 barrel of oil at atmospheric pressure and 60° F. The oil in the Second sand flowed from the wells because of the hydrostatic pressure in the sand. The oil was saturated with gas at 194 pounds per square inch absolute and 60° F. Analysis of an oil sample taken at a pressure of 790 pounds per square inch gage showed that 375 cubic feet of gas was released from solution when the pressure was reduced from 194 pounds per square inch absolute (saturation pressure at 60° F.) to 14.4 pounds per square inch absolute and 60° F. for each barrel of residual or produced oil. The analysis also showed that 1.27 barrels of oil in the reservoir at 2,330 pounds gage and 140° F. was required to produce 1 barrel of oil at atmospheric pressure and 60° F. High-pressure (250 pounds per square inch) and low-pressure (28 pounds per square inch) gas separators were used to liberate the gas from the oil. The oil then was stabilized by removing the propane and most of the butane in a plant designed for that purpose. Analyses of the oil from the First and Second Sundance sands, gas from the First Sundance sand, and water from the Second Sundance sand are given under Crude-oil Analyses (pp. 153 and 154) in table 5 (p. 116), and in table 6 (p. 118), respectively.

In three wells drilled on top of the Medicine Bow structure gas was found in the First Sundance and oil in the Second Sundance, whereas in wells down the structure oil was found in the First sand with edge water in wells at the south end of the structure and water in the Second sand. The productive area of the First Sundance sand was estimated as 1,200 acres and of the Second sand about 150 acres. Oil production from the field began in August 1936; 1,354,094 barrels of oil and 1.2 billion cubic feet of gas were produced to January 1, 1938.

The oil was transported from the field to a loading rack at Medicine Bow through a 4- and 6-inch pipe line 13 miles long. Some of the

gas from the field was delivered into the Allen Lake-Laramie gas pipe line; since the fall of 1937 all excess gas and the propane and butane from the crude-oil stabilizing plant have been piped to the Rock River oil field and injected into the sands in that field.

MIDWAY

The Midway oil field (fig. 46, case) in the east half of T. 35 N., R. 79 W., Natrona County, occupies the crest of an elliptical dome on the north end of the Midway-North Geary anticline about 10 miles northeast of Casper and 22 miles south of the Salt Creek field. The Teapot sandstone member at the top of the Mesaverde formation is the lowest formation exposed. The altitude of the field ranges from 5,345 to 5,370 feet. The dome has more than 1,000 feet of closure and is separated from the North Geary dome by a saddle. The east flank of the dome dips 5° to 10° and the west flank 15° to 25°.

Oil was discovered in the Midway field in 1931 on drilling a well in the NE¼NE¼ sec. 23 that produced 400 barrels of 31° A.P.I. gravity oil daily from the Second Wall Creek sand, lower Frontier formation, at 5,156 to 5,186 feet. In 1932 a well completed in the Muddy sand at 6,050 to 6,077 feet produced initially 80 barrels of 30° A. P. I. gravity oil and about 40 barrels of water daily. Later a well was drilled to the Second Wall Creek sand. The discovery well reached the base of the Sundance formation before being completed in the Second Wall Creek sand. The formations penetrated were: Shannon sand at 2,429 to 2,481 feet (contained water and a showing of gas); First Wall Creek sand at 4,715 to 4,778 feet; Second Wall Creek sand at 5,162 to 5,232 feet, overlying a water-bearing sand (contained oil); Muddy sand at 5,967 to 5,983 feet; Dakota and Lakota sands at 6,024 to 6,072 feet; Second Sundance sand at 6,406 to 6,422 feet; and Third Sundance sand at 6,505 to 6,610 feet. The well was drilled 6,610 feet to the Third Sundance sand, which contained water.

On June 1, 1938, two wells produced at a daily rate of about 50 barrels of oil and a greater quantity of water, and one well in the Second Wall Creek sand was shut in. Water has been a source of trouble in all wells; the oil has to be treated chemically and heated before the water will settle out. Analyses of the oil from the Second Wall Creek sand and waters from the Shannon and Second Wall Creek sands are given under Crude-oil Analyses (p. 154) and in table 6 (p. 118), respectively. The field has produced 112,445 barrels of oil to 1938; yearly production is listed in table 7 (p. 120). The field has not been developed sufficiently to permit an estimate of the probable productive area, but water conditions in wells already drilled indicate that the Muddy and Second Wall Creek areas probably will not exceed 100 acres. The oil is piped 2 miles to a pipe line transporting Salt Creek oil to Casper.

MOORCROFT, WAKEMAN, AND THORNTON

The Moorcroft area (known as Belle Fourche in the early life of the field and also Butte) covers the west flank of a rather irregular anticline on the extreme west edge of the Black Hills uplift. Wells were drilled in an area about 2 miles wide and 12 miles long, beginning in the north part of T. 50 N. near the range line between Rs. 66 and 67 W. and extending slightly west of north to the center of T. 52 N.,

R. 67 W., Crook County. The attitude of the formations is monoclinal, dipping 2° to 10° W. The Upper Cretaceous formations outcrop in successive bands across the area. Drilling in most of the wells was started in the Graneros shale at altitudes of 4,100 to 4,300 feet.

Lubricating oils were required for gold mining in the Black Hills; before a railroad was built into that area oil was collected from seeps in the vicinity of the Moorcroft field and, according to Ricketts,[7] was " transported to mining towns in the Black Hills, where it commanded a ready sale as a lubricating oil at a price of $28 per barrel." Ricketts also reported that operations in this field were begun before 1888 and that oil was collected from more than a dozen springs and was pumped from one well 300 feet deep at the rate of 5 barrels a day. Since about 1887 at least 60 wells, most of which were failures, were drilled throughout the area to depths of 400 to 1,650 feet. Probably the largest well produced 5 barrels of dark-green 22° A. P. I. gravity oil daily. Seven wells in the NW¼ sec. 34, T. 52 N., R. 67 W., were equipped for pumping from a central power; these apparently were the only wells that warranted being "put on production." The main oil-bearing zone in the field is a sandstone and shale member (Newcastle sand), approximately 45 feet thick, in the lower part of the Graneros shale. This zone was found at a depth of 615 feet in five of the seven wells mentioned and 830 feet in the other two wells. One or two wells were drilled into or through the Sundance formation; and one in the NE¼ sec. 25, T. 52 N., R. 67 W., was drilled to a depth of 2,102 feet into the Pahasapa limestone, but no oil or gas was discovered.

By 1936 the field virtually was abandoned. Seven of the wells in the NW¼ sec. 34 still could produce a few barrels of oil daily and had been produced some years before, when the oil was used as fuel for drilling. Some of the wells in the area were used as water wells. Production of oil from the area has been small (estimates are not available), and the field has been uneconomical to operate.

The Wakeman area, known also as Wakeman Flats and Moorcroft, in secs. 17 and 20, T. 49 N., R. 66 W., Crook County, is in a belt or region of oil seeps and small oil wells, as at Moorcroft to the north and Thornton to the south. Oil accumulation in this region was due probably to lensing of the sands and to a change in dip or terracing of the southwestward dipping monoclinal features of the Cretaceous formations on the southwest flank of the Black Hills. At Wakeman the Pierre shale forms the surface at an altitude of about 4,100 feet. The discovery of oil at Thornton, 3 miles south of the Wakeman area, stimulated drilling activity at Wakeman, and in the fall of 1919 several small wells were completed at a depth of about 600 feet in a sand member 12 to 16 feet thick near the base of the Carlile shale, known locally as the Wall Creek sand. About 20 wells were drilled in this area, 12 of which probably could produce some oil (each 2 to 10 barrels daily). By 1932 all the wells except one or two—which, however, were not being produced—had been abandoned. Three or four wells have been drilled since 1931, the deepest to 2,153 feet, but neither oil nor gas of economic value was discovered.

The Thornton field, known also as the Upton-Thornton, in secs. 32 and 33, T. 49 N., R. 66 W., Crook County, and secs. 4 and 5, T. 48 N., R. 66 W., Weston County, is on a well-defined structural ter-

[7] Ricketts, L. D., Annual Report of the Territorial Geologist to the Governor of Wyoming: 1888, p. 43.

race. The Niobrara and Carlile shales form the surface at an altitude range of 4,200 to 4,300 feet. About 1915 a well drilled in the SW¼ sec. 33 to a depth of 657 feet located oil in a soft, sandy shale and sand zone near the base of the Carlile shale. Active drilling followed, about 16 oil wells being completed at depths of 480 to 880 feet (depending on the distance from the sand outcrop) in an oil-bearing zone 29 to 47 feet thick near the base of the Carlile shale. Each of the wells produced initially 5 to 10 barrels of 40° A. P. I. gravity light-green oil daily; an incomplete analysis of the oil is given under Crude-oil Analyses (p. 173). By 1938 the wells were abandoned or shut down. The productive area of the field was not over 200 acres. Estimates of the quantity of oil produced are not available, but production was small. For a time a topping plant in the field processed the crude oil for local consumption.

MULE CREEK AND WEST MULE CREEK

Mule Creek oil field (fig. 47, case) occupies an elongated dome, the axis of which lies along the line between Rs. 60 and 61 W. and the crest of which is about the center of T. 39 N., Niobrara County. The dome has over 200 feet of closure, and outcropping formations on all sides dip 3° to 6°. The Carlile shale forms the surface at an altitude of 4,000 to 4,100 feet.

The first oil well in the field—in the SW¼ NW¼ sec. 19—was completed in 1919, producing 160 barrels of 31.5° A. P. I. gravity green oil daily from the Lakota sand at 1,300 to 1,355 feet. Most of the 40 wells in the field were drilled during the following year or two, initial daily production ranging from 10 to 220 (average 95) barrels of oil. Well depths ranged from 1,345 to 1,555 feet. In 1929 a well in the SW¼NW¼ sec. 19 disclosed 25.5° A. P. I. gravity black oil in the Minnelusa sandstone at 3,145 to 3,184 feet. After the well had been pumped for several days the production did not exceed 10 barrels a day.

On June 1, 1938, there were 40 wells in the Lakota sand and 1 in the Minnelusa sandstone. These have been shut in since 1930, except for sporadic periods of production. The field can produce about 800 barrels of oil daily by pumping. The oil contains only a little gas in solution. Edge-water encroachment in the field has been gradual, and some of the edge wells produce water. Analyses of the oils from the Lakota sand and Minnelusa sandstone and of water from the Dakota sand are given under Crude-oil Analyses (pp. 155 and 156) and in table 6 (p. 118), respectively. To 1938 the field produced 1,281,315 barrels of oil; yearly production is stated in table 7 (p. 120). The productive area of the field is considered to be approximately 320 acres. The oil either was transported to a railroad through an 18-mile, 3-inch pipe line or was trucked from the field.

West Mule Creek oil field (fig. 47), about 3 miles north and west of Mule Creek field, occupies an elongated dome in the northeast corner of T. 39 N., R. 61 W., and the southeast corner of T. 40 N., R. 61 W., Niobrara County. The structure has a closure of at least 300 feet and is separated from the Mule Creek dome by a syncline. The Greenhorn limestone formation outcropping on the west flank dips 10° to 25°, flattening off to 6° to 8° toward the north and south of the crest of the structure and steepening to 15° at the syncline

between the two Mule Creek domes. The Mowry shale member of the Graneros shale forms the surface at an average altitude of 3,700 feet.

Some drilling was done in this field before 1920, generally to validate claims. The holes reaching the Newcastle sandstone member of the Graneros shale (referred to locally as the Muddy sand) indicated oil. In 1920 a well was drilled in the SW¼SW¼ sec. 36 to the Embar lime to a depth of 1,650 feet. A showing of oil was found in the Muddy sand at 170 to 182 feet and water in the Morrison, Sundance, and Embar formations. About 1927 oil was found in the Muddy sand; in 1929, in the Dakota sand; and in 1930, in the Lakota sand. The wells were small producers, average initial daily production not exceeding 10 barrels of oil. The Muddy sand was penetrated at a depth of about 220 feet; the Dakota (3 to 18 feet thick) at 260 feet; and the Lakota (about 13 feet thick) at 330 feet. Drilling to the shallow Dakota and Lakota sands continued to 1937. In 1934 a test well in the NE¼SE¼ sec. 2 was drilled 3,047 feet to the Pahasapa limestone; 89 barrels of 31° A. P. I. gravity oil a day was obtained at the base of the Minnelusa sandstone at 2,820 to 2,830 feet. The log of the well shows the Muddy sand at 305 to 330 feet; Dakota sand at 375 to 402 feet; Lakota sand at 470 to 482 feet; Morrison formation to 842 feet; Sundance formation to 1,090 feet; Spearfish formation to 1,660 feet; Minnekahta limestone to 1,700 feet; Opeche formation to 1,800 feet; Minnelusa sandstone to 2,830 feet, with a showing of gas at 2,243 feet, a production of 100,000 cubic feet of sour gas daily at 2,525 to 2,545 feet, and oil production at 2,820 to 2,830 feet; and the Pahasapa limestone below 2,830 feet.

On June 1, 1938, there were about 18 shallow wells in the field, producing approximately 30 barrels of green 35° A. P. I. gravity oil daily and 1 well producing about 12 barrels of oil daily from the Minnelusa sandstone. Analyses of the oils from the Dakota sand and the Minnelusa sandstone and gas from the Minnelusa sandstone are given under Crude-oil Analyses (p. 156) and in table 5 (p. 116), respectively. The productive area in the shallow-well section of the field is probably not much over 40 acres. To 1938 the field produced 65,751 barrels of oil; yearly oil production is given in table 7 (p. 120). The oil is refined in a small plant in the field.

A unit plan for the development and operation of the West Mule Creek field was approved by the Acting Secretary of the Interior on July 29, 1937.

MUSKRAT

The Muskrat area (fig. 48, case) includes a series of domes and fault blocks along a line of major folding in the upper half of T. 33 N., R. 91 W., the northeast part of T. 33 N., R. 92 W., and the lower half of T. 34 N., R. 92 W., Fremont County. A test well drilled in the NE¼NE¼ sec. 24, T. 33 N., R. 91 W., on the Puddle Springs dome disclosed water in the Frontier sands; another drilled in the SE¼SW¼ sec. 8, T. 33 N., R. 91 W., on the Ohio dome also disclosed water in the Frontier sands.

In 1928 a test well drilled in the SE¼SE¼ sec. 34, T. 34 N., R. 92 W., on the High dome located gas in the Frontier formation at 4,290 to 4,300 feet; the initial open-flow volume of the well was 47 million cubic feet of gas a day and the shut-in wellhead pressure 1,430 pounds per square inch. The Fort Union forms the surface of

this dome at an altitude of 6,280 feet, and the Niobrara shale is near the surface. Analysis of the gas from the Frontier formation is given in table 5 (p. 116).

In 1936 and 1937 a well in the SW¼NW¼ sec. 1, T. 33 N., R. 92 W., on the Middle dome was drilled 8,112 feet to the Madison limestone. The log of the well shows the Frontier formation at 4,205 to 4,750 feet with showings of oil and gas at 4,469 to 4,549 feet; Dakota sand at 5,270 to 5,320 feet; Lakota sand at 5,432 to 5,458 feet; Morrison formation at 5,458 to 5,740 feet; Sundance formation (containing water) at 5,935 to 6,188 feet; the top of the Embar lime at 7,225 feet (oil-saturated cores were recovered at 7,268 to 7,313 feet in the top of the Embar); the top of the Tensleep sandstone at 7,632 feet (slight oil saturation at 7,634 to 7,635 feet); the top of the Amsden formation at 7,851 feet; and the top of the Madison limestone at 8,094 feet. The Embar lime was acidized at 7,268 to 7,293 feet with 2,000 gallons of acid, but when the well was tested it produced only 35 to 40 barrels of 30° A. P. I. gravity oil daily. In November 1937 the well was plugged back, and the casing was perforated opposite the Lakota sand (5,440 to 5,444 feet); a flow of 25 million cubic feet of gas a day was obtained. The shut-in wellhead pressure was 2,175 pounds per square inch. Analysis of the oil from the Embar lime is given under Crude-oil Analyses (p. 157).

In June 1938 a well in the NW¼NE¼ sec. 4, T. 33 N., R. 92 W., on the Horseshoe dome was completed in the Lakota sand at 5,306 to 5,321 feet, with an initial open-flow volume of 49 million cubic feet of gas a day and a shut-in wellhead pressure of 2,140 pounds per square inch. This well was located from geophysical data. From 1929 to 1931 a well in the SW¼NE¼ sec. 33, T. 34 N., R. 92 W., on the Horseshoe dome was drilled to the Sundance formation to a depth of 6,081 feet; some gas was found in the Frontier sands, but the sands below contained water. The Shannon sand was penetrated at 1,965 feet, the First Frontier sand at 4,260 to 4,278 feet, the Dakota sand at 5,520 to 5,590 feet, and the basal Sundance sand at 5,992 to 6,081 feet.

On July 1, 1938, there were three gas wells in this area, one producing from the Frontier formation on the High dome, one from the Lakota sand on the Middle dome, and the third from the Lakota sand on the Horseshoe dome. The wells were produced during the winter months, the gas being delivered into the Big Sand Draw-Casper pipe line about 2 miles from the field. The volume of gas produced to 1938 was 4.6 billion cubic feet; yearly production is given in table 8 (p. 122).

A unit plan for the development and operation of the Muskrat structure was approved by the Acting Secretary of the Interior on February 27, 1936.

NAVAL RESERVE NO. 3 AND EAST TEAPOT

The Naval Reserve No. 3 oil and gas field (fig. 61, p. 87) in Tps. 38 and 39 N., R. 78 W., Natrona County, occupies a dome at the southern end of the Salt Creek anticline and includes about 500 acres of the Salt Creek dome. The dome underlying the field is cut by numerous transverse faults, one of which has a displacement of 280 feet. The south half of the structure is defined by prominent escarpments of the Teapot and Parkman sandstone members of the Mesaverde formation. The Parkman sandstone dips 10° to 12° on the east side,

6° to 10° on the south, and 15° to 24° on the west. The upper part of the Steele shale is exposed on the crest of the structure at an altitude of 5,000 to 5,200 feet.

Naval Reserve No. 3 was leased in April 1922. The first well in the reserve, in the SW¼SW¼ sec. 2, T. 38 N., R. 78 W., was completed in October 1922, producing 28,000 to 30,000 barrels of oil daily from shale above the First Wall Creek sand at 1,515 to 1,520 feet. The well evidently was drilled into a shale crevice filled with oil under high pressure, as it flowed a solid stream of oil from the 12.5-inch casing over the derrick crown block. The flow soon declined to 800 barrels a day. Later the United States Government brought suit to have the lease canceled, and a receivership was established on March 13, 1924. Control of Naval Reserve No. 3 was transferred to the Navy Department on December 29, 1927, and the field was shut in. During the period of operation of the lease 86 wells were drilled, 59 being oil wells and 14 gas wells; 13 holes were plugged and abandoned. The wells produced principally from the Second Wall Creek sand (40 to 90 feet thick) at depths, to the top of the sand, of 2,624 to 3,080 feet. About 14 wells were so-called shale wells 1,160 to 2,100 feet deep. A few wells produced from the Third Wall Creek sand. The initial daily open-flow volume of the gas wells ranged from 7 to 60 million cubic feet of gas, and the maximum shut-in wellhead pressure was 1,100 pounds per square inch. The initial daily production of the oil wells ranged (with few exceptions) from 40 to 400 barrels of 36° A. P. I. gravity oil. The most notable exception was the first well completed in the reserve.

A typical stratigraphic section of Naval Reserve No. 3 structure gives the following formation thickness in feet, starting with the top of the Shannon sandstone member of the Steele shale: Shannon sand, 125 to 135; gray shale (Steele), 1,090; Niobrara shale, 730; Carlile shale, 200; Frontier formation, 1,035 (including First Wall Creek sand, 120; gray shale, 230 to 310; Second Wall Creek sand, 70; gray shale, 165; Third Wall Creek sand, 15; gray shale, 400); Mowry shale, 230; Thermopolis shale, 200 (including 7 feet of Muddy sand near the top); Cloverly, 100 (including 8 feet of Dakota sand at the top and 50 feet of Lakota at the base); Morrison, 315; Sundance, 250; Chugwater, 705; Embar, 220; and Tensleep, 270. Figure 61 (p. 87), a map of the Salt Creek anticline, shows the main structural features and wells drilled in Naval Reserve No. 3.

On June 1, 1938, Naval Petroleum Reserve No. 3 was still shut in. The shut-in wellhead pressure of the gas wells ranged from 13 to 525 pounds per square inch—the low pressure in the north end and the high pressure in the area south of the main fault block. Analyses of the oil from the Second Wall Creek sand, gas from the Second Wall Creek sand, and typical waters from the various producing zones of the Salt Creek anticline are given under Crude-oil Analyses (p. 157), in table 5 (p. 116), and in table 6 (p. 118), respectively. The field produced 3,549,227 barrels of oil before being shut in; yearly production is shown in table 7 (p. 120). The figures after 1927 represent the production from East Teapot. The productive area of the Second Wall Creek sand is 3,500 acres—2,050 acres in the oil zone and 1,450 acres in the gas zone. Based on 2,050 acres, the oil production per acre has been 1,730 barrels. The volume of gas produced was 7.2 billion cubic

feet. The oil was piped with some Salt Creek oil through a 12-inch line to the Clayton tank farm near Douglas, Wyo.

The East Teapot oil field (fig. 61, p. 87) is in the eastern parts of secs. 2 and 11, T. 38 N., R. 78 W., Natrona County. The oil wells are adjacent to the eastern boundary line of Naval Petroleum Reserve No. 3 on the eastern flank of the southern dome on the Salt Creek anticline. Oil was discovered here in July 1927 in a well in the NE¼-NE¼ sec. 11, which produced initially 297 barrels of 42° A. P. I. gravity oil daily from shale zones at 2,440 and 2,780 feet. The altitude at the discovery well was 5,244 feet. Later another oil well was completed in the NE¼ sec. 2, producing 250 barrels of 35° A. P. I. gravity oil daily from a shale at 2,660 to 2,708 feet. Two or three small producing wells also were developed in the Shannon sand. About 12 wells were drilled on the east side of the reserve, but on July 1, 1937, only 2 wells in the area were active, producing about 13 barrels of oil a day; this was refined in the field and marketed locally. Analysis of the oil from the Shannon sand is included under Crude-oil Analyses (p. 132). The total oil production reported for the East Teapot area to 1938 was 62,670 barrels; yearly production is given in table 7 (p. 120) under Naval Reserve No. 3, the production since 1928 being entirely from East Teapot.

NORTH CASPER CREEK

The North Casper Creek anticline (fig. 49, case) is at the adjoining corners of Tps. 36 and 37 N., Rs. 81 and 82 W., Natrona County. Most of the drilling was done in sec. 36, T. 37 N., R. 82 W., and sec. 1, T. 36 N., R. 82 W. The Carlile shale covers most of the surface at an altitude of about 5,600 feet. The structure has about 1,000 feet of closure.

This anticline was drilled as early as 1912 but was not proved productive until early in 1925 when a well in the SE¼SE¼ sec. 36 was completed, producing 80 barrels of black 21° A. P. I. gravity oil daily from the Tensleep sandstone at 3,202 to 3,307 feet. A well completed in 1928 produced approximately 100,000 cubic feet of gas daily from the Mowry shale at 997 to 1,120 feet. In 1929 two oil wells, which produced 60 and 136 barrels a day, were completed in the Tensleep sandstone at 3,200 to 3,233 feet. In 1932 another gas well was completed in the Mowry shale at 1,013 to 1,103 feet, with an estimated open-flow volume of 3 million cubic feet of gas daily; the shut-in wellhead pressure was 325 pounds per square inch.

On June 1, 1938, there were two shut-in oil wells in the field and two gas wells, which supplied gas for camp use only. At the time the oil wells were shut down they were producing a total of about 40 barrels of oil a day. The wellhead pressure of the gas wells was 200 pounds per square inch, and the total daily open flow was estimated to be about 200,000 cubic feet of gas. Most of the sands penetrated in drilling contained water, and when the wells were "brought in" water was produced with the oil. Water production increased with decrease in the quantity of oil produced. Analyses of the oil from the Tensleep sandstone, gas, and water in the Sundance formation are given under Crude-oil Analyses (p. 158), in table 5 (p. 116), and in table 6 (p. 118), respectively. Production reported for the field was 7,700 barrels in 1931 and 2,278 barrels in 1932. The productive area probably is about 100 acres.

NOTCHES DOME

Notches Dome oil field (fig. 50) in secs. 3, 4, 9, and 10, T. 37 N., R. 85 W., Natrona County, occupies a triangular dome on the southern part of the Cottonwood Creek anticline. The north and east flanks of the dome dip 15° to 30° and the southwest flank 2° to 10°. The dome has about 400 to 500 feet of closure. An escarpment of Frontier forma-

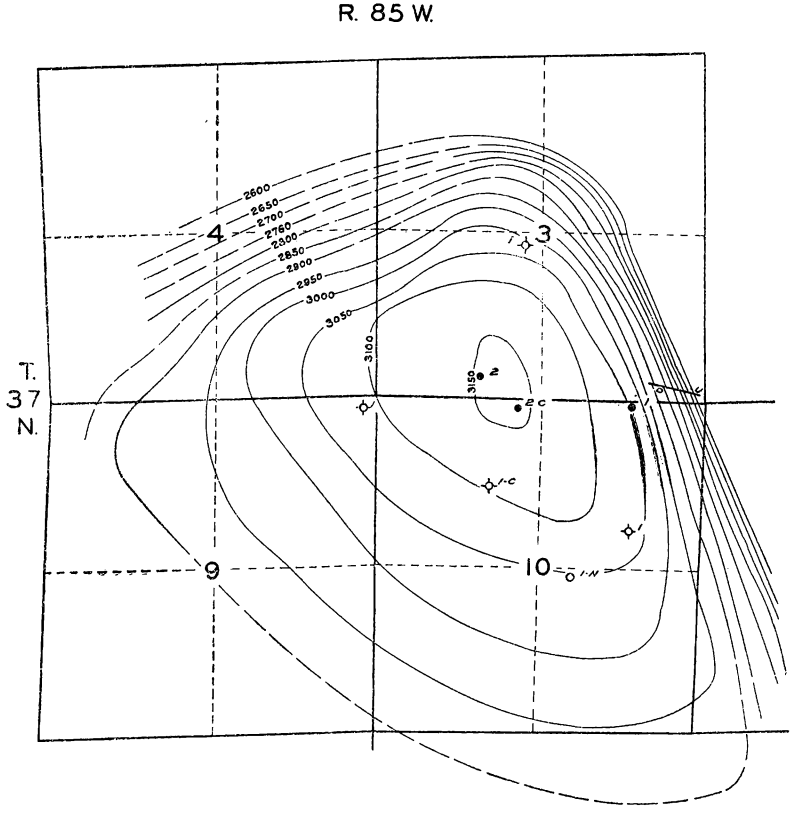


FIGURE 50.—Map of Notches dome, Natrona County, Wyo. Geology by John G. Bartram and J. E. Hupp. Contours on oil horizon in Tensleep formation. Datum, sea level; well status, July 1, 1938. A resurvey may change the position of the section lines.

tion surrounds the field, the area inside being deeply eroded into the Mowry shale; the altitude range is 5,800 to 5,900 feet.

Oil was found in a well in the NW¼SE¼ sec. 10 in 1918, but not until 1923 was the first commercially productive well in the NE¼NW¼ sec. 10 completed in a sand at 2,738 to 2,775 feet in the Tensleep sandstone; the well flowed 300 barrels of 23° A. P. I. gravity oil daily. Two other wells were drilled, producing initially 95 and 200 barrels of oil daily. Oil production from each of these three wells, however, soon declined to about 40 barrels a day. Water was found in several holes lower on the structure in the Tensleep sandstone. The Dakota sand at 890 to 950 feet contains flowing sulfur water; the Sundance at 1,490 to 1,600 feet contains a showing of oil and flowing water; and

the Tensleep at 2,725 and 2,830 feet contains oil on the crest and water lower on the structure.

On June 1, 1938, the three wells in the field were shut in, having been inactive since 1927. When last pumped they yielded a total of about 100 barrels of oil daily. Water in appreciable quantities was produced with the oil and was a problem to the operators. Analyses of the oil and the waters from the Dakota and Tensleep sands are given under Crude-oil Analyses (p. 158) and in table 6 (p. 118), respectively. The field produced 168,550 barrels of oil from 1923 to 1927; yearly figures are given in table 7 (p. 120). Approximately 320 acres is considered to be oil bearing. A 2-inch pipe line was laid from the field to the railroad at Lox (7½ miles) for transporting the oil.

OREGON BASIN

The Oregon Basin oil and gas field (fig. 51, case) in Tps. 50, 51, and 52 N., west half of R. 100 W., Park County, occupies two large domes (referred to as North and South Oregon Basin domes) adjoining one another but separated by a narrow saddle. The north dome is cut by three or more lines of faulting and the south dome by one or more. Oregon Basin, about 6 miles wide and 11 miles long, is the largest surface depression on the west side of the Big Horn Basin. The surface formation on the floor of the basin is largely Cody shale, but the Frontier formation is exposed on the crest of each of the domes. The basin is surrounded by an escarpment of Mesaverde sandstones—most pronounced on the north and south ends—which dips 15° to 30°. The south dome has an independent closure of about 800 feet and the north 400 feet. The altitude of the north dome ranges from 5,256 to 5,350 feet and of the south dome from 5,400 to 5,550 feet.

The field was discovered in August 1912 on completing a gas well on the crest of the south dome, NW¼SW¼ sec. 32, in the Cloverly formation at a depth of 1,320 feet, with an open-flow volume of 20 million cubic feet of gas a day. In 1916 a gas well in the SE¼NW¼ sec. 5 on the crest of the north dome in a fault block was completed in the Cloverly formation at 1,328 to 1,340 feet, with an estimated open-flow volume of more than 25 million cubic feet of gas a day and a shut-in wellhead pressure of 680 pounds per square inch. In October 1923 the Morrison formation at depths of 1,723 to 1,725 feet was proved productive; a gas well in the NE¼NW¼ sec. 8, north dome, produced initially 2 million cubic feet of gas daily. This well and another gas well in the Morrison formation, drilled 2 years later, have since been plugged and abandoned. Water was found in the Cloverly formation.

In March 1927 oil was discovered in the Embar lime and Tensleep sandstone at 3,354 to 3,650 feet in a well in the NW¼NE¼ sec. 8, north dome. The well produced 800 barrels of 22° A. P. I. gravity black oil daily. In 1928 a well in the SW¼N¼E sec. 32, north dome, produced initially 1 million cubic feet of gas a day from the Chugwater formation at 2,850 to 2,890 feet; the shut-in wellhead pressure was 1,580 pounds per square inch. In 1930 a well drilled in the SW¼SW¼ sec. 33, north dome, produced initially 1.6 million cubic feet of gas a day from the Chugwater formation at 2,785 feet; the shut-in wellhead pressure was 1,150 pounds per square inch. In 1929 a well in the

SE¼SE¼ sec. 6, north dome, produced initially 6 million cubic feet of gas a day from the Embar lime at 3,276 to 3,291 feet; the shut-in wellhead pressure was 1,600 pounds per square inch. In 1934 a well in the NW corner, lot 2, sec. 9, on a fault block in the south end of the south dome produced 7.6 million cubic feet of gas a day from the Frontier formation at 898 to 1,154 feet; the shut-in wellhead pressure was 520 pounds per square inch.

Four gas wells (three in the Cloverly and one in the Frontier formation) were completed on the south dome and four (one in the Cloverly, two in the Chugwater, and one in the Embar) on the north dome. One of the gas wells in the Chugwater formation was produced from the bradenhead of a well that yielded oil from the Embar-Tensleep zone. Thirty-nine oil wells were completed in the field, 19 on the south dome and 20 on the north. Most of the early wells were completed with both the Embar and Tensleep zones exposed in the wells, whereas most of the later wells were completed in the first zone of oil saturation in the Embar lime. Initial daily production ranged from 100 to 2,800 barrels (average, 560 barrels) of 22° A. P. I. gravity black oil. A composite log of the field compiled from drilling reports shows the following formation thickness in feet: Frontier, 445; Mowry, 250; Thermopolis, 705 (including a 10-foot section of the Muddy sand); Cloverly, 85; Morrison, 465; Sundance, 450; Chugwater, 845; Embar, 260; Tensleep, 85; and Amsden, 250. The Madison is below the Amsden.

On April 1, 1938, there were 6 gas wells and 39 oil wells in the field. One gas well produced from the Frontier formation; 2 gas wells were in the Cloverly formation (1 of these was shut in and the other, with an open-flow capacity of about 8 million cubic feet a day, supplied Cody with gas); 2 wells in the Chugwater formation were shut in, except when they supplied gas for lease and camp use; and 1 well in the Embar lime was shut in. There were 14 oil wells in the Embar-Tensleep zone, 24 in the Embar lime, and 1 in the Tensleep sandstone. About half of these wells were shut in owing to lack of a market for oil. About 20 wells produced 2,000 barrels of oil daily, although the field had a daily potential capacity of about 15,000 barrels. Most of the wells were pumped, but several could flow oil, one as much as 1,000 barrels a day. In 1935 the beneficial effects of acidizing the wells in the Embar lime started a program of acidizing that was still being followed in the summer of 1937. Some Embar wells, especially those that were drawn upon heavily, yielded water with the oil. The Tensleep sandstone produced clean oil except on the edge of the field where it carried water. This was separated from the oil by electrical dehydration. Analyses of the oil from the Embar lime and of a composite oil sample from the field (Embar and Tensleep zones) are given under Crude-oil Analyses (p. 159). Comparison of these analyses shows little, if any, difference between the two oils. Analyses of gases from the Cloverly and Embar-Tensleep producing zones and waters from the Frontier formation and Embar lime are given in tables 5 and 6 (pp. 116 and 118), respectively.

The total production of oil to 1938 was 8,675,435 barrels and of gas, 3.2 billion cubic feet. Yearly production of oil and gas is given in tables 7 and 8 (pp. 120 and 122), respectively. The gas-bearing area of the field has been estimated at 1,300 acres and the oil-bearing area at 7,500 to 9,000 acres. By April 1938 the field was only partly

developed, the well density being 1 well to about 310 acres. The field contains a large reserve of black oil from which withdrawals have been restricted because of the limited market. Part of the oil was transported 14 miles through an 8-inch pipe line to Cody where it was refined or shipped by rail to refineries in southern Montana. The remainder of the oil was trucked directly to refineries. About 250 million cubic feet of gas per year was transported 13 miles through a 4-inch line to Cody for domestic and industrial use.

OSAGE AND PEDRO

The Osage oil field in T. 46 N. and the south part of T. 47 N., Rs. 63 and 64 W., Weston County, is on a westerly dipping monocline on the southwest flank of the Black Hills uplift. Figure 52 (case), a map of the field, shows the terraced structure in which the oil has collected during its migration up dip. There are three terraces in the field. The upper or shallow one is in the northwest corner of T. 46 N., R. 63 W., and in the southwest corner of T. 47 N., R. 63 W., north and east of the hogback formed by the outcropping Greenhorn limestone; oil is found on this terrace at depths of 100 to 600 feet. The middle terrace is west and southwest of the hogback; oil is found here at depths of 1,100 to 2,200 feet. Logs of wells drilled in secs. 15 and 16, T. 46 N., R. 64 W., indicate that the relatively flat middle terrace ends near the middle sec. 15, and a region in which the beds dip more steeply extends toward a still deeper western terrace. Oil is found in the region of steeply dipping beds at depths of 3,100 to 3,400 feet. The Pierre shale, Niobrara shale, Carlile shale, Greenhorn limestone, Graneros shale (comprising the Belle Fourche shale, Mowry shale, Newcastle sandstone, and Skull Creek shale members), and Dakota sandstone outcrop in successive bands across or near the field. The highest altitude of the field is about 4,300 feet.

The first well—in the SE¼NW¼ sec. 5, T. 46 N., R. 63 W.—was completed in 1919 in one of the upper shale members of the Graneros shale at a depth of about 350 feet. In 1920 a well in the NW¼NE¼ sec. 19, T. 46 N., R. 63 W., was completed in the Newcastle sand (locally known as Muddy) at 1,335 to about 1,400 feet, with an estimated initial daily production of 200 barrels of 40° A. P. I. gravity oil. From that date to June 1938 drilling has continued until about 945 wells have been drilled in the field. In the upper terrace oil is derived from the shales above and in the Newcastle sand at depths (to the Newcastle sand) of 300 to 600 feet, except on the hogback where it is derived at depths of 800 to 1,100 feet. Initial oil production from the wells in the upper terrace was as high as 200 barrels a day, but production declined rapidly to a daily average of 2 to 15 barrels. The oil from shale wells ranged in gravity from 32° to 40° A. P. I., whereas that from the Newcastle sand was about 40° A. P. I. gravity.

The wells in the middle terrace reach the Newcastle sand at 1,100 to 2,200 feet, depending on the down-slope position of the wells. Initial oil production from wells in the middle terrace ranged from 5 to a reported 500 barrels of 40° A. P. I. gravity green oil daily, but production declined within 6 months to 5 to 25 barrels. A few wells, however, produced 50 to 150 barrels daily for several years. The middle terrace has small closure; on the high of this slight dome six

gas wells were completed in the Newcastle sand, with an initial open-flow volume of 0.5 to 10 million cubic feet of gas daily; shut-in wellhead pressure was as high as 450 pounds per square inch. The volume of gas in the sand was not large, and production declined rapidly to 100,000 cubic feet a day. The oil in the Newcastle sand contains considerable gas in solution, and in April 1931 when oil production was at its peak 2.5 million cubic feet of gas was produced daily. Virtually all of the gas, except ½ to ¾ million cubic feet a day used in the field, was blown to the air.

In 1931 oil was discovered in the so-called west extension of the field; wells drilled on the steeply dipping region in the west half of sec. 15 and east half of sec. 16, T. 46 N., R. 64 W., produced as much as 70 barrels of oil daily from the Newcastle sand at a depth of 3,120 to 3,345 feet. The deepest hole in the area was drilled in the SE¼NW¼ sec. 30, T. 46 N., R. 64 W., to a depth of 4,610 feet; the Newcastle sand was found at 4,507 feet and some oil at 4,494 to 4,515 feet. This hole was abandoned later. Most of the 945 wells in the field were drilled to the Newcastle sand. Geologic formations in the field and approximate thickness in feet are as follows: Pierre shale, 2,600; Niobrara shale, 200; Carlile shale, 610; Greenhorn limestone, 100; Belle Fourche shale, 500; Mowry shale, 175 to 200; Newcastle sandstone, 40 to 60 (including a 2- to 35-foot oil-bearing sand); Skull Creek shale, 200; Dakota, 50 to 100; Fuson shale, 30; and Lakota, 200.

The "shooting" of sand wells with 10 to 40 quarts of nitroglycerin was general practice, and good results were obtained. The shooting of shale or sandy-shale wells in the upper terrace ruined them. The shale and Newcastle sand do not produce water, but the Dakota and Lakota sands do. There appears to be no hydrostatic pressure on the shale or Newcastle oil-bearing zones. An interesting operating feature since 1935 has been the use of electric heaters; these are lowered in the wells to the sand and left there long enough to melt the wax deposited by the oil on the sand face. Inasmuch as the temperature of the formation is unusually low (around 60°F.), the production of many wells has been stimulated greatly by this method.

On June 1, 1938, about 395 wells (approximately 340 in the Newcastle sand and 55 in the shale above the Newcastle sand) still were producing 650 to 750 barrels a day. Approximately 0.5 million cubic feet of gas was being produced with the oil, mostly from the wells in the west extension of the field. The gas wells, except one small producer, had been abandoned. Analyses of the oil from the Newcastle sand, gas, and water from the Greenhorn limestone are given under Crude-oil Analyses (p. 160), in table 5 (p. 116), and in table 6 (p. 116), respectively. The total production of oil from the field to 1938 was almost 4 million barrels; yearly figures from a number of sources are given in table 7 (p. 120). Only estimates are available for the volume of gas produced; these are given in table 8 (p. 122). The total estimated gas production to 1938 was 7.8 billion cubic feet. About 10,000 acres is considered oil bearing. The oil is gathered in two pipeline systems and piped to a refinery at Osage and to a loading rack for shipment by rail. Some of the oil is trucked to small refineries throughout the eastern part of Wyoming, western Nebraska, and western South Dakota.

The Pedro oil field is southeast of the Osage field at the intersection of Tps. 45 and 46 N. and Rs. 62 and 63 W., Weston County. In

this field wells drilled in a continuation of the upper terrace of the Osage field into shale at depths of 200 to 500 feet produced oil of the same quality as that of the shale wells in Osage. The area was developed at about the same time as the Osage field. Initial production from approximately 20 wells ranged from 2 to 5 barrels of oil daily. About 35 wells were drilled in the Pedro area, half of which were unproductive. On June 1, 1938, the five wells in the field produced about 8 barrels of oil daily. The small production reported from this area is included in the figures for the Osage field. Analysis of the oil is included under Crude-oil Analyses (p. 160).

PILOT BUTTE

The Pilot Butte oil field (fig. 53, case) in the south central part of T. 3 N., R. 1 W., Wind River Indian Reservation, Fremont County, occupies an irregular dome-shaped structure broken by numerous faults. Exposed beds on the west side dip 20° to 30° and on the other sides 10° to 20°. Because the Tertiary beds cover most of the surface in this area, it is difficult to estimate the closure of the structure. The Wind River formation has been eroded at the crest of the dome, exposing the Steele shale at an altitude of 5,450 to 5,500 feet.

Oil was discovered in 1916 in the Steele or Niobrara shale. About 90 wells have been drilled in the field; the oil wells produce from one or more of three saturated zones of fractured or sandy shale, each 10 to 30 feet thick, in the Steele or Niobrara shale (more likely the Steele) at depths of 500 to 1,050 feet. Initial daily production of the wells ranged from 20 to 200 barrels of a light 37° A. P. I. gravity oil and a small quantity of water. The Frontier sands were tested and found to contain water. In 1931 a large volume of gas was discovered in the Muddy sand at 3,341 to 3,368 feet in a well in the SE¼SW¼ sec. 22; its estimated open-flow volume was 80 million cubic feet of gas a day, and its shut-in wellhead pressure was 1,000 pounds per square inch. This well was drilled 4,630 feet into the Sundance formation. The formations below the Muddy sand yielded no commercial quantities of gas or oil. Another well drilled 4,123 feet was reported as having a "show" of oil and a daily open-flow volume of 2 million cubic feet of gas from the Muddy sand at 3,565 to 3,625 feet. The Dakota sand at 3,779 to 3,791 feet could yield 1 million cubic feet of gas daily, and the Lakota sand at 4,095 feet contained water at 4,110 feet.

On April 1, 1938, about 10 wells were being pumped, producing about 30 barrels of 38° A. P. I. gravity oil daily. The two gas wells in the Muddy sand were shut in. Free migration of oil or gas to the top of the structure was hindered by the shale formation from which the oil was produced, and water could not exert its hydrostatic pressure to force oil from the formation. Wherever oil was found the well was likely to be a small producer but long-lived. Analysis of the oil is given under Crude-oil Analyses (p. 161) and of the water from the Frontier formation in table 6 (p. 118). To 1938 the field produced 546,962 barrels of oil; yearly production is given in table 7 (p. 120). Approximately 380 acres may be considered as having been productive. The recovery of oil per acre has been 1,440 barrels. The oil formerly was transported through a pipe line from the field to Riverton, but the line was abandoned and the small production is now refined at a plant in the field.

PINE MOUNTAIN AND OIL MOUNTAIN

The Pine Mountain oil and gas field, known also as Pine Dome, in the southeast corner of T. 34 N., R. 84 W., and the southeast quarter of T. 35 N., R. 84 W., Natrona County, is on a prominent topographical high on the northwest end of the Pine Mountain-Oil Mountain fold. The formations on the north and east side of the mountain dip 6° to 24° and those on the south and west 11° to 100° (overturned). The Morrison and Sundance formations cover the summit of the mountain at an altitude of about 6,000 feet.

In the summer of 1914 a well with a daily open-flow volume of 2 million cubic feet of gas from the Embar lime was completed on the east side of the mountain in sec. 36, T. 35 N., R. 84 W. In 1921 a well in SW¼ SW¼ sec. 36, T. 35 N., R. 84 W., was completed in the Embar lime at 1,810 to 1,825 feet, producing 18 barrels of oil daily. In 1926 a well in NW¼ SE¼ sec. 26, T. 35 N., R. 84 W., was completed in the Tensleep sandstone at 1,791 to 1,793 feet, with an initial daily open-flow volume of 10 million cubic feet of gas and a shut-in wellhead pressure of 400 pounds per square inch. The log of the deepest well drilled on Pine Mountain in the NW¼ NW¼ sec. 35, T. 35 N., R. 84 W., shows the Chugwater formation at 885 to 1,560 feet, Embar to 1,858 feet, Tensleep to 2,190 feet, Amsden to 2,340 feet, and Madison to 2,643 feet. The Deadwood formation was drilled from 2,643 to 3,127 feet. A sand in the Deadwood formation at 2,820 to 2,824 feet was reported to have yielded a small quantity of 19° A. P. I. gravity black oil. This is the first oil reported in the State from a formation below the Madison limestone. Seventeen holes were drilled on Pine Mountain, but none produced oil or gas in commercial quantities. By 1937 the wells were plugged, and the field was abandoned.

The Oil Mountain anticline in the southeast quarter of T. 33 N., R. 82 W., Natrona County, is a high on the southeast end of the Pine Mountain-Oil Mountain fold. The strata on the west flank dip as much as 75° and those on the east flank 8°. A strike fault cuts the anticline, causing a displacement of 800 to 1,000 feet.

In 1851 oil was discovered on this anticline at a seep in sec. 28. The seep was "located" and owned by Kit Carson, James Baker, and half-breed Indians, who transported the oil on ponies to the California (Mormon) trail; here it was sold at $1 a quart to freighters and emigrants who mixed it with flour and used it for axle grease. About 1895 six shallow holes and pits were dug or drilled by "spring pole" near the oil seep but were barren. In 1918 a well in the NW¼-NW¼ sec. 35 was drilled to a depth of 3,200 feet into the Tensleep sandstone, which was water bearing. No oil or gas other than showings in the Embar was reported.

PITCHFORK

The Pitchfork anticline (fig. 54) in the east half of T. 48 N., R. 102 W., Park County (the crest of the structure is in secs. 11 and 14), is a long, narrow anticline with steep flanks, the west flank dipping 65° to 80° and the east 35° to 45°. The Mowry shale is exposed on the crest of the structure at an altitude of 7,000 feet. The anticline has at least 1,200 feet of closure defining an area 4 miles long and ½ mile wide.

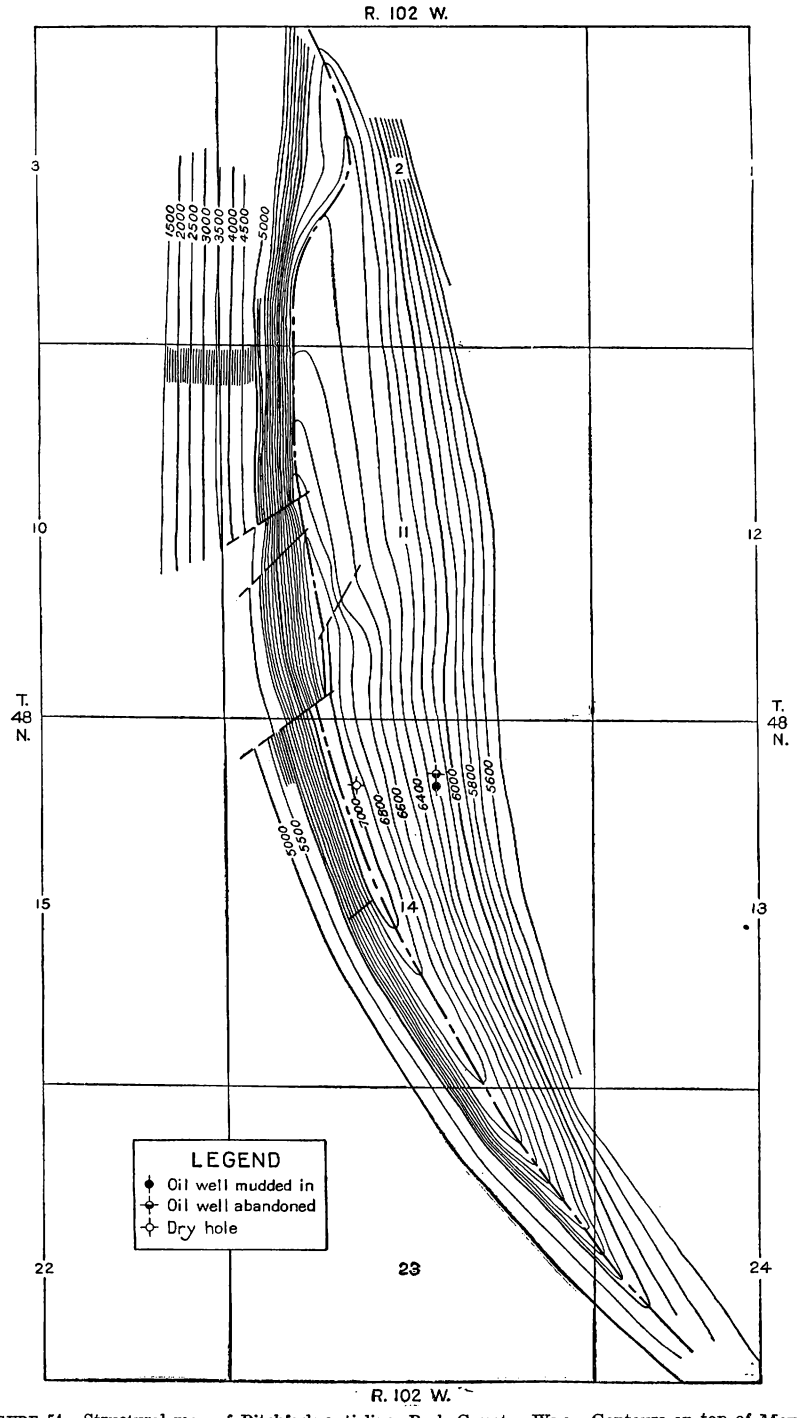


FIGURE 54.—Structural map of Pitchfork anticline, Park County, Wyo. Contours on top of Mowry shale. Approximate sea-level elevations; geologist, P. B. Roberts, Jr.; instrumentman, P. F. Brown; drawn June 1927; well status revised July 1, 1937.

Oil was discovered in November 1930 on drilling a well in the NW¼-NE¼ sec. 14 to 3,903 feet into the Amsden formation that produced 434 barrels of 18.6° A. P. I. gravity black oil daily from the Embar lime and Tensleep sandstone. The Embar lime at 3,350 to 3,356 feet and 3,420 to 3,450 feet could produce about 100 barrels, and the Tensleep sandstone at 3,600 to 3,615 feet and 3,743 to 3,822 feet increased this to 434 barrels a day. Later the well was "mudded in." Analysis of the oil is given under Crude-oil Analyses (p. 161).

A unit plan for the development and operation of the Pitchfork structure was approved by the Secretary of the Interior on November 30, 1932, effective as of January 1, 1932.

POISON SPIDER AND SOUTH CASPER CREEK

The Poison Spider field (fig. 55, case) in the northeast corner of T. 33 N., R. 83 W., and in secs. 7 and 18, T. 33 N., R. 82 W., Natrona County, occupies one of the minor domes and anticlines on the Pine Mountain-Oil Mountain fold. The dome is circular except for a nose to the southeast. The outcropping sandstones on the northeast and southwest flanks dip 5° to 10°. Shales of the Frontier form the surface over the productive area of the Poison Spider dome at an altitude range of 5,710 to 5,860 feet. The structure has about 175 feet of closure independent of the South Casper structure to the northwest.

The field was discovered in 1917 on drilling a well in the NW¼ NW¼ sec. 12 that could produce 5 million cubic feet of gas daily from the Sundance formation at a depth of 1,242 feet. Between 1917 and 1924, 10 gas wells were completed in the upper Sundance sand at depths of 1,242 to 1,448 feet. The average thickness of the Sundance sand is 23 feet. Initial open-flow volume of these wells ranged from 1 to 8¼ million cubic feet of gas daily; the shut-in wellhead pressure was 540 pounds per square inch. The upper sand, essentially a gas-bearing sand, contained a narrow ring of oil below the gas. In 1919 oil was discovered at a depth of 1,506 feet in a lower Sundance sand in a well in the NE¼ SE¼ sec. 12 about 100 feet lower structurally than the crest of the dome. The initial daily production of the well was 100 barrels of oil. By the summer of 1937 about 21 oil wells had been completed in the lower Sundance sand at depths of 1,420 to 1,500 feet. One gas well also was completed in the lower Sundance sand at 1,479 feet, with an initial daily production of 13.5 million cubic feet of gas. This sand averages 91 feet in thickness and is the principal oil-producing sand, although it, too, contained gas on top of the structure. Production from wells in the lower sand ranged from 8 to 80 barrels of 20° A. P. I. gravity oil daily. The Dakota sand at depths of 683 to 805 feet and the Tensleep sandstone (in one well) at a depth of 2,626 feet were water bearing. A deep-test well in the SW¼ SW¼ sec. 1 showed the Tensleep sandstone at 2,520 to 2,700 feet, Madison limestone at 2,940 to 3,248 feet, Deadwood formation to 3,825 feet, granite wash to 4,090 feet, and granite at 4,110 feet.

On June 1, 1938, there were about 6 exhausted gas wells, which had been shut in, and 20 oil wells that could produce about 220 barrels of oil daily with at least 5 times as much water. The oil and water were separated by heating to 160° to 180° F. and treating in electrical dehydrators. Analyses of the oil (dehydrated), gas, and water in the Dakota and Sundance sands are given under Crude-oil Analyses

(p. 162), in table 5 (p. 116), and in table 6 (p. 118), respectively. Gas production reported from the field from 1920 to 1927 was 5.5 billion cubic feet. Total oil production to 1938 was 740,170 barrels. Yearly production of oil and gas is included in tables 7 and 8 (pp. 120 and 122), respectively. The gas-bearing area of the field probably was not over 160 acres and the oil-bearing area about 480 acres. The gas formerly was piped through a 10-inch line to Casper and the oil to Casper through a 6-inch line from South Casper Creek oil field. For several years, however, most of the oil has been hauled by trucks. It is used primarily for the manufacture of road oils, and the field is shut down during the winter.

The South Casper Creek oil field (fig. 56, case) in secs. 2 and 3, T. 33 N., R. 83 W., and secs. 33 and 34, T. 34 N., R. 83 W., Natrona County, is on an anticline having a structural high on each end and lying along the Pine Mountain-Oil Mountain fold. The high on the north end of the anticline has about 100 feet of independent closure and that on the south end 150 feet. The anticline has about 300 feet of closure separating it from the Poison Spider dome to the southeast. The Wall Creek sandstone escarpment surrounding the anticline dips 15° to 20° on the southwest flank and 18° to 25° on the northeast flank. The Third Wall Creek sand of the Frontier formation forms the surface at an altitude range of 6,000 to 6,020 feet on the north high and of 5,800 to 5,880 feet on the south high.

The field was discovered in 1918 when gas was found in the Sundance sand. Fourteen gas wells were completed in the Sundance formation at depths of 1,300 to 1,585 feet; initial daily open-flow volume ranged from 1 to 30 million cubic feet of gas. The gas was piped to Casper until the field was depleted in 1925. One well yielded some oil from the Sundance formation, apparently from a ring of oil between the gas and water, but not enough to warrant pumping. In June 1922 a well on the south high in the SW¼NE¼ sec. 3 was drilled 2,532 feet, stopping in the Tensleep sandstone; it produced 200 barrels of black 15° A. P. I. gravity oil. From 1922 to 1929 new wells were drilled and depleted gas wells deepened into the Embar lime and Tensleep sandstone. Eighteen wells were completed at depths of 2,400 to 2,500 feet, initial daily production ranging from 65 to 200 barrels of oil. In 1937 an old gas well on the north high in the SE¼NE¼ sec. 33, deepened to the Embar formation at 2,630 to 2,667 feet, produced initially 130 barrels of oil a day. A log of a well on the crest of the north high gave the following depth in feet to the top of the various formations: Muddy, 590; Dakota, 770; Morrison, 880; Sundance, 1,095; Chugwater, 1,490; Embar, 2,280; Tensleep, 2,660; and Amsden, 2,825.

On June 1, 1938, there were 17 wells in the Embar and Tensleep zones and 1 in the Embar, which produced a daily total of about 550 barrels of oil. All the wells drilled into the Tensleep sandstone produced as much water as oil; the oil contained no gas in solution. The wells were pumped, although hydrostatic pressure in the Tensleep sandstone was adequate to flow a small quantity of oil. After being heated to 160° to 180° F. the oil was treated in electric dehydrators to separate the oil and water. The oil well in the Sundance formation was shut in, and the six remaining gas wells furnished some fuel for lease operations. Analyses of the oil from the Tensleep sandstone after dehydration, gas from the Sundance formation, and water from

the Dakota, Morrison, Sundance, and Tensleep formations are given under Crude-oil Analyses (p. 170), in table 5 (p. 116), and in table 6 (p. 118), respectively. The total oil production reported to 1938 was 2,470,942 barrels and the total gas production from 1920 to 1927, inclusive, 11.4 billion cubic feet; yearly production is given in tables 7 and 8 (pp. 120 and 122), respectively. Approximately 240 acres on the south high is considered oil bearing; the north high has not been drilled sufficiently to estimate its productive area. Some oil is piped through a 6-inch line, and some is trucked to Casper where it is refined for road oil. The field is not operated during the winter.

POLECAT

The Polecat anticlines (fig. 57, case) are three structural highs, two of which are on the same line of folding as the Garland anticline but about 10 miles northwest of it. These two highs are referred to as the Danker and McMahon domes or together as the Big Polecat anticline. The Big Polecat anticline extends through the center of T. 57 N., R. 98 W., Park County. The Danker dome is in secs. 16 and 21 and the McMahon dome in sec. 27. The upper beds of the Cody shale outcrop on the Danker dome, and Mesaverde sandstone hogbacks flank the dome. The altitude is 4,334 feet in the southwest corner of sec. 22. Each dome has an independent closure of not over 100 feet.

Gas was discovered on the McMahon dome in 1916 on drilling a well in the SE¼NW¼ sec. 27 that produced an open-flow volume of 2½ million cubic feet of gas daily from the Frontier formation at 2,232 to 2,272 feet. Four other wells were drilled on the anticline to the Frontier sands at depths of 2,230 to 2,775 feet, three yielding gas in commercial quantities, although one of the three had to be abandoned because of casing difficulties. The fourth, a dry hole, was in the saddle between the two highs. The wells produced initially ½ to 7 million cubic feet of gas daily; shut-in wellhead pressures were 600 pounds per square inch. On June 1, 1938, three gas wells were potential producers. Analysis of the gas is included in table 5 (p. 116). Owing to the lack of a market, only 74 million cubic feet of gas was produced in this field to 1938; yearly production is given in table 8 (p. 122). Approximately 800 acres is considered gas bearing. The gas is piped to Frannie and Deaver for domestic consumption.

The Little Polecat gas structure (fig. 57) is a small elliptical dome about 3 miles south and west of the Big Polecat anticline in secs. 30 and 31, T. 57 N., R. 98 W., and secs. 25 and 36, T. 57 N., R. 99 W., Park County. The Lance or surface formation dips about 15° on the east side and 5° to 10° on the other sides. The dome has a closure of 300 to 400 feet. In 1922 a well in the SE¼SW¼ sec. 30 produced initially an open-flow volume of 4 million cubic feet of gas daily from the Frontier formation at 3,905 to 3,909 and 4,183 to 4,188 feet; the shut-in wellhead pressure was 1,425 pounds per square inch. This well was the only one drilled on the Little Polecat anticline. Analysis of the gas is given in table 5 (p. 116). Because of the limited market for gas, only 828 million cubic feet was produced to 1938; yearly production is given in table 8 (p. 122). The productive area was estimated at 500 acres. The gas is piped 9 miles through a 3-inch line to Powell for domestic consumption.

POWDER RIVER

The Powder River field in secs. 23, 24, and 25, T. 36 N., R. 85 W., Natrona County, is near the crest of an anticline about 4 miles long and 2 miles wide, the axis of which trends northwest and southeast. The anticline has a closure of about 300 feet; its flanks dip 5° to 10°. The Niobrara shale forms the surface at an altitude range of 5,900 to 6,000 feet.

In July 1917 a well in the NE¼SE¼ sec. 23 produced a small volume of gas from a sand in the Frontier formation at 880 to 948 feet. From July 1917 to 1931, 11 wells were drilled in secs. 23, 24, and 25. One well in the SW¼NW¼ sec. 24 was reported to have produced initially 75 barrels of oil daily and another in the SE¼NE¼ sec. 24, 100 barrels—both from the Wall Creek sands at depths of 1,333 to 1,380 and 1,410 to 1,418 feet, respectively. A well in the NW¼NE¼ sec. 25 produced by swabbing 26 barrels of oil daily from the Muddy sand at 2,280 to 2,285 feet. The well was drilled to a depth of 3,460 feet into the Chugwater formation, and all sands, except one in the Morrison formation (which was dry), were found to be water bearing. The following sands were logged in the well (in feet): Frontier, 1,132 to 1,240, 1,484 to 1,560, 1,626 to 1,745, and 1,815 to 1,825; Muddy, 2,280 to 2,286; Dakota, 2,485 to 2,558; Morrison, 2,700 to 2,750; Sundance, 3,045 to 3,185; and the basal Sundance, 3,195 to 3,315. The field has never produced oil or gas commercially and had been virtually abandoned by 1938.

QUEALY DOME

Quealy Dome oil field (fig. 58) is on one of several structures on the eastern slope of the Medicine Bow Mountain Range; the crest of the dome is in sec. 13, T. 17 N., R. 77 W., Albany County. The structure is a small, sharply folded elongated dome covered entirely by alluvium and terrace gravels, except for scattered outcrops of Steele shale. The altitude of the field ranges from 7,450 to 7,500 feet. The east flank of the dome dips about 20° toward the Laramie Basin, and the west flank plunges until it becomes almost vertical. As a few scattered outcrops indicated a possible structure in this area, a well was drilled in 1921, but neither oil nor gas was found; two wells drilled later likewise failed. A seismograph survey then was made, and the area was mapped more accurately; as a result, Quealy dome was the first productive structure defined by seismograph in the Rocky Mountain area.

In November 1934 a well drilled in the SE¼SE¼ sec. 13 to the Muddy sand at 3,146 to 3,165 feet had an initial daily production of about 50 barrels of green 36° A. P. I. gravity oil; later it was deepened to the Dakota sand at 3,231 to 3,263 feet, and production increased to 450 barrels. To June 1, 1938, 17 wells were drilled, 2 of which were failures. Fourteen wells were completed in the Dakota and Lakota sands at depths of 3,160 to 3,458 feet (to the tops of the sands), with initial daily flowing production of 70 to 525 (an average of 300) barrels of green 33° A. P. I. gravity oil. One well in a fault block at the south end of the field penetrated the Dakota at 3,595 feet and produced initially, by pumping, 35 barrels of oil daily. In February 1937 a well on the crest of the structure was drilled into the Sundance formation; at 3,660 to 3,764 feet the initial daily flowing production was 15 barrels

of oil. It was estimated that the well, if pumped, would produce 150 barrels of oil daily. Five wells on the anticline were drilled into the Sundance formation; casing was set on top of the Sundance sand, the bottom of the casing plugged with cement, and the casing then perforated opposite the Dakota and Lakota sands, permitting these

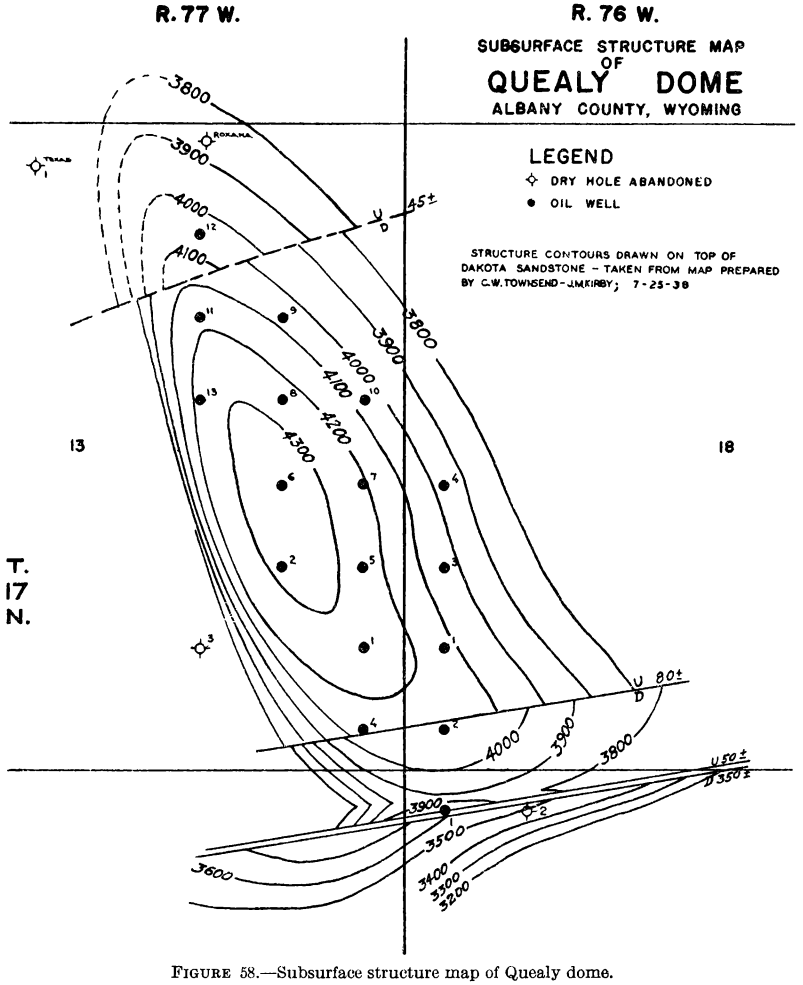


FIGURE 58.—Subsurface structure map of Quealy dome.

sands to produce into the well. Production from the Sundance formation may be obtained by cementing off the Dakota and Lakota sands and drilling out the plug in the casing.

The Muddy sand is 20 to 30 feet thick and proved productive only in the discovery well. The Dakota sand is 30 to 50 feet thick and the Lakota sand about 30 feet. The oil-saturated zone in the Sundance formation is 40 to 60 feet thick. A log of one well approximately 100 feet down from the crest of the structure shows that the Frontier formation was topped at 2,490 feet, Muddy sand at 3,115 feet, Dakota sand at 3,212 feet, Lakota sand at 3,256 feet, Sundance sand at 3,678 feet, and Chugwater formation at 3,758 feet.

On June 1, 1938, the 14 flowing oil wells and 1 pumping well in the field produced at the rate of about 750 barrels of oil a day. The oil in the Dakota and Lakota sands contains very little gas in solution and is under hydrostatic pressure, which causes the wells to flow. Analysis of the oil from the Dakota and Lakota sands is given under Crude-oil Analyses (p. 162). Oil production for 1936—the first year the field was produced—was 80,147 barrels and for 1937, 268,499 barrels. At least 160 acres of the Dakota and Lakota sands appeared to be oil bearing. In 1936 a 4-inch pipe line was laid from the field to a railway loading rack at Rock River; from there the oil was shipped to a refinery at Parco, Wyo.

REX LAKE

The Rex Lake oil field (fig. 59) occupies a small, elongated dome on the eastern slope of the Medicine Bow Mountain Range in secs. 23, 24, 26, and 27, T. 16 N., R. 77 W., Albany County. The Steele shale forms the surface at an altitude of about 7,580 feet. Sandstone members of the Mesaverde formation surrounding part of the structure, especially to the south, dip 10° to 30°; outcrops nearer the crest dip 10° to 15°. The dome has at least 400 feet of closure.

This field became a producer in 1923 when a well in the NE¼NW¼ sec. 26 yielded 60 barrels of oil daily from the Muddy sand. Later the well was deepened into the Dakota and Lakota sands, producing from them about 400 barrels of 31° A. P. I. gravity, mixed-base oil daily. In 1924 and 1925, 11 other wells were drilled in the field, 4 of which were oil wells and 2 shallow gas wells. One well having a daily open-flow volume of 200,000 cubic feet of gas was completed in the Shannon sand at 425 to 434 feet. In general, the Muddy sand occurs at a depth of approximately 3,810 feet and is about 25 feet thick; the Dakota sand occurs at depths of 3,900 to 4,030 feet, is 10 to 20 feet thick, and yielded 300 to 450 barrels of oil per well daily; and the Lakota, a 15-foot sand separated from the Dakota sand by a 2-foot shale break, is water bearing except on the top of the structure.

On June 1, 1938, the three wells in the field could produce daily about 100 barrels of oil with an appreciable quantity of water, most of which apparently was edge water. One small, shallow gas well had been completed in 1937 to furnish gas for camp use. The gas-bearing zones in the other two gas wells had been depleted. Analyses of the oil from the Dakota sand and gas from the Shannon sand are given under Crude-oil Analyses (p. 163) and in table 5 (p. 116), respectively. To 1938, 206,339 barrels of oil was produced; yearly production is stated in table 7 (p. 120). Approximately 300 acres is considered productive. The oil is either trucked from the field or piped a few miles to a railroad.

ROCK RIVER

Rock River oil field, known also as Rock Creek oil field (fig. 60, case), in the northeast corner of T. 19 N. and the southeast corner of T. 20 N., R. 78 W., Carbon County, is on an asymmetrical anticline, one of several structures on the east slope of the Medicine Bow Mountain Range. The east flank of the structure dips toward the basin at angles up to 70° and the west flank toward the mountains at angles of 20° to 35°. The structure has about 1,600 feet of closure. A sandstone in the Steele shale is exposed on the north end of the structure, although

most of the anticline is covered with Quaternary gravels and alluvium at altitudes of 7,150 to 7,300 feet.

The discovery well—in the SE¼SW¼ sec. 35—was completed in May 1918; the initial production was 50 barrels of oil daily from the Muddy sand at 2,581 to 2,609 feet. Later 70 oil wells were completed in the Dakota sands. The first oil-bearing sand is the Muddy (First

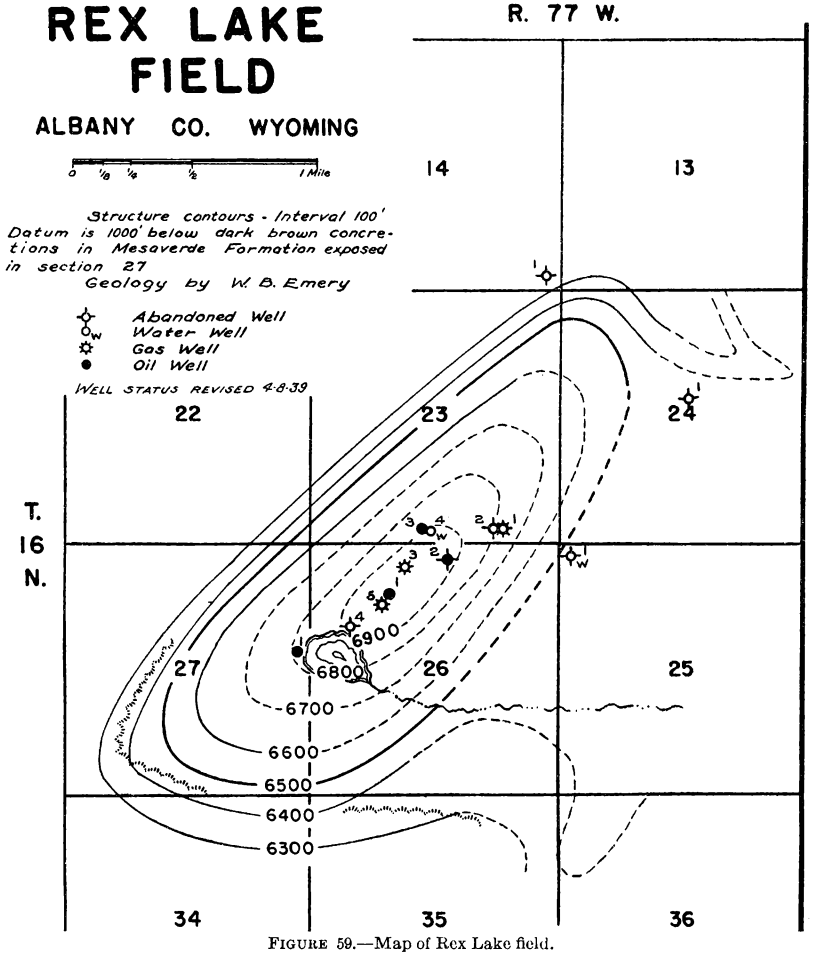


FIGURE 59.—Map of Rex Lake field.

Muddy), the second the Dakota (Second Muddy), and the third the Lakota (Dakota). These sands occur at depths of 2,500, 2,600, and 2,650 feet or more, respectively, and are approximately 55, 30, and 70 feet thick. The Wall Creek sand (about 750 feet above the Muddy sand) is 20 feet thick; in one well it yielded 40 barrels of oil daily. The log of a well in the southwest corner of sec. 35 showed the Wall Creek sand at 2,155 to 2,175 feet, Muddy at 2,888 to 2,920 feet, Dakota at 2,995 to 3,051 feet, Lakota at 3,052 to 3,101 feet, and Sundance at 3,436 to 3,616 feet. The 70 wells in the Dakota sands had an initial daily production of 30 to 2,676 barrels, an average of 365 barrels. The small wells were edge wells. The oil is brownish green and its

A. P. I. gravity 34° to 37°, the lighter oil coming from the upper part of the structure and the heavier from the flanks. It contained a large quantity of gas in solution, but only one well on the crest of the structure was predominantly a gas well; this produced initially about 15 million cubic feet of gas a day and had a shut-in wellhead pressure of 250 pounds per square inch. In 1921 a gasoline plant with a capacity of 3 million cubic feet was placed in operation to process casinghead gas; to April 1937, when the plant was shut down, it had processed approximately 10¼ billion cubic feet. Gasoline recovey ranged from 1 to 3 gallons per 1,000 cubic feet of gas; approximately 17½ million gallons of gasoline was extracted. In addition to the gas shown in table 8 (p. 122), large volumes produced in 1918, 1919, and 1920 were not metered and therefore not recorded. During the years 1929 to 1936 a small volume of gasoline-plant residue gas (excess above field operating requirements) was recycled into the Dakota sand—10 to 100 million cubic feet annually. An interesting feature in this field is the steep plunge of the water table in the Muddy sand—estimated to be 750 feet in 3.5 miles. In the lower sands the water table plunges less steeply but at least 150 feet in 3.5 miles.

In June 1935 oil was discovered in the Sundance sand when a well in the Dakota sand on the crest of the structure was deepened to the Sundance sand at 3,096 to 3,200 feet, producing 200 barrels of oil daily. By May 1, 1938, 17 other wells had been deepened and 5 new wells drilled; 13 of the 22 wells produced 25 to 778 barrels (an average of 348 barrels) of 36° A. P. I. gravity oil from the Sundance sand at a depth of about 3,300 feet. The sand averages 62 feet in thickness. The remaining wells were on the flank of the structure and produced water; the oil-bearing area of the Sundance sand in the field was thus fairly well defined. Two of the wells that were deepened were drilled into the Casper formation to depths of 5,431 and 5,671 feet, but only water was found in that formation.

On June 1, 1938, there were about 60 wells in the field capable of producing oil; 43 in the Cloverly formation could produce approximately 2,000 barrels of oil daily, although they actually produced about 125 barrels, and 13 in the Sundance formation also could produce approximately 2,000 barrels daily, although they produced about 90 barrels. Analyses of the oils from the Dakota and Sundance sands, gas from the Cloverly formation, and waters from the Cloverly formation and Sundance sand are given under Crude-oil Analyses (pp. 163 and 164), in table 5 (p. 116), and in table 6 (p. 118), respectively. To 1938, 17,300,151 barrels of oil was produced from the field, of which 454,542 barrels was from the Sundance formation. The volume of gas reported was 10.8 billion cubic feet. Yearly production is stated in tables 7 and 8 (pp. 120 and 122), respectively. An oil-production curve is plotted in figure 10 (p. 11). The productive area of the Dakota sands has been estimated at 1,400 acres and that of the Sundance sand about 160 acres. The oil is piped to Rock River, whence it is shipped by rail. The casinghead gasoline was transported 10.5 miles through a 2-inch gasoline line to Rock River.

ROCKY FORD

The Rocky Ford field, known also as Manhattan, is in sec. 13, T. 52 N., R. 62 W., Crook County. Wells were drilled in a small structure underlying the Spearfish formation, which forms the surface at

an altitude of about 4,200 feet. In 1909 heavy black oil was obtained from wells drilled to a depth of about 175 feet in the Minnelusa sandstone, and showings of oil were obtained at different depths in the Minnelusa sandstone. Several wells were drilled in the area, but only four yielded oil—about 2 barrels per day per well. The log of a well drilled for water at Sundance, Wyo., showed the following formations: Top of Minnekahta at 37 feet, Opeche at 71 feet, Minnelusa at 160 feet, Pahasapa at 800 feet, Englewood at 1,300 feet, and Deadwood at 1,469 feet. The field has been abandoned; the last well, drilled in 1935, was a failure.

SAGE CREEK

The Sage Creek field, also called Shoshone oil field in the early literature, in T. 1 N., R. 1 W., Fremont County, is on an asymmetrical anticline near the northwest end of the Shoshone anticlinal. The structure is complicated by a small structural spur in the northwest part of the anticline. The Chugwater is the surface formation at an altitude of 5,500 to 5,600 feet.

An oil seepage in the NW¼SW¼ sec. 35 was first mentioned in reports in 1864 and attracted attention to this structure when drilling was undertaken along the Shoshone anticlinal. A well drilled near the oil seepage in 1909 to a depth of 800 feet yielded some oil at 650 feet from the Chugwater formation and an appreciable flow at 670 feet as long as it was agitated. Ten wells—most of them along the axis of the anticline—were drilled to depths of 713 to 1,958 feet to the Embar, Tensleep, and Amsden formations, but none of them produced oil or gas in commercial quantities. What oil was found was a heavy, dark-brown asphaltic oil, the same as that obtained in the Dallas Dome field. In 1934 two wells in sec. 16, after being cleaned out, each produced 2 barrels of oil daily from the Chugwater formation. By 1938 two wells in the field were shut in, and one was being drilled; the other wells had been plugged and abandoned.

SALT CREEK

The Salt Creek field in Tps. 39 and 40 N., Rs. 78 and 79 W., Natrona County, is the largest oil field in the Rocky Mountain region. The contour map of the field (fig. 61), like others in this bulletin, is intended to portray the general features of the structure rather than to present contours that are accurate in detail. The Salt Creek dome near the northern end of the Salt Creek anticline is asymmetrical and is cut by many transverse normal faults. It is outlined by an escarpment of Shannon sandstone member of the Steele shale, forming an elliptical basin; the floor of the basin is quite rough where the lower part of the Steele shale outcrops. The Shannon sandstone dips 20° to 30° on the steep west side, 8° to 12° on the more gentle north and northeast sides, and 2° to 8° on the south and southeast sides. The dome has a closure of about 1,500 feet. The altitude of the field ranges from 4,700 feet at the north gap in the escarpment to 5,300 feet at the highest part of the escarpment in the southeast part of the field.

Oil seepages were known to exist at Salt Creek before 1880. In 1889 a well was drilled into the Shannon sand on the north end of the Salt Creek dome. This sand outcrops less than 2 miles south of the Shannon pool and forms the escarpment around the Salt Creek dome.

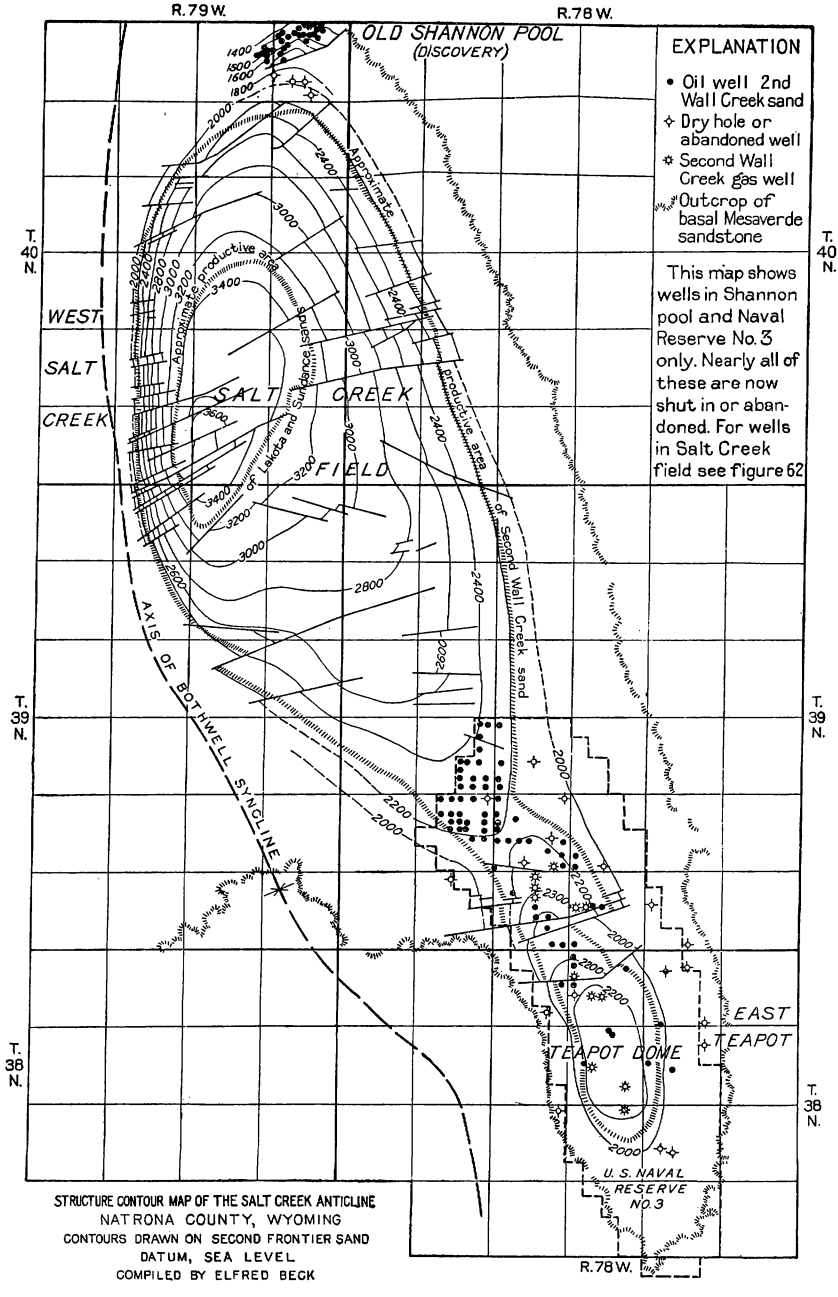


FIGURE 61.—Structural contour map of Salt Creek anticline.

The Shannon oil sand in the Shannon pool was found at depths of 700 to 1,000 feet. The wells were small producers, yielding daily 5 to 15 barrels of green, paraffin-base, 24° A. P. I. gravity oil, which contained but little gasoline. By June 1, 1938, 48 wells had been drilled in the pool, of which 39 were shut in and 9 had been abandoned. The productive area of the Shannon pool is about 160 acres. Production of oil from the pool during the period 1893 to 1915, as estimated by Estabrook and Rader,[8] was 53,441 barrels, of which about 15,000 barrels was produced from 1893 to 1896 and hauled by teams to Casper and 38,441 barrels was piped to Casper from January 1913 to May 1915. The wells were shut down in May 1915. From 1897 to 1911 a small quantity of oil was produced. Yearly production for Wyoming[9]—essentially production from the Shannon pool—is given below:

	Barrels		*Barrels*
1894	2,369	1901	5,400
1895	3,455	1902	6,253
1896	2,878	1903	8,960
1897	3,650	1904	11,542
1898	5,475	1905	8,454
1899	5,560	1906	[1]7,000
1900	5,450		

[1] Estimate.

Quite probably most of the oil produced from the Shannon pool to 1907 was used as fuel in developing the area and the Salt Creek field. Analysis of the water from the Shannon sand in the Salt Creek dome is given in table 6 (p. 118).

Although some oil had been discovered in the shales above the First Wall Creek sand in 1906, the Salt Creek dome did not attract the attention of oil producers until 1908 when a well drilled to the First Wall Creek sand "came in," producing 200 barrels of oil a day; this well was plugged and abandoned in 1937. In chronological order the following sands proved to be oil bearing in the Salt Creek field: Second Wall Creek in 1917, Lakota in 1921, Third Wall Creek in 1923, Second Sundance in 1925, Third Sundance in 1926, and Tensleep in 1930. A composite log of the Salt Creek field showing the formations, formation thickness, and position of the productive sands is shown in figure 62 (case).

By the end of 1937, 276,868,683 barrels of oil, 467 billion cubic feet of gas, and approximately 529¼ million gallons of natural gasoline had been produced from the Salt Creek field. Yearly oil-production data are given in table 2 and plotted in figure 63. The production from the upper shale given in table 2 for the years 1930 to 1937 (particularly 1934 to 1937) is too low because some shale oil has been included in the production from the Second Wall Creek. In 1937 the field produced 5,915,683 barrels of oil, an average per well of almost 11 barrels a day. At its peak production in 1923 it produced 35,301,607 barrels of oil from 907 wells, an average per well of 107 barrels a day. During April 1938 the field averaged 16,047 barrels of oil with 9,297 barrels of water daily, little of which came from the main-producing sand (Second Wall Creek). By April 1938, 2,304 wells had been drilled in the field, exclusive of those in the Shannon, West Salt Creek, and Naval Reserve areas; 1,489 of these were active, 415 were shut in,

[8] Estabrook, E. L., and Rader, C. M., History of Production of Salt Creek Oil Field, Wyoming: Am. Inst. Min. and Met. Eng., Petroleum Development and Technology in 1925, 1926, pp. 199–249.
[9] Griswold, W. T., Petroleum: Geol. Survey Mineral Resources of the United States, 1906, p. 880.

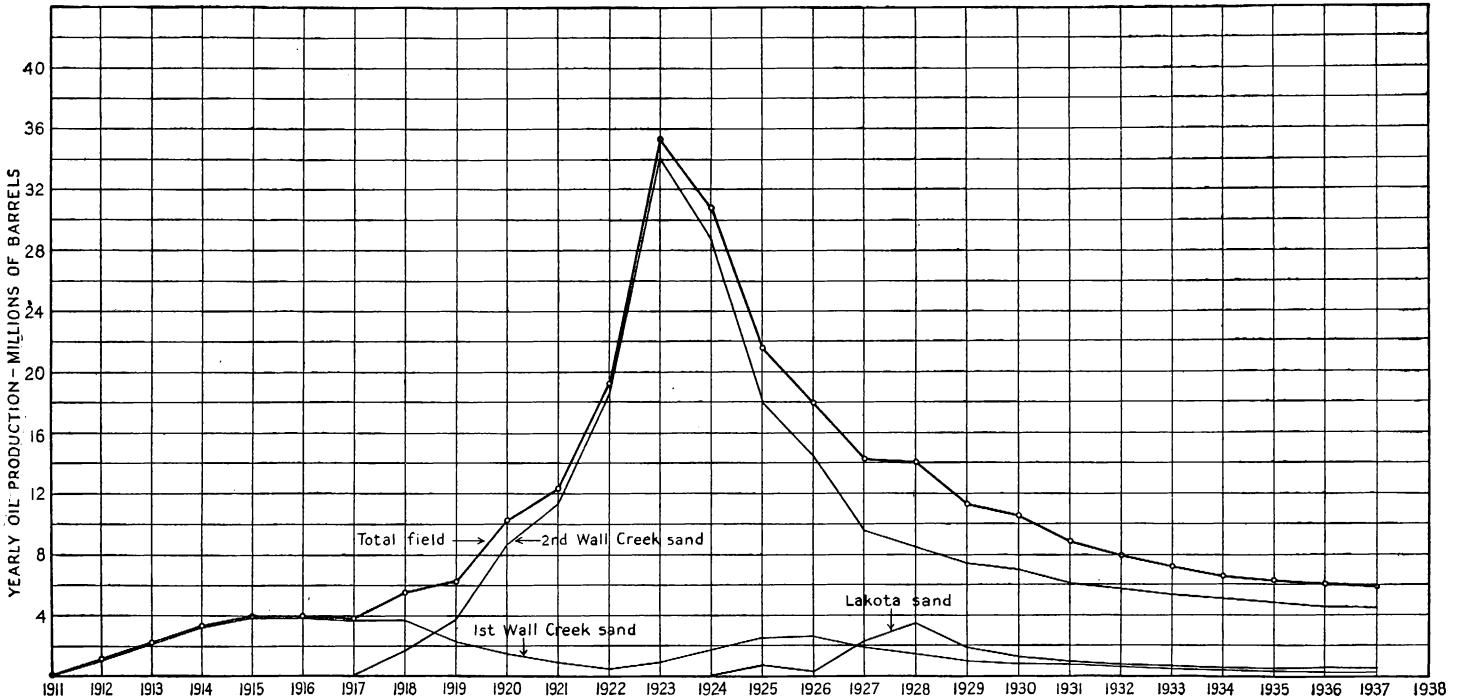


FIGURE 63.—Oil-production curves, Salt Creek field.

TABLE 2.—*Production of petroleum in the Salt Creek field, barrels*

Year	Total	Upper shale	First Wall Creek	Second Wall Creek	Third Wall Creek	Lakota (shale)	Lakota	Morrison	Second Sundance	Third Sundance	Tensleep
1911	51,798	8,569	43,229								
1912	1,157,899	31,389	1,126,510								
1913	2,254,946	51,055	2,203,891								
1914	3,379,329	93,692	3,285,637								
1915	3,936,328	77,989	3,858,339								
1916	4,000,433	158,445	3,841,988								
1917	3,840,502	104,773	3,718,548	17,181							
1918	5,512,993	144,449	3,723,516	1,645,028							
1919	6,208,716	164,684	2,330,945	3,713,087							
1920	10,255,410	127,398	1,478,878	8,649,134							
1921	12,378,689	188,408	878,318	11,298,031			13,932				
1922	19,261,116	254,399	514,523	18,492,194							
1923	35,301,607	389,943	883,567	34,028,097							
1924	30,831,704	389,379	1,764,680	28,582,032	34,286		61,327				
1925	21,590,606	289,473	2,534,529	17,889,467	65,602	21,862	787,991		1,682		
1926	17,974,624	230,704	2,541,865	14,424,978	55,240	352,808	325,478		8,744	34,812	
1927	14,352,791	133,833	1,894,631	9,584,539	17,775	382,095	2,334,570		5,348		
1928	14,041,031	108,268	1,472,260	8,591,348	10,799	199,636	3,421,154		54,025	183,541	
1929	11,312,094	84,235	984,232	7,461,363	51,256	110,066	1,804,384	35,624	226,988	553,946	
1930	10,514,845	73,622	862,591	7,001,635	45,290	88,115	1,249,419	22,852	267,118	841,642	62,561
1931	8,845,372	61,554	877,019	6,064,944	33,283	92,462	976,290	16,178	175,069	548,573	
1932	7,890,973	54,361	719,096	5,615,197	28,839	95,822	789,117	11,449	107,213	464,065	5,814
1933	7,154,059	42,147	462,824	5,341,227	25,261	97,652	649,721	9,350	87,795	438,082	
1934	6,566,075	12,635	332,593	5,015,263	34,291	104,689	556,034	8,278	84,545	417,747	
1935	6,318,958	12,471	294,029	4,826,912	45,584	104,249	533,036	6,522	80,616	415,539	
1936	6,020,102	16,264	277,665	4,562,156	44,000	100,695	560,801	5,853	82,054	366,996	3,618
1937	5,915,683	12,425	274,884	4,447,564	38,579	97,850	548,186	4,820	77,039	337,900	76,436
Total	276,868,683	3,316,564	43,180,787	207,251,372	530,085	1,848,001	14,611,440	120,926	1,258,236	4,602,843	148,429

and 400 were abandoned or plugged. Well development is indicated in figure 62 (case), a map of the field. By 1938 all the production, except that from the Third Sundance sand and the Tensleep sandstone, was obtained by pumping the wells either individually or from central powers. Approximately three-fourths of the wells were pumped by electric-power units and one-fourth by gas engines.

In 1906 some oil was discovered in the Carlile and Niobrara shales of the Salt Creek field just above the First Wall Creek sand. This shale production, however, has been overshadowed by the production from the First and Second Wall Creek sands. During the period 1911 to 1938, 3,316,564 barrels of oil was obtained from the Carlile and Niobrara shales from at least 108 wells drilled to depths of 200 to 800 feet. In April 1938, 26 wells still were producing 0.66 percent of the oil from the field, an average of 4.1 barrels of oil and 0.2 barrel of water per well per day, and 18 were inactive. The gravity of the oil is about the same as that produced from the First Wall Creek sand. The largest well that produced from shale was in the SE¼NW¼ sec. 27 and was completed at a depth of 1,283 to 1,435 feet; it produced initially 2,250 barrels of oil a day and after 2 years still produced 90 barrels a day. Most of the wells in the shale were short-lived, and production declined rapidly; they flowed a few weeks or months and then had to be pumped. Some oil was found in the shale in virtually all the wells; whenever a daily production of 25 barrels of oil or more could be developed it was the practice in this field to suspend drilling operations and complete the wells in the shale. If the original objective was to drill to a deeper zone, a new hole was started. Approximately 160 acres was considered oil bearing during 1937.

An area of oil-bearing shale along and west of the axis of the Bothwell syncline, in secs. 21, 28, and 33, T. 40 N., R. 79 W., adjoins the west border of the Salt Creek field proper. This area is known as West Salt Creek. Oil is found in the shale (Niobrara-Carlile) at depths of 2,000 to 2,400 feet; a few wells produced from the Second Wall Creek sand. The production characteristics of the wells in the shale were similar to those of the shallow shale wells in the north end of the field, in that the flush production period of several weeks or months was followed by a rapid decline in yield. A few wells, however, continued to produce for several years. Eighty-one wells were drilled at West Salt Creek; during April 1938, 11 still were producing, and 7 were shut in. Of the 11 active wells 8 produced from shale and 3 from the Second Wall Creek sand. In table 2 production from these wells is included in the production from the upper shale. Approximately 300 acres was productive in the West Salt Creek area.

The first well in the First Wall Creek sand—in the NE¼SE¼ sec. 23—came in on October 23, 1908, producing 200 barrels of oil daily. The initial production of the 105 wells drilled into the First Wall Creek sand from 1908 to 1919 averaged 335 barrels of oil per day per well. One of the largest wells in the field, in the NW¼SE¼ sec. 23, was reported to have produced initially 4,000 barrels of oil a day. At least 340 producing wells were drilled to the First Wall Creek sand. Depths to the sand ranged from 930 to 1,050 feet. The gravity of the oil was reported to be 39° to 41° A. P. I. originally, but in 1937 it was 37° to 38° A. P. I. Analyses of the oil and water are given under Crude-oil Analyses (p. 164) and in table 6 (p. 118), respectively. In April 1938

there were 257 wells in the First Wall Creek sand, of which 82 were inactive, 5 were used as gas-injection wells, and 170 produced 4.92 percent of the oil from the field, an average of about 4.5 barrels of oil and 10.3 barrels of water per well per day. Originally all the wells flowed, but since 1920 they have been placed gradually "on the pump." The oil contained some gas in solution, and the original wellhead pressures are reported to have been about 550 pounds per square inch. The total production of oil from the First Wall Creek sand has been 43,180,787 barrels; yearly production is given in table 2 and is plotted in figure 63. It was estimated that approximately 2,500 acres was oil bearing—a recovery to 1938 of 17,272 barrels per acre. An active water drive is evident in the First Wall Creek sand.

The Second Wall Creek sand at a depth of 1,330 to 2,100 feet proved commercially productive August 26, 1917, on completion of a well in the SW¼SE¼ sec. 11, T. 39 N., R. 79 W., that produced 60 barrels of oil daily. The initial daily production of 339 oil wells drilled into the Second Wall Creek sand from 1917 to 1921 averaged 669 barrels; of 85 wells drilled in 1922, 545 barrels; of 212 wells drilled in 1923, 272 barrels; and of 407 wells drilled in 1924, 236 barrels. The largest well—in the SW¼SE¼ sec. 25—produced initially over 10,000 barrels of oil a day—possibly 20,000 barrels during the first 24 hours. The oil from the Second Wall Creek sand contained an appreciable quantity of gas in solution. The original shut-in wellhead pressure was about 850 pounds per square inch. The dissolved gas in the oil seems to have been distributed uniformly throughout the field, except along the contact between the oil and edge water where a zone of relatively "dead" oil appeared to extend 50 to 100 feet above the oil-water contact. Originally the average gravity of the oil in most of the Second Wall Creek sand was 37° to 38° A. P. I., whereas that of the oil in the zone immediately above the edge water was 33° to 35° A. P. I. This difference in gravity was temporary; the oil in the zone above the edge water increased in A. P. I. gravity as the original oil was produced, and the lighter-gravity oil from up structure migrated into the zone. Analyses of the oil from the Second Wall Creek sand, gas, and water are given under Crude-oil Analyses (p. 165), in table 5 (p.116), and in table 6 (p. 118), respectively.

Almost 1,700 wells were drilled into the Second Wall Creek sand. During April 1938, 1,014 wells produced 72.31 percent of the oil from the field, or an average of 9.7 barrels of 37° to 38° A. P. I. gravity oil and 0.2 barrel of water per well per day; 303 were inactive; and 182 were used as gas-injection wells. From 1917 until 1923 virtually all the wells producing from the Second Wall Creek sand were flowing wells. In 1923 an intensive program of putting wells "on the pump" was initiated; by the end of 1924 half of the 1,127 producing wells were being pumped, and by the end of 1925 all of the wells in the Second Wall Creek sand were being pumped. Water encroachment has been extremely slow in the Second Wall Creek sand. By 1938 wells on top of the dome were "going dry," whereas flank wells sustained and sometimes actually increased their production. Of the 467 billion cubic feet of gas produced from the Salt Creek field from 1911 to 1937, inclusive, 384.4 billion cubic feet was produced from the Second Wall Creek sand. From 1926 to the end of 1937 approximately 87.5 billion cubic feet of dry gas was returned to the Second Wall Creek sand. The total production of oil from this sand

has been 207,251,372 barrels. Yearly production is given in table 2 and plotted in figure 63. Approximately 20,500 acres is oil bearing—a recovery of 10,110 barrels per acre.

Over 80 percent of the gas produced in the Salt Creek field was produced from the Second Wall Creek sand. The total gas production of the Salt Creek field by years and other gas data are given in table 3. The production shown in the first column of the table for the years preceding 1933 was determined by applying gas-oil-ratio factors to the total oil produced from the various producing zones during the several years. The volume for the years 1931 and 1932 is too low, as evidenced by the greater volume of gas processed for its gasoline content (table 3). Of the total gas produced to 1938, 384,412 million cubic feet came from the Second Wall Creek sand, 63,735 million cubic feet from the First Wall Creek sand, 13,700 million cubic feet from the Lakota sand, 1,922 million cubic feet from the Sundance formation, and 3,240 million cubic feet from other zones. The Tensleep sandstone carried no gas. From 1911 to 1918 all gas in excess of that required for field operations was burned. In January 1918 the first gasoline plant with a capacity of 3 million cubic feet per day was completed. This plant was enlarged later, two other plants were built, and six "booster" plants were erected in the field; by 1924 the gasoline plants had a total capacity of 60 million cubic feet. On July 1, 1937, about 28 million cubic feet of gas was processed daily—about 93 percent in a compression-refrigeration plant and 7 percent in two low-pressure absorption plants. The variation in gasoline yields obtained in the early life of the plants was due primarily to the fact that only the richest gas was processed. As plant capacity was increased, leaner gas was treated. Approximately 529¼ million gallons of gasoline was extracted from the gas from 1918 to 1938.

TABLE 3.—*Natural-gas production, Salt Creek field*

Year	Gas produced, M cubic feet	Gas processed, M cubic feet	Gasoline recovery, gallons per M cubic feet	Gas returned to producing zones, M cubic feet
1911	47, 300			
1912	1, 142, 600			
1913	2, 229, 500			
1914	3, 331, 800			
1915	3, 896, 900			
1916	3, 921, 200			
1917	3, 788, 400			
1918	5, 441, 200	613, 454	2. 13	
1919	6, 126, 300	1, 120, 183	2. 59	
1920	11, 921, 300	1, 649, 115	3. 98	
1921	14, 714, 160	2, 498, 127	4. 66	
1922	24, 835, 650	4, 816, 827	3. 41	
1923	52, 520, 300	9, 455, 963	1. 68	
1924	60, 942, 433	17, 458, 201	1. 46	
1925	51, 741, 816	19, 819, 590	1. 47	
1926	37, 858, 531	18, 708, 074	1. 84	2, 180, 457
1927	28, 559, 530	16, 625, 358	2. 08	4, 987, 011
1928	28, 191, 122	17, 521, 098	1. 96	9, 640, 437
1929	21, 604, 467	17, 464, 331	2. 22	9, 094, 320
1930	18, 715, 350	16, 739, 509	2. 72	9, 312, 293
1931	16, 075, 172	16, 661, 097	2. 75	10, 134, 163
1932	14, 635, 378	14, 810, 638	2. 66	8, 626, 371
1933	11, 718, 133	11, 481, 442	2. 62	6, 306, 992
1934	11, 315, 099	10, 606, 599	2. 89	6, 776, 670
1935	11, 083, 432	10, 399, 961	2. 80	6, 527, 908
1936	10, 297, 596	9, 893, 062	2. 94	6, 996, 788
1937	10, 354, 252	10, 354, 252	2. 71	6, 907, 180
Total	467, 008, 921	228, 696, 881		87, 490, 590

On May 1, 1924, when approximately 183 million cubic feet of gas was produced, 49 million was processed at gasoline plants, 15 million was used as fuel in the field, and 119 million was being wasted. As a result of the large wastage of gas and the realization that repressuring of the producing zones would be profitable, a program of returning excess gas to the oil sands was initiated in 1926. By 1930 no gas was being wasted. All the gas returned to producing formations was returned to the Second Wall Creek sand except for the following: From 1927 to 1937, 20 to 400 million cubic feet was returned annually to the First Wall Creek sand; from 1931 to 1937, 3 to 6 million cubic feet was returned annually to the Lakota sand; and from 1930 to 1936, 2 to 17 million cubic feet was returned annually to the Sundance sand. A rough estimate of the disposition of the gas produced in 1936 follows: 6,996 million cubic feet of gasoline-plant residue gas was returned to the formations; 1,176 million cubic feet was used in field operations; 825 million cubic feet was used as fuel in gasoline plants and gas-booster stations; 808 million cubic feet represented the gas equivalent of 29,556,288 gallons of gasoline extracted; and 618 million cubic feet was used as fuel in the generation of electricity.

The Third Wall Creek sand proved to be oil bearing in 1923. Production from this sand was not consistent over any given area because of the lenticularity of the sand. Only 23 wells, at depths of 1,600 to 1,700 feet, in the south and southwest part of the field were productive in this sand. During April 1938, 12 wells in the Third Wall Creek sand produced 0.84 percent of the oil from the field, an average of about 11.3 barrels of 37° A. P. I. gravity oil and 0.2 barrel of water per well per day. Three wells were inactive. The productive area of the sand has not been estimated. Since 1923, 530,085 barrels of oil has been produced from the Third Wall Creek sand. Analyses of the oil and water are given under Crude-oil Analyses (p. 165) and in table 6 (p. 118), respectively.

The Lakota sand is the next important producing formation below the Third Wall Creek sand. However, the Muddy sand between 2,100 and 2,250 feet and the Dakota sand and Fuson shale between 2,350 and 2,400 feet produced some oil. Apparently the oil that accumulated in the Fuson shale migrated from the underlying Lakota sand. Eighteen wells, generally referred to as Lakota shale wells, were completed in the Muddy sand, Dakota sand, and Fuson shale. During April 1938, 14 such wells produced (mainly from the Fuson shale) 1.83 percent of the oil from the field, a daily average of 21.0 barrels of 38° A. P. I. gravity oil and 1.4 barrels of water per well. From 1925 to 1938, 1,848,001 barrels of oil was produced from the Muddy, Dakota, and Fuson zones. Analyses of the Muddy and Dakota waters are given in table 6 (p. 118).

Oil was discovered in the Lakota sand in September 1921 on drilling a well in the NW¼SE¼ sec. 25 that produced 274 barrels of oil and 1,000 barrels of water daily. Initial daily production of the next few wells ranged from 430 to 3,240 barrels of oil. In 1926, 28 wells were completed in the Lakota, with initial daily productions of about 1,000 barrels of oil. The largest producer in the Lakota sand in the NW¼-SW¼ sec. 24 (a region of prolific production from the Lakota sand) was completed in 1926, yielding 14,202 barrels of oil daily. The Lakota sand was 60 feet thick in this well. A well in the Lakota sand in the SW¼NW¼ sec. 35 was completed in July 1925, with an initial

daily production of 3,243 barrels of 36° A. P. I. gravity oil and 21 million cubic feet of gas; the shut-in wellhead pressure was 1,110 pounds per square inch. Wells in sec. 26 were erratic, in that many offsets to wells producing 1,000 to 1,500 barrels produced 5,500 barrels of oil a day, and wells adjacent to 500-barrel wells "came in," yielding 2,400 barrels. The wells in the SE¼ sec. 26 were small producers, most of them yielding 200 to 400 barrels of oil daily. The Lakota sand, however, was only 10 feet thick in this quarter section. Gas-oil ratios in 58 wells, including some Lakota shale wells, averaged 726 cubic feet of gas per barrel of oil when the wells first "came in." Sixty-seven wells were drilled to the Lakota sand. During April 1938, 27 wells in the Lakota sand were active, and 5 were inactive. The active wells produced 8.76 percent of the oil from the field, an average of 52 barrels of 35° to 37° A. P. I. gravity oil and 219.2 barrels of water per day per well. There is an active water drive in the Lakota sand. The productive area of the Lakota sand, roughly outlined by the 3,300-foot contour shown in figure 61, is estimated at 2,125 acres. Since 1921, 14,611,440 barrels of oil has been produced from the Lakota sand, a recovery per acre of 6,875 barrels. Yearly production is given in table 2 (p. 90) and plotted in figure 63 (p. 89). Analyses of the oil, gas, and water are given under Crude-oil Analyses (p. 166), in table 5 (p. 116), and in table 6 (p. 118), respectively.

Two wells produced oil from the Morrison formation at depths of 2,320 to 2,420 feet. During April 1938 one well produced 0.08 percent of the oil from the field, a daily average of 13.3 barrels of 33° A. P. I. gravity oil and 140 barrels of water. Since 1929 these wells have produced 120,926 barrels of oil. Analysis of the Morrison water is given in table 6 (p. 118).

The Sundance formation contains three sand benches; the second (middle) and third (lower), at depths of 2,800 to 3,000 feet, are oil bearing. Oil was discovered in the second sand in December 1925 on completion of a well in the NW¼NW¼ sec. 26. The initial daily production was 75 barrels of oil. Oil was discovered in the third sand in April 1926 on completion of a well in the NW¼SW¼ sec. 26 that produced 87 barrels a day. Initial production from the second sand ranged from 75 to 1,773 barrels a day (an average of 482 barrels) and that from the third sand from 87 to 5,800 barrels (an average of 1,724 barrels). The gravity of the Sundance oil is 36° to 37° A. P. I. The largest well—in the SE¼NW¼ sec. 35—was completed in May 1926, with an estimated production of 5,800 barrels of oil a day and a shut-in wellhead pressure of 740 pounds per square inch. Forty-nine wells, about equally divided between the two sands, were drilled to and produced from the Sundance formation. The wells in the second sand had to be pumped, but those in the third sand flowed because of an active water drive in the sand. From 1925 to 1938, 1,258,236 barrels of oil was produced from the second sand and 4,602,843 barrels from the third sand. Analyses of the oil from the Sundance sands and waters in the Sundance formation are given under Crude-oil Analyses (p. 166) and in table 6 (p. 118), respectively. During April 1938 there were 32 producing and 2 inactive wells in the Sundance formation in the field. The wells in this sand produced 6.81 percent of the oil from the field, a daily average of 34.1 barrels of oil and 35.9 barrels of water per well. Considering that approximately 920 acres of the Sundance

formation is productive, the recovery of oil per acre to 1938 has been 6,370 barrels.

On November 25, 1930, a well in the SW¼NW¼ sec. 35, drilled 5,420 feet into the granite, was completed as an oil producer in the Tensleep sandstone at 3,775 to 3,802 feet; the initial daily production was 1,949 barrels of 27.5° A. P. I. gravity oil. To 1937, 71,993 barrels of oil had been produced from the well, which had been shut in most of the time. Water was found in the bottom of the Tensleep sandstone. At 4,375 feet in the Madison lime (4,365 to 4,855 feet) 22° A. P. I. gravity oil was obtained but not in commercial quantities; at 4,605 feet a large flow of hot water (183° F.), estimated at 138,500 barrels a day, was found. In 1937 another well was completed in the Tensleep sandstone, and by April 1938 four more wells had been completed; the flowing production of these five wells ranged from 180 to 300 barrels of oil a day. Analyses of the oils from the Tensleep and Madison formations and water in the Tensleep sandstone are given under Crude-oil Analyses (p. 167) and in table 6 (p. 118), respectively. During April 1938 six wells produced 3.79 percent of the oil from the field, an average of 101.4 barrels of oil and 0.3 barrel of water per well per day. Approximately 1,000 acres in the Tensleep sandstone is estimated to be oil bearing.

During the early life of the Shannon and Salt Creek fields the oil was transported 40 miles to Casper by wagon, 16- to 20-horse teams hauling 30 to 35 barrels a load. Late in 1911 a 6-inch pipe line to Casper was placed in operation. Construction of other pipe lines to Casper followed—a 6-inch in 1912, an 8-inch in 1918, another 8-inch in 1920, two 8-inch in 1922, and a 6- and 8-inch in 1923. A 12-inch line was laid to Clayton tank farm near Douglas in 1923. These lines had a total daily capacity of 200,000 barrels of oil. By 1937 two 8-inch and the 12-inch lines had been taken up. Three oil lines remained—one a 6- and 8-inch through Casper to Parco; one twin 6-inch to Naval Reserve No. 3 and an 8-inch from there to Casper; and one twin 6-inch to a point east of the naval reserve and an 8-inch from there to Casper. There was also a 4-inch and a 3-inch natural-gasoline line to Casper; the 3-inch, however, was not used. Water from Casper is pumped to the Salt Creek field through an old 6-inch oil line. There are no gas lines out of the field.

SHAWNEE

Shawnee area is in T. 32 N., R. 69 W., Converse County. Most of the drilling has been done in secs. 16, 17, 21, 22, 25, and 27. The White River formation covers the surface to a depth of 500 to 800 feet; the beds of the formation, monoclinal in general attitude, dip gently toward the northwest but indicate a slight folding in secs. 25, 26, and 27. Little information is available on the attitude of the Cretaceous beds beneath, except that they form the northwest flank of the Hartville uplift. It is believed that the Lance and other Upper Cretaceous beds have a monoclinal dip northwest, greater than that of the White River formation.

The area was drilled as early as 1925, but interest was stimulated when gas and a showing of oil were obtained in several core holes drilled in 1930. Late in 1934 a well in the SE¼SE¼ sec. 17 produced 62,000 cubic feet of gas daily from the base of the White River formation at 520 to 565 feet. In the spring of 1935 another small gas

well was drilled in the SE¼NE¼ sec. 17. In November 1936 and May 1937 two wells were completed in the NW¼SE¼ sec. 27; one at a depth of 480 feet in the White River formation produced 7 million cubic feet of gas and had a shut-in wellhead pressure of 170 pounds per square inch, and the other at 451 to 453 feet in the White River formation produced 2¼ million cubic feet of gas and had a shut-in wellhead pressure of 165 pounds per square inch. In June 1937 a well in the NW¼SW¼ sec. 26 produced approximately 10 barrels of a green 24.8° A. P. I. gravity oil daily from a sand at or near the base of the White River formation at 558 to 561 feet.

This discovery revived activity in the area; by June 1938, 10 wells had been drilled to a depth of 500 to 1,110 feet. One, a gas well in the SW¼NW¼ sec. 25, was productive; this tested 2.8 million cubic feet of gas daily from a sand at 525 to 526 feet and had a shut-in wellhead pressure of 100 pounds per square inch. A well in the SW¼SW¼ sec. 16 was drilled 4,049 feet, presumably near the base of the Pierre shale. Analysis of the oil is given under Crude-oil Analyses (p. 168). By June 1938 about 22 wells had been drilled in the area; 1 was an oil well and 5 were gas wells with a reported total initial open-flow volume of 12 million cubic feet daily. The oil well has been shut in most of the time, and the gas produced was used for drilling purposes.

SHOSHONE

The Shoshone anticline (fig. 64) in the west half of T. 53 N., R. 101 W., Park County, sometimes is referred to as the Cody structure, although another anticline (the axis of which is about 2 miles west of the Shoshone axis) is known as the Cody anticline. The Shoshone anticline has about 1,500 feet of closure; the east flank of the structure dips about 50° and the west flank 30° to 35°. The Frontier formation outcrops on the crest of the structure at an altitude of about 4,900 feet.

Oil was discovered in 1912 in a well in the SE¼SW¼ sec. 21 at a reported depth of 1,720 feet in the Thermopolis shale; daily production was estimated as 10 barrels of oil. A number of wells were drilled after completion of the discovery well, but none proved to be commercial producers. During the period 1926 to 1928 drilling was revived after a well completed in the Muddy sand at 1,083 to 1,098 feet produced 15 barrels of 44° A. P. I. gravity green oil daily. In 1929 a well that produced 45 barrels of black oil daily was completed in the Embar lime at 4,510 to 4,770 feet in the northwest corner of tract 39, sec. 28, and in 1930 another well produced about 75 barrels of black oil daily from the Embar lime at 4,309 to 4,360 feet and 4,523 to 4,540 feet. Approximately 13 wells had been drilled by 1938, and all but 1 or 2 had been abandoned. During June 1938 an old well in the SE¼NE¼ sec. 20 was deepened and completed, with an initial production of 200 barrels of oil daily from the Embar lime at 4,756 to 4,800 feet. Analyses of the oils from the Muddy sand and Embar lime are given under Crude-oil Analyses (p. 169). Only 16,709 barrels of oil was reported from the field; yearly production is given in table 7 (p. 120).

SIMPSON RIDGE

The Simpson Ridge anticline, known also as Saddleback Hills anticline (fig. 65), extends through the west side of T. 21 N., R. 80 W.,

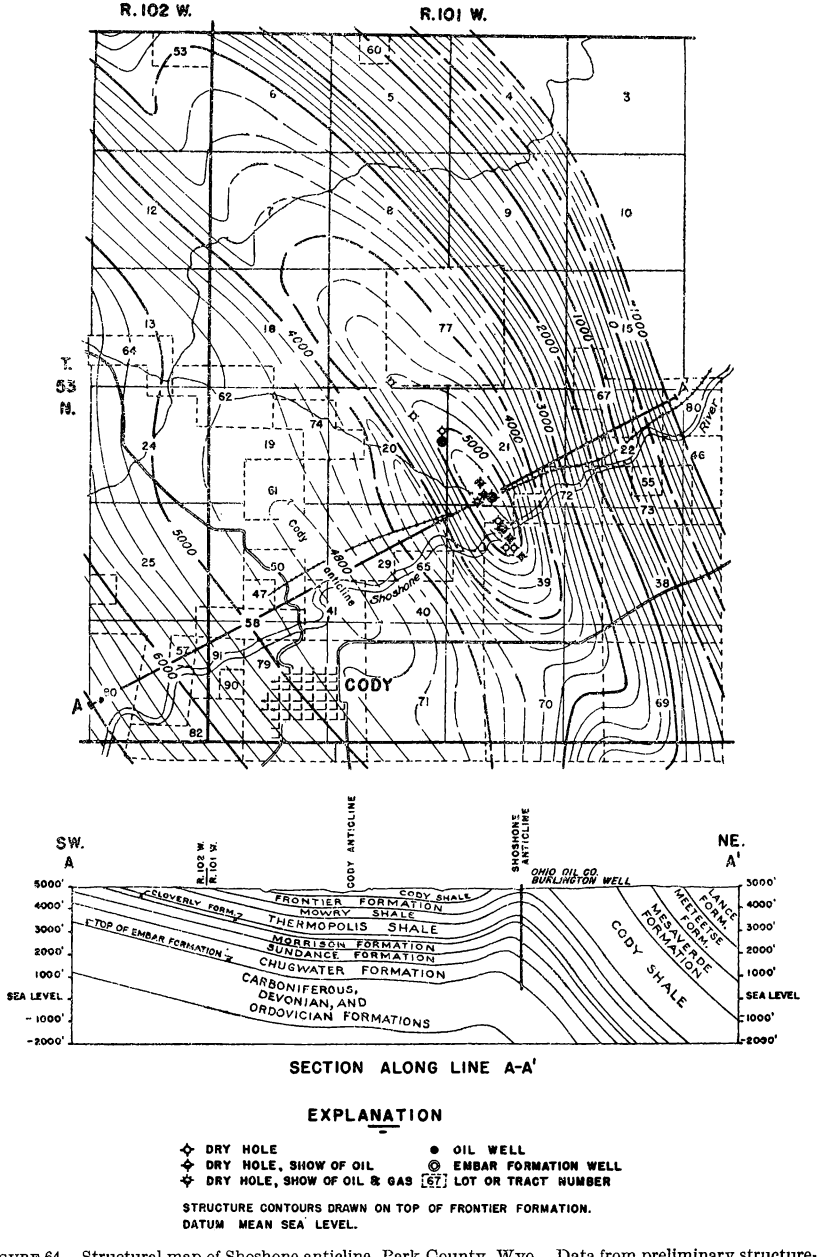


FIGURE 64.—Structural map of Shoshone anticline, Park County, Wyo. Data from preliminary structure-contour map of Shoshone anticline and the adjoining region near Cody, Park County, Wyo., based on mapping in 1936-38 by W. G. Pierce, assisted by W. C. Warren and R. P. Bryson, and issued by the United States Department of the Interior, Geological Survey, with a press release dated November 18, 1939.

Carbon County; its crest is in sec. 20. It is a long, narrow, steeply dipping, and faulted anticline with a closure of 700 feet. The Mesaverde formation covers the surface; altitude in the producing area, sec. 20, ranges from 7,380 to 7,480 feet.

The field was discovered in September 1923 when a well in the SE¼NW¼ sec. 20 was brought in, producing 25 barrels of 23° A. P. I. gravity brown oil daily from the Quealy sand in the bottom of the Mesaverde formation at 644 to 680 feet. In 1925 and 1926, 13 holes were drilled, and 7 oil wells were completed at depths of 624 to 815 feet in the Quealy sand. Most of the wells were about 700 feet deep, penetrating about 27 feet of sand. The initial daily oil production of the wells ranged from 20 to 250 barrels. One well was drilled to a depth of 6,931 feet, through the Frontier and into the Cloverly formation, but only a showing of oil and gas was obtained in the Frontier. The field was produced until 1931 when the wells were mudded in. At that time there were eight wells in the field, with a total daily capacity of 60 barrels of oil and 1,000 barrels of water. During 1936 and 1937 several wells were cleaned out and again placed on a producing basis, and in the fall of 1937 two new wells were drilled, one in the NW¼NW¼ sec. 20 to a depth of 5,619 feet before being abandoned. The Quealy sand at depths of 2,620 to 2,910 feet and the Shannon sand at 3,700 and 4,060 feet were unproductive. Analysis of the oil from the Quealy sand is given under Crude-oil Analyses (p. 170). To 1938 the field produced about 179,361 barrels of oil; yearly production is given in table 7 (p. 120). The productive area is about 160 acres. Formerly a pipe line transported the oil to Hanna.

SPINDLETOP

The Spindletop dome (fig. 16, case) is in secs. 5 and 6, T. 29 N., R. 81 W., and secs. 31 and 32, T. 30 N., R. 81 W., Natrona County. The structure comprises two small domes about half a mile apart and separated by a fault and has a total closure of about 1,000 feet. The formations on the west and south flanks of the structure dip as much as 40° and those on the east and north flanks about 15°. The Frontier is the surface formation at an altitude of about 6,800 feet.

The Spindletop oil field was discovered in August 1922 when a well in the SW¼SW¼ sec. 32 was completed in the Sundance formation at 1,035 to 1,105 feet, producing initially 30 barrels of 21° A. P. I. gravity oil a day. By 1937 three other wells had been completed in this formation; one was converted later to a water well. In 1937 two additional wells were completed here, each producing initially 30 barrels a day. A third well was drilled 2,805 feet to the Tensleep sandstone, but this formation contained water. The earlier wells in the field had been shut in but during 1937 were "put on production," yielding 10,463 barrels of oil during that year. A log based on drilling records and field data showed the following formations and thickness (in feet): Frontier, 240; Mowry and Thermopolis, 285; Cloverly, 100; Morrison, 210; Sundance, 450; Chugwater, 1,170; Embar, 380; Tensleep, 347; Amsden, 122; Madison, 260; Deadwood, 200; and granite.

On January 1, 1938, there were four oil wells in the Sundance formation that could produce 60 barrels of oil daily. Apparently the productive acreage in the Sundance formation is small. Analysis of the oil from the Sundance formation is given under Crude-oil Analyses (p. 171). The oil is trucked to refineries in Casper, Wyo.

SPRING CREEK

Spring Creek anticline (fig. 66, case) in Tps. 49 and 50 N., R. 102 W., Park County, includes two structural highs, the north one having an

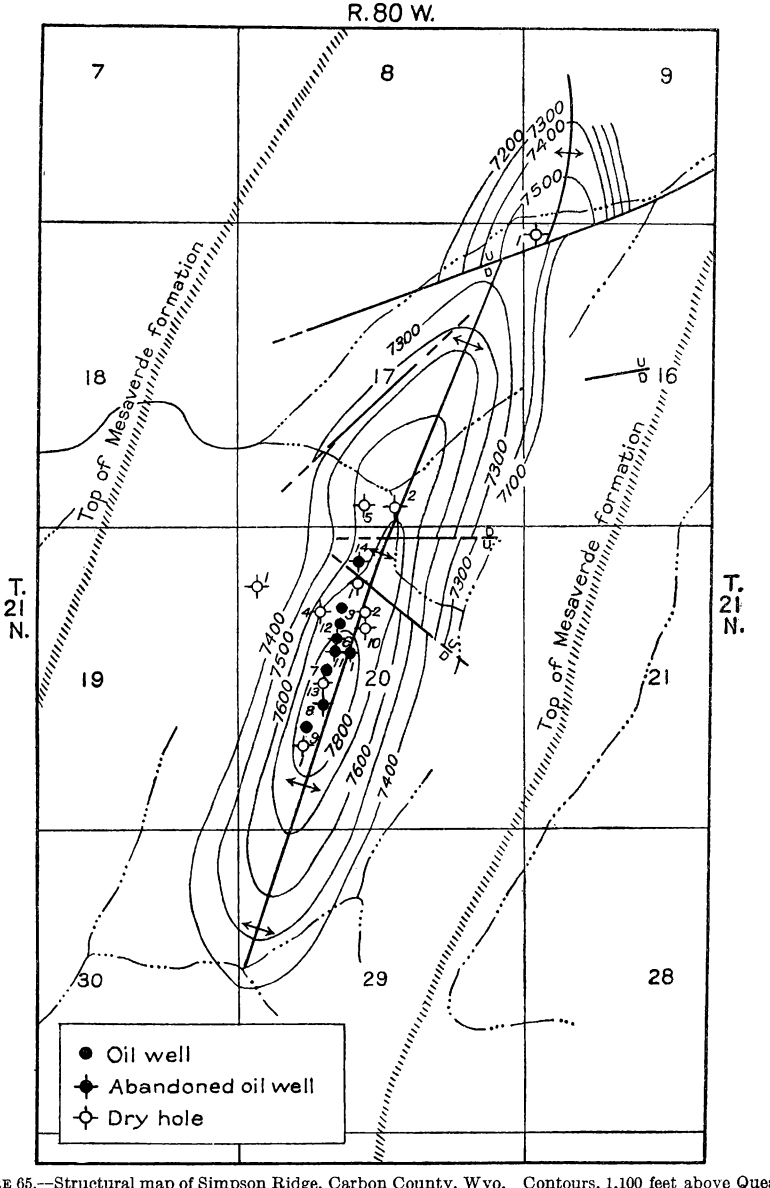


FIGURE 65.—Structural map of Simpson Ridge, Carbon County, Wyo. Contours, 1,100 feet above Quealy sand; datum, sea level; geology by E. R. Beck; well status revised November 1938.

independent closure of about 800 feet and the south one having a closure of about 600 feet. The Frontier formation is exposed at the crest of the south dome in secs. 11, 13, and 14 at an altitude of about 7,000 feet.

In 1930 a well in the SE¼SE¼ sec. 11, T. 49 N., R. 102 W., drilled on the south dome to a depth of 4,254 feet, produced oil from the Embar, Tensleep, and Amsden formations. The potential yield from the productive zones in the Embar lime at 3,657 to 3,697 feet and the Tensleep sandstone at 3,810 to 4,037 feet was about 115 barrels of oil daily, but when the hole was deepened to the Amsden formation at 4,247 to 4,253 feet the yield increased to 185 barrels of 15° A. P. I. gravity black oil. Analysis of the oil is given under Crude-oil Analyses (p. 171). Because of the lack of a market for the oil the well was mudded in. During the summer of 1937 the well again was pumped, producing as much as 220 barrels of oil a day.

A unit plan for the Spring Creek unit area was approved by the Secretary of the Interior on March 15, 1938.

SPRING VALLEY AND ASPEN

The Spring Valley oil field (fig. 67, case) in secs. 12, 14, 22, and 26, T. 15 N., R. 118 W., Uinta County, is on a monocline—the west flank of the Spring Valley anticline—which dips about 18° W. The surface formations in the area are Wasatch, Frontier, and Aspen.

The field was discovered in October 1900 incident to drilling for water at Spring Valley. However, oil seepages were known to exist in the area as early as 1847, oil from this source having been used by emigrants traveling westward. From the date of the initial discovery of oil to 1938 more than 70 wells were drilled in the area; about 30 of these were productive, yielding initially 1 to 100 barrels of oil daily. The gravity of the oil from the Frontier formation and the Aspen shales ranged from 20° to 44° A. P. I., and that from the Bear River sand was 22° A. P. I. Production in the Frontier formation came from a 5-foot sand at depths of 800 to 1,400 feet; in the Aspen shale, at depths of 500 feet (on the east) to 2,300 feet (on the west), the producing zone being 10 to 36 feet thick; and in the Bear River sand, at depths of 800 to 900 feet, the productive zone being 10 to 30 feet thick. The only deep test in the area was drilled southwest of the field in the NE¼SE¼ sec. 6, T. 14 N., R. 118 W., to a depth of 5,100 feet. Neither oil nor gas in commercial quantities was found in this well.

On July 1, 1937, the 10 wells in the field could yield a total of 25 barrels of 39° A. P. I. gravity oil daily from the Aspen shales by pumping; individual wells produced 1 to 5 barrels of oil daily. Twelve wells were shut down. Analyses of the oil from the Aspen shale and gas are given under Crude-oil Analyses (p. 172) and in table 5 (p. 116). Data on the oil produced at Spring Valley before 1912 are not available. The production from 1902 to 1912, inclusive, is estimated to be 113,174 barrels; it was never large, seldom exceeding 200 barrels a day. In 1907 a 125-barrel refinery at Spring Valley was put in operation, and in 1909 oil was shipped to Salt Lake City for refining. About 192,000 barrels of oil was produced from the field to 1938. The proved productive area was estimated to be about 150 acres.

The Aspen field is in secs. 3 and 10, T. 14 N., R. 118 W., Uinta County. As early as 1903 a well drilled in the field produced some oil. However, little was done until 1927 when a well in the NE¼NW¼ sec. 10 penetrated the Bear River formation; the reported daily

initial production was 126 barrels of oil. Three wells were completed in 1927 and 1928 in the Bear River formation at depths of 838 to 1,283 feet; the total daily initial production of the wells was 346 barrels of 22° A. P. I. gravity black oil. Analysis of the oil is given under Crude-oil Analyses (p. 125). The wells have been shut in, except when they were pumped to furnish oil for drilling operations.

SUNSHINE (NORTH AND SOUTH)

North Sunshine (fig. 68, case) is a narrow anticline at least 5 miles long, extending north and south through the center of T. 47 N., R. 101 W., Park County. The east flank dips about 30° and the west 45° to 50°. The approximate closure is 1,500 feet, the structure opening into the syncline between the North and South Sunshine structures. The Mowry shale is exposed on the surface at an altitude at the wells of 6,423 feet.

A well drilled on the anticline in 1922 had showings of oil in the Embar lime. Oil in commercial quantities, however, was not discovered until 1928 when a well in the NW¼NW¼ sec. 22 produced approximately 25 barrels of 15° A. P. I. gravity black oil daily from the Tensleep sandstone at 3,486 to 3,632 feet. The well was drilled to a depth of 3,780 feet in the Amsden formation. In 1928 it produced 3,015 barrels of oil but since then has been shut in. Analysis of the oil is given under Crude-oil Analyses (p. 172).

South Sunshine (fig. 68), an elliptical dome just south of the North Sunshine anticline, is in the center of the north half of T. 46 N., R. 101 W., Park County, and has a closure of about 3,600 feet. The flanks dip 60° to 70° E. and 20° to 30° W. The Morrison formation is exposed on the crest of the structure. In 1926 a well in lot 4, sec. 9, yielded 335 barrels of 18° to 19° A. P. I. gravity black oil daily from the Embar lime at 2,480 to 2,514 feet. Analysis of the oil is given under Crude-oil Analyses (p. 173). Production reported for 1926, 1927, and 1928 was 4,171, 5,886, and 1,616 barrels, respectively, a total of 11,673 barrels. Since 1928, except during a production test in 1936 when the well produced 300 barrels a day, the well has been shut in.

TORCHLIGHT AND LAMB

The Torchlight structure (fig. 69, case), an elliptical dome in the center of T. 51 N. on the line between Rs. 92 and 93 W., Big Horn County, lies just south of the Lamb anticline and has an independent closure of about 350 feet. The Torchlight sandstone member of the Frontier formation is exposed on the crest of the structure at an altitude range of 4,150 to 4,250 feet.

Wells were drilled as early as 1904 on the Torchlight dome, and showings of oil and gas were reported. The first oil well to develop commercial production was drilled in 1913 near the center of sec. 24; most of the drilling in the field was done in 1914, 1915, and 1916. The wells produced from two sandy zones in the Mowry shale, the upper (Kimball sand) averaging about 50 feet in thickness and the lower (Octh Louie) about 25 feet. The interval between the sands is about 45 feet. The depth to the sands ranges from 300 feet on top of the dome to 900 feet on the flanks. About 130 wells were drilled; initial daily production averaged 30 barrels of a green 46° A. P. I. gravity oil. The oil contained enough gas in solution to cause some

of the early wells on the crest to flow. The Greybull sandstone at 1,110 to 1,130 feet in wells on the crest of the dome was water bearing. In a well about 200 feet down from the crest of the structure the Sundance formation was found at 2,100 feet; Embar at 3,210 feet (containing water and a showing of oil); Tensleep at 3,550 feet (containing water and a fairly thick oil-saturated sand); Amsden at 3,640 feet; and Madison at 3,870 feet (showing about 50 feet of oil-saturated lime at 4,000 to 4,050). The Madison lime yielded an estimated flow of 10,000 barrels of water from just above the bottom (4,165 feet) of the well; this had a very low content of total solids.

By June 1938 the field virtually was abandoned; the 13 remaining wells had been shut down. Water had encroached as the sands became depleted. An incomplete analysis of the oil from the Kimball sand is given under Crude-oil Analyses (p. 174). Analyses of waters from the Amsden and Madison formations are given in table 6 (p. 118). The production of oil to 1932 was 199,284 barrels; yearly production is given in table 7 (p. 120). Based on a productive area of approximately 600 acres, the recovery of oil per acre has been 332 barrels. The oil was pumped 3 miles through a 3-inch pipe line to Basin, whence it was shipped by rail to Greybull for refining.

The Lamb anticline (fig. 69) in the north part of T. 51 N., on the line between Rs. 92 and 93 W., Big Horn County, joins the Torchlight structure, being separated from it by less than 100 feet of independent closure. The Cody shale forms the surface at an altitude of about 4,300 feet.

In 1913 a well drilled 435 feet into the Peay sand (lower sand in Frontier formation) produced about 5 million cubic feet of gas daily. Six other gas wells were developed in the Peay sand, topped at depths of 440 to 675 feet. In 1923 a well drilled into the Muddy sand at 1,370 to 1,395 feet had an initial open-flow volume of 8 million cubic feet of gas a day; the shut-in wellhead pressure was 510 pounds per square inch. In this well the Frontier formation was found at 440 to 885 feet, Mowry (Kimball sand) at 990 to 1,060 feet (water bearing), and Muddy at 1,370 feet. By June 1938 the field virtually was depleted, and all but 2 of the 19 wells had been abandoned. Analyses of the gases from the Peay and Muddy sands are given in table 5 (p. 116). The production of gas reported for 1914 to 1920, inclusive, is given in table 8 (p. 122); the total production was 1.8 billion cubic feet. The gas was used in Greybull and Basin.

WALKER DOME

Walker Dome field in secs. 4, 5, 8, and 9, T. 46 N., R. 99 W., Hot Springs County, occupies a small dome-shaped structure directly west of and adjoining the Little Grass Creek structure. The structure has about 370 feet of closure. The Mesaverde formation is exposed on the surface. In 1929 a well in the SE¼NE¼ sec. 8 produced gas from the Frontier formation at 3,130 to 3,138 feet. It was drilled 4,412 feet into the Cloverly formation, which was water bearing. The well was then completed in the Frontier formation, with an initial open-flow volume of 1.1 million cubic feet of gas daily; the shut-in wellhead pressure was 980 pounds per square inch. The well has been shut in since its completion in 1934.

WARM SPRINGS

The Warm Springs oil field (fig. 70, case) occupies two small, elongated domes—both of which are oil bearing—on the major Warm Springs anticlinal fold. The East Dome field is in sec. 31, T. 43 N., R. 93 W., and sec. 36, T. 43 N., R. 94 W., and has about 300 feet of closure; the West Dome field is in secs. 34 and 35, T. 43 N., R. 94 W., Hot Springs County, and has about 150 feet of closure. The Chugwater is the surface formation of both domes.

The first well in the field was drilled in 1916; most of the drilling was done during the following 3 or 4 years. About 58 wells were drilled to the Embar lime at depths of approximately 900 to 1,000 feet, which yielded 22° A. P. I. gravity black oil. One well drilled in 1926 on the crest of the West dome was reported to have produced initially 50 barrels of oil a day. In 1935 and 1936 a number of wells on the East dome were cleaned out, and modern pumping equipment was installed in an attempt to produce them commercially. As large volumes of water were produced with the oil, operations proved unprofitable and were suspended in the fall of 1936. The four best reconditioned wells produced about 50 barrels of oil and 2,000 barrels of water per well per day. The East Dome field was operated from 1917 to 1923, inclusive, and again in 1935 and 1936. The West Dome was operated from 1919 to 1923, inclusive, from 1929 to 1932, inclusive, and again near the end of 1936. Late in 1937 a well in the NW¼SW¼ sec. 35 was deepened to 1,416 feet into the Tensleep sandstone, but this was barren. In July 1938 a well in the NW¼NW¼ sec. 35 was completed in a second zone of oil saturation in the Embar formation at 1,061 to 1,063 feet, producing at the rate of 600 barrels a day by bailing. The production of the well settled to 100 barrels of 20.8° A. P. I. gravity oil daily.

In June 1938 there were about 18 old wells on the West dome; 13 of these had been cleaned out and were producing about 120 barrels of oil a day. The 21 wells (including the 8 that had been reconditioned in 1935 and 1936) on the East dome had been shut down. Analysis of the oil from the West dome is given under Crude-oil Analyses (p. 174). To 1938, 174,840 barrels of oil had been reported from the East dome and 173,830 barrels from the West dome, a field total of 348,670 barrels; yearly production is given in table 7 (p. 120). About 60 acres is productive in the West dome and about 120 acres in the East dome. The oil is trucked to Thermopolis, where it is refined.

WAUGH

Waugh dome, known also as Coal Draw dome and Ilo Ridge (fig. 72, case), is an elliptical dome in sec. 7, T. 44 N., R. 96 W., and secs. 1, 2, and 12, T. 44 N., R. 97 W., Hot Springs County. The Cody shale is the surface formation at an average altitude of 5,010 feet. Outcrops on the northeast flank of the structure dip about 15° and on the southwest flank about 50°. The dome has about 700 feet of closure.

Oil was discovered in December 1934 on drilling a well in the SE¼NE¼ sec. 12 to 3,807 feet in the Embar lime (topped at 3,714 feet) that produced initially 583 barrels of 28° A. P. I. gravity black oil from an oil-saturated zone at 3,780 to 3,807 feet. Earlier the Dakota sand (in a well drilled to a total depth of 1,683 feet) and the Sundance

sand (in a well drilled to a total depth of 2,355 feet) were found to be water bearing. In 1935 a well drilled 4,242 feet into the Tensleep sandstone disclosed some oil-saturated sand in the Tensleep sandstone but produced only water. In 1938 the discovery well was deepened through the Tensleep sandstone, which was water bearing; it was then abandoned. Analyses of the oil and water in the Embar are given under Crude-oil Analyses (p. 175) and in table 6 (p. 118), respectively. The production of oil to 1938 was 189,786 barrels. The oil was trucked to Thermopolis, where it was refined.

A unit plan for the development and operation of the Waugh oil and gas field was approved by the Secretary of the Interior on August 7, 1935.

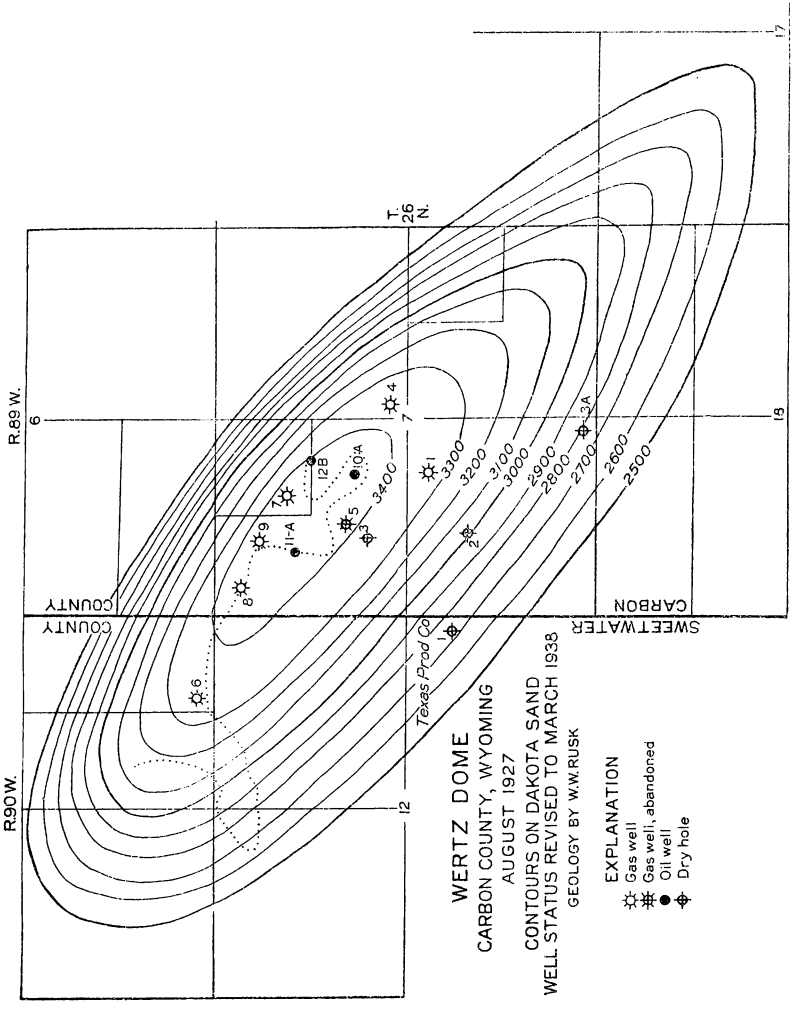
WERTZ

Wertz dome (fig. 25, case, and fig. 71), an elliptical dome in secs. 1 and 12, T. 26 N., R. 90 W., Sweetwater County, and secs. 6, 7, 17, and 18, T. 26 N., R. 89 W., Carbon County, is one of several structural highs on an anticlinal axis parallel to the Sweetwater uplift. The Steele shale forms the surface at altitudes ranging from 6,725 to 6,975 feet. The structure has about 900 feet of independent closure opening into Lost Soldier dome.

Gas was discovered on Wertz dome in 1920 on completing a well in the NE¼SW¼ sec. 7, T. 26 N., R. 89 W., in the Dakota sand at 3,427 to 3,435 feet that produced 42 million cubic feet daily and had a shut-in wellhead pressure of 1,800 pounds per square inch; the Dakota sand is 30 to 50 feet thick. A 40° A. P. I. gravity oil was obtained from the Mowry shale at 3,210 feet in this well, and the well was cased so that oil from the shale flowed to the surface between the casings. Three other wells were completed in the Dakota sand, including two that had been completed temporarily in the Frontier formation at 2,160 to 2,265 feet; the open-flow volume ranged from 6 to 7 million cubic feet of gas a day, and the shut-in wellhead pressure was 850 pounds per square inch. After producing 704 million cubic feet of gas the two wells were deepened, as only about 40 acres in the Frontier formation was productive. Initial open-flow volume of the four wells in the Dakota sand ranged from 18 to 42 million cubic feet of gas daily. In 1928 a well in the SW¼NW¼ sec. 7 produced initially 6 million cubic feet of gas a day from the Lakota sand at 3,549 to 3,610 feet; the shut-in wellhead pressure was 1,340 pounds per square inch. A second well in the Lakota sand produced 12 million cubic feet of gas a day. The Lakota sand averages 70 feet in thickness. In 1929 the Sundance formation proved gas bearing at 4,150 feet in a well in the NW¼NW¼ sec. 7, which produced initially 57 million cubic feet of gas a day; the shut-in wellhead pressure was 1,520 pounds per square inch. In 1936 oil was found in a well in the SE¼NW¼ sec. 7 at 5,872 to 5,886 feet in the Tensleep sandstone. The well flowed initially at a rate of 35 barrels an hour—840 barrels a day—of 35° A. P. I. gravity black oil. The maximum production from this well was 1,500 barrels of oil a day. In this well the Dakota sand was logged at 3,480 to 3,588 feet; Lakota sand at 3,616 to 3,630 feet; Sundance sand at 4,048 to 4,063 feet (produced water and 4 million cubic feet of gas a day); and a saturated zone in the Tensleep sandstone at 5,872 to 5,886 feet. By June 1, 1938, two other oil wells were completed in the Tensleep sandstone,

with initial daily production of 440 and 650 barrels, respectively; later these wells produced as high as 525 and 997 barrels.

On June 1, 1938, there were six gas wells (four in the Dakota, one in the Lakota, and one in the Sundance sand) and three oil wells in the field. The gas wells, except the well in the Sundance sand, had been shut in since the fall of 1937. The well in the Sundance sand was



71.—Map of Wertz dome.

producing about 1 million cubic feet of gas daily, and the three wells in the Tensleep sandstone were producing about 900 barrels of oil daily. Analyses of the gases from the Cloverly and Sundance formations and oil from the Tensleep sandstone are given in table 5 (p. 116) and under Crude-oil Analyses (p. 175), respectively. Approximately 62.6 billion cubic feet of gas was produced from the field to 1938; yearly production is given in table 8 (p. 122). The Mowry shale in the discovery well produced 8,967 barrels of oil from 1921 to 1924, inclusive, before the oil stopped flowing between the casings. The

Tensleep formation did not produce oil until 1937, when 96,732 barrels was produced. The productive area in the Dakota sand was estimated to be 500 acres; the productive area in the Sundance and Tensleep formations has not been defined.

In 1921 an 89-mile pipe line for transporting gas was laid to Casper. The line from Wertz field to Mahoney and Ferris domes was 10 inches in diameter, and from there to Casper it was 12 and 14 inches. This line was operated until the fall of 1937. Gas from the Wertz field was piped through it to Casper and also through an 8- and 10-inch line to Parco where it was used as refinery fuel. An absorption plant of 30 million cubic feet capacity was built at Casper in 1922 to process the gas. Gasoline recoveries were low (approximately 0.2 gallon per 1,000 cubic feet of gas) because the rich gas from Wertz field was diluted with the dry gas from Mahoney Dome field. In 1931 the plant at Casper was dismantled, and an absorption plant was built at the Wertz field and operated until the fall of 1937, when the Wertz gas field was shut in. The oil is transported to the Lost Soldier field and from there to Parco, Wyo., where it is refined.

A unit plan for the development and operation of the Wertz dome unit area was approved by the Acting Secretary of the Interior on November 4, 1937.

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APPENDIX

This appendix includes tables 4 to 8 and analyses of crude oils from fields in Wyoming.

Table 4 gives data on the casing programs used in drilling and completing wells in 25 fields of the State.

Table 5 presents analyses of 66 natural gases from 48 fields in the State. These analyses, with the exception of 9, which were obtained from several operating companies, the United States Geological Survey, and from published reports, were made in the gas laboratories of the Bureau of Mines helium plant, Amarillo, Tex.

Table 6 gives analyses of 62 waters from 32 fields; most of the analyses were made in the Midwest (Wyo.) laboratories of the Oil and Gas Leasing Division, Conservation Branch, Geological Survey, United States Department of the Interior.

Tables 7 and 8 are compilations of annual petroleum and natural-gas production by fields, based mainly on reports of gross production submitted by operators to the State Board of Equalization of the State of Wyoming for taxation purposes. Such reports available for examination extend back to 1912 but in the first several years were not always complete. When it was possible to do so more accurate data were obtained from other sources and are included in the tables. Table 8, production of gas, unquestionably contains low figures for some fields, especially those in which the gas was produced with oil. Most of the figures represent gas produced and sold for domestic or industrial consumption or processed for natural gasoline or carbon black. Operators seldom reported gas wasted through leakage, blown to the air, lost from wells out of control, and used in the field to develop power for drilling and lease operations, nor did they keep accurate records of that gas. In several fields some gas was recycled, but only for the Salt Creek field would the volumes of original gas differ greatly from those given. Table 3 (p. 93) gives more detailed data on the volume of gas produced in the Salt Creek field.

Most of the analyses of 104 crude oils from 67 fields were made at the Bureau of Mines Petroleum Experiment Station, Laramie, Wyo.; 19 analyses were made in the Midwest (Wyo.) laboratories of the Oil and Gas Leasing Division, Conservation Branch, Geological Survey.

TABLE 4.—*Casing programs, active fields in Wyoming*[1]

Field	Formation	Type of drilling	Old style		A. P. I.		Old style		A. P. I.		Old style		A. P. I.		Old style		A. P. I.		Old style		A. P. I.				A. P. I. or old style	
			20 inches	Sacks of cement	16 inches	Sacks of cement	15½ inches	Sacks of cement	13⅜ inches	Sacks of cement	12¼ inches	Sacks of cement	10¾ inches	Sacks of cement	10 inches	Sacks of cement	8⅝ inches	Sacks of cement	8¼ inches	Sacks of cement	7⅝ inches	Sacks of cement	7 inches	Sacks of cement	6⅝ inches	Sacks of cement
Allen Lake	Sundance	Cable					300	50			1,500	300	1,700	75					1,900	45						
		Rotary									300	120									2,100	300				
Badger Basin	Frontier	do							250	60							3,600	200					8,200	1,000		
Baxter Basin (North)	Dakota	Cable					100	25					2,600	150			3,100	100								
		Rotary					300	200									3,100	400								
Do	Sundance	Cable					100	25					2,600	150									3,600	100		
		Rotary					300	200															3,600	300		
Baxter Basin (South)	Frontier	Cable					200	50	700	50							2,600	75								
Do	Dakota	do					200	50	700	50													3,600	75		
Big Sand Draw	Frontier	do	20	10							600	100	1,900	250			2,300	75								
		Rotary									600	200					2,300	175								
Billy Creek	do	do									195	100							3,200	500						
Black Mountain	Embar	Cable	40	30	800	60					1,300	50	1,600	60			2,050	50					2,900	75		
Byron	Embar-Tensleep	Rotary									400	150											5,100	750		
Frannie	Tensleep	Cable	40	30							1,300	100	2,150	60			2,700	100								
		Rotary									300	100					2,700	350								
Garland	Madison	do									600	175					[2]2,600	300					3,800	100		
Grass Creek	Embar[3]	Cable	40	30	500	100					1,100	175	2,100	100			2,800	50					3,650	75		
		Rotary									1,100	300											3,650	200		
Hamilton Dome	do	Cable									200	20	1,300	100			2,400	125								
Hiawatha	Wasatch	do					118	150			1,000				1,568	100			1,998	100					2,100	100
		Rotary									200	100					2,800	250								
Hidden Dome	Frontier	Cable											40	30			1,500	60								
LaBarge	Almy	do									40	15			350	(4)			700	(4)					1,000	50
Lance Creek	Sundance	Rotary							200	200													3,800	400		
Do	Minnelusa	do							200	200													5,200	600		
Lost Soldier	Tensleep[3]	do									200	200											4,100	500		
Medicine Bow	First Sundance	do							500	300													5,400	1,000		
Oregon Basin	Embar	Cable	40	30	700	100					1,200	75	1,800	75			2,400	100					3,250	75		
		Rotary									100	50											3,250	250		
Osage	Muddy	Cable																	400	10					1,500	
Quealy Dome	Dakota	Rotary					200	100															3,400	300		
Rock River	Sundance	do							200	200													3,100	400		
Salt Creek	Tensleep[3]	do	77	50			1,022	50							3,147	405	3,775	100								
Spindletop	Sundance	Cable													80	50							1,100	75		
Wertz	Tensleep	Rotary					400	200															5,900	600		

[1] Prepared by Geological Survey, U. S. Department of the Interior, Casper, Wyo., December 1937.
[2] In areas where there are no shallow wells 8⅝-inch casing may not be required.
[3] Upper sands drilled.
[4] Pulled.

TABLE 5.—*Analyses of natural gases from Wyoming oil and gas fields* [1]

Field	Producing zone	Date sampled	Analysis					
			Carbon dioxide, percent	Oxygen, percent	Methane equivalent, percent	Ethane equivalent, percent	Nitrogen, percent by difference	Total heating value, B. t. u. per cubic foot [2]
Alkali Butte	Dakota	August 1930	0.4	0.1	95.1	4.3	0.1	1,042
Allen Lake	Morrison	June 1924	.0	.0	97.4	.0	2.6	989
Do	Sundance [3]	December 1933	.5	.2	92.3	3.6	3.4	1,001
Allen Lake (East)	do. [3]	December 1936	1.9	.2	92.9	3.7	1.3	1,009
Badger Basin	Frontier		.4	.4	36.8	59.2	3.2	1,434
Baxter Basin (North)	do	July 1930	.2	.1	89.8	.7	9.2	924
Do	Dakota	do	.5	.7	96.2	.3	2.3	981
Do	Sundance	do	1.5	.0	98.4	.0	.1	999
Baxter Basin (South)	Frontier	do	.8	.1	92.8	4.2	2.1	1,017
Do	Dakota	do	[4] 1.1	.0	70.9	1.1	26.9	[5] 740
Big Muddy	Wall Creek	May 1924	.7	.3	78.8	20.1	.1	1,160
Big Sand Draw	Frontier	July 1930	1.1	.1	97.2	1.5	.1	1,014
Do	Cloverly	September 1932	.3	.7	84.0	11.4	3.6	1,057
Billy Creek	Second Wall Creek	August 1930	.2	.2	97.5	.0	2.1	990
Bison Basin	Frontier	August 1924	2.8	.3	87.9	6.9	2.1	1,016
Black Mountain	Embar	August 1930	[4] 6.2	.6	86.1	5.5	1.6	[5] 972
Boone Dome	Sands in Steele shale	May 1924	.0	.0	84.1	15.7	.2	1,135
Byron	Frontier [6]	October 1925	.5	.4	82.1	16.9	.1	1,136
Dallas Dome	Embar	August 1930	.7	.0	32.8	64.7	1.8	1,491
Dutton Creek	Shannon [3]	January 1934	.0	.0	100.0	.0	.0	1,012
Elk Basin	Cloverly	August 1930	.3	.1	77.5	19.7	2.4	1,140
Enos Creek	Frontier	do	.1	.0	99.6	.0	.3	1,011
Ferris	Cloverly [6]	April 1920	.2	.0	96.8	2.8	.2	1,033
Garland	Frontier [6]	October 1925	1.3	.7	84.3	12.7	1.0	1,083
Do	Cloverly [6]	August 1930	.2	.2	77.7	18.9	3.0	1,127
Do	Embar and Tensleep	do	[4] 1.2	.1	90.5	6.2	2.0	[5] 1,030
Do	Madison	September 1931	[4] 1.2	.1	83.5	9.7	5.5	[5] 1,022
Golden Eagle	Mesaverde [6]	September 1925	.4	.5	96.1	.0	3.0	975
Greybull	Greybull [3]	1912	.2	.0	81.7	17.4	.7	1,140
Hatfield Dome	Thermopolis (Muddy)	July 1930	.8	.1	96.7	.0	2.4	982
Do	Dakota	June 1924	1.0	.6	98.3	.0	.1	998
Hiawatha	Wasatch [3]		.9	1.1	77.8	18.2	2.0	1,116
Do	do. [3]		.3	.0	95.8	4.7	.2	1,056
Hidden Dome	Frontier	August 1930	.6	.0	98.7	.3	.4	1,007
Iron Creek	Dakota	July 1930	5.5	.1	85.5	8.8	.1	1,028
LaBarge	Almy [6]	September 1930	.8	.3	66.9	31.3	.7	1,239
Lamb	Peay [3]	1914	.4	.0	93.5	3.5	2.6	1,012
Do	Cloverly	August 1930	.2	.1	85.9	4.0	9.8	944
Lance Creek	Dakota	do	.6	.1	69.9	25.0	5.2	1,157
Do	Lakota	do	.5	.1	71.0	28.3	.1	1,226
Little Buffalo Basin	Frontier [6]	do	.2	.1	83.9	12.6	3.2	1,077
Little Grass Creek	do	do	.1	.2	88.7	1.5	9.5	927
Lost Soldier	do	July 1930	8.6	.0	81.3	9.1	1.0	988
Do	Thermopolis (Muddy)	do	7.2	.1	32.8	19.3	40.6	678
Do	Lakota	do	5.7	.1	91.1	3.0	.1	979
Mahoney Dome	Cloverly	do	1.9	.1	90.5	5.3	2.2	1,014
Do	Sundance [3 7]	November 1935	1.0	.0	98.1	.9	.0	1,012
Medicine Bow	Sundance (First) [3 7]	1936	.0	.0	69.0	31.0	.0	1,255

See footnotes at end of table.

TABLE 5.—*Analyses of natural gases from Wyoming oil and gas fields*—Con.

Field	Producing zone	Date sampled	Analysis					
			Carbon dioxide, percent	Oxygen, percent	Methane equivalent, percent	Ethane equivalent, percent	Nitrogen, percent by difference	Total heating value, B. t. u. per cubic foot
Mule Creek (West)	Minnelusa	April 1934	0.0	0.1	22.6	16.9	60.4	532
Muskrat	Frontier	August 1930	.2	.0	97.5	.2	2.1	994
Naval Reserve No. 3	Second Wall Creek	May 1924	.7	.6	76.5	21.4	.8	1,159
North Casper Creek	Thermopolis (Muddy)	August 1930	.2	.1	65.6	15.6	18.5	945
Oregon Basin	Cloverly	do	.1	.0	86.6	10.1	3.2	1,060
Do	Embar and Tensleep [6]	do	.8	.1	82.7	14.3	2.1	1,095
Osage	Newcastle [3]	April 1931	.2	.1	60.7	38.4	.6	1,303
Polecat (Big)	Frontier [6]	October 1925	.2	.5	85.1	13.6	.6	1,107
Polecat (Little)	do. [6]	do	.5	.6	94.8	3.0	1.1	1,016
Poison Spider	Sundance [6]	July 1930	.2	.1	70.8	26.8	2.1	1,199
Rex Lake	Shannon	August 1930	.2	.0	99.7	.0	.1	1,012
Rock River	Cloverly	do	.3	.1	2.5	93.6	3.5	1,700
Salt Creek	Second Wall Creek [3 7]	1925	.5	.0	[8] 5.5	94.0	.0	1,824
Do	Lakota	January 1925	1.4	.7	75.3	21.6	1.0	1,125
South Casper Creek	Sundance	July 1930	1.2	.5	90.2	6.3	1.8	1,029
Spring Valley	Aspen	September 1930	1.0	.3	54.3	42.1	2.3	1,305
Wertz	Cloverly [6]	July 1930	1.8	.2	86.0	9.5	2.5	1,043
Do	Sundance	August 1930	.0	.1	99.8	.0	.1	1,013

[1] The data in this table, unless otherwise noted, were obtained from a report on analyses of natural gases in the western part of the United States, being prepared for publication by C. C. Anderson, Bureau of Mines, Amarillo, Tex. When published, Anderson's report may be consulted for additional analyses and more detailed data. Analyses were made by the absorption and combustion method, except for 3 samples (see footnote 7).

[2] Computed for gas, free from water vapor, at 60° F. and 30 inches of mercury, absolute.

[3] Analyses from sources other than the report by C. C. Anderson.

[4] Includes hydrogen sulfide.

[5] Excludes hydrogen sulfide.

[6] Average of 2 samples.

[7] Analyses by fractional distillation, hydrocarbon percentages changed to equivalents according to the method described by Walter J. Podbielniak, Apparatus and Methods for Precise Fractional-Distillation Analysis: Ind. and Eng. Chem., anal. ed., vol. 3, April 15, 1931, pp. 177–188.

[8] Propane equivalent.

TABLE 6.—*Analyses of Wyoming oil-field waters* [1]

Field	Formation	Parts per million								Reacting value, percent					
		Sodium and potassium	Calcium	Magnesium	Sulfate	Chloride	Carbonate	Bicarbonate	Total solids	Sodium and potassium	Calcium	Magnesium	Sulfate	Chloride	Carbonate bicarbonate
Alkali Butte	Frontier	5,576			29	5,929	(2)	4,560	16,094	50.0			0.1	34.5	15.4
Big Muddy	Shannon	5,556	130	48	95	8,558		533	14,920	47.9	1.3	0.8	.4	47.9	1.7
Do	Second Wall Creek	2,992				2,595	109	3,260	8,956	50.0				28.1	21.9
Do	Sundance	1,492			1,330	686	37	1,015	4,560	50.0			21.3	14.9	13.8
Black Mountain	Embar	7,500	488	266	7,821	3,354		7,020	26,449	43.8	3.3	2.9	21.9	12.7	15.4
Do	Tensleep	70	78	20	92	12		385	657	17.7	22.7	9.6	11.2	2.0	36.8
Bolton Creek	Dakota	226			143	32	18	325	744	50.0			15.2	4.6	30.2
Derby Dome	Embar	373	220	43	1,178	12		355	2,181	26.3	17.9	5.8	40.0	.5	9.5
Dutton Creek [3]	Dakota(?) and Lakota	665	(2)	(2)	186	47	186	1,074	2,158	50.0			6.6	2.3	41.1
Ferris [3]	Embar and Tensleep	362	620	98	2,357	20		310	3,767	14.3	28.3	7.4	44.8	.5	4.7
Frannie [3]	Dakota	419	(2)		329	43	39	533	1,363	50.0			19.0	3.3	27.7
Do	Tensleep	585	256		846	674		78	2,439	33.3	16.7		23.3	25.3	1.4
Do	Tensleep near fault	51	760	240	2,303	27		691	4,072	1.9	31.7	16.4	39.7	.7	9.6
Do	Madison		640	110	1,780	8		235	2,773		39.0	11.0	45.2	.2	4.6
Garland	do	400	530	138	1,626	734		37	3,465	15.7	24.0	10.3	30.7	18.8	.5
Grass Creek [3]	Frontier	1,087	5	2	6	256	1,211		2,567	49.6	.3	.1	.1	7.6	42.3
Do	Chugwater	1,320	244		2,003	643		574	4,784	41.7	8.3		30.0	13.2	6.8
Do	Embar	10,364	1,452	393	5,160	15,765		198	33,332	40.5	6.6	2.9	9.6	40.1	.3
Hamilton Dome	do	3,673	338	75	4,159	2,970		760	11,975	43.7	4.6	1.7	23.7	22.9	3.4
Iron Creek	Dakota	583	18	6	61	21	166	1,175	2,030	47.4	1.7	.9	2.4	1.1	36.5
Kirby Creek	Frontier	303			384	5	24	255	971	50.0			30.5	.5	19.0
Lance Creek	Dakota	1,295				324		2,880	4,499	50.0				8.1	41.9
Do	Basal Sundance	1,892	101	26	3,138	473	(2)	660	6,290	46.0	2.8	1.2	36.5	7.5	6.0
Lander	Embar	117	109	28	256	38		390	938	19.8	21.2	9.0	20.8	4.2	25.0
Do	Tensleep	111	38	(2)	38	67		245	499	35.8	14.2		5.9	14.1	30.0
Little Buffalo Basin [3]	Frontier	3,062	24	(2)	58	3,576	(2)	1,977	8,697	49.6	.4		.4	37.2	12.4
Lost Soldier	Dakota	1,781				1,119	(2)	2,800	5,700	50.0				20.4	29.6
Do	Lakota	3,909				3,202	(2)	4,870	11,981	50.0				26.5	23.5
Do	Sundance	2,509			193	2,333	838	695	6,568	50.0			1.8	30.1	18.1
Maverick Springs [3]	Tensleep	15	224	87	469	36		457	1,288	1.0	29.9	19.1	26.5	3.0	20.5
Medicine Bow	Second Sundance	733			447	221	50	890	2,341	50.0			14.6	9.8	25.6
Midway	Shannon [3]	1,600	10	5	17	1,300	1,001		3,933	49.5	.3	.2	.3	26.0	23.7
Do	Second Wall Creek	2,573			156	2,609		2,140	7,478	50.0			1.4	32.9	15.7
Mule Creek	Dakota	304			233	44	59	315	955	50.0			18.3	4.7	27.0
North Casper Creek [3]	Sundance	1,275	4		1,880	304		495	3,958	49.8	.2		35.1	7.6	7.3
Notches Dome	Dakota	616			823	33	24	480	1,976	50.0			32.1	1.7	16.2
Do	Tensleep [4]	264	208	77	882	122		392	1,945	20.3	18.4	11.3	32.5	6.1	11.4
Oregon Basin	Frontier	606				105	72	1,280	2,063	50.0				5.6	39.8
Do	Embar	1,439	564	166	3,154	395		1,685	7,403	30.0	13.5	6.5	31.4	5.3	13.3

See footnotes at end of table.

Osage	Greenhorn	5,369	28		925	7,333	24	490	14,169	49.7	.3		4.1	44.0	1.9
Pilot Butte[3]	Frontier	1,688	24	57		1,395	(2)	2,472	5,636	46.3	.8	2.9		24.6	25.4
Poison Spider[4]	Dakota	427	9	4	627	11	31	301	1,410	48.2	1.0	.8	33.8	.8	15.4
Do	Sundance	745			41	196		1,588	2,570	50.0			.9	8.5	40.6
Rock River	Cloverly	6,174				9,018	84	695	15,971	50.0				47.4	2.6
Do	Sundance	744			272	152	210	940	2,318	50.0			8.8	6.6	34.6
Salt Creek and Naval Reserve No.3[5]	Shannon	1,256	22	27	1,350	289	292	733	3,969	47.1	1.0	1.9	24.2	7.0	18.8
	First Wall Creek	2,150	8	9	14	567	196	4,413	7,357	49.4	.2	.4	.2	8.6	41.3
Do	Second Wall Creek	4,680	17	14	68	4,930	354	3,934	13,997	49.5	.2	.3	.3	33.9	15.8
Do	Third Wall Creek	6,382	23	14	39	8,198	143	2,629	17,428	49.6	.2	.2	.1	41.4	8.5
Do	Muddy	3,232	10		82	3,250	4	2,920	9,498	49.8	.2		.6	32.7	16.7
Do	Dakota	4,420	65	20	240	6,008	14	1,257	12,024	49.1	.4	.5	1.7	44.1	4.2
Do	Lakota	1,158	17	5	10	422	70	2,287	3,969	48.8	.8	.4	.2	11.5	38.3
Do	Morrison	4,580	36	24	334	6,361		1,049	12,384	49.1	.4	.5	1.7	44.1	4.2
Do	Sundance	3,300	70	33	1,284	3,675		1,179	9,541	47.9	1.2	.9	8.9	34.6	6.5
Do	Tensleep	518	233	115	678	821		374	2,739	25.8	13.3	10.9	16.3	26.6	7.1
South Casper Creek[4]	Dakota	296	(2)	(2)	333	22	30	265	946	50.0			26.7	2.3	21.0
Do	Morrison	6,140	245	146	12,946	753			20,230	45.8	2.1	2.1	46.3	3.7	
Do	Sundance	964	29		281	1,347	25		2,646	48.6	1.4		5.0	44.0	1.0
Do	Tensleep	331	660	139	2,151	310		323	3,914	12.3	27.9	9.8	37.9	7.8	4.5
Torchlight	Base of Amsden	20	58	23		9		330	440	7.8	25.5	16.7		2.2	47.8
Do	Madison	54	46		47	4	(2)	215	366	25.1	24.9		10.6	1.2	38.2
Waugh	Embar	905	173	65	1,376	340		915	3,774	36.9	8.1	5.0	26.9	9.0	14.1

[1] Unless otherwise indicated, analyses by Midwest (Wyo.) Laboratory, Oil and Gas Bearing Division, Conservation Branch, Geological Survey, U. S. Department of the Interior.
[2] Trace.
[3] Coffin, R. Clare, and DeFord, Ronald K., Waters of the Oil- and Gas-Bearing Formations of the Rocky Mountains: Problems of Petroleum Geology, 1934, pp. 927-952.
[4] Parks, E. M., Water Analyses in Oil Production and Some Analyses from Poison Spider, Wyoming: Bull. Am. Assoc. Petrol. Geol., vol. 9, 1925, pp. 927-946.
[5] Stabler, Herman, Waters of the Salt Creek-Teapot Dome Uplift: Geol. Survey Prof. Paper 163, 1931, pp. 38-62. Parts-per-million figures were averaged from tables in reference.

TABLE 7.—*Production of petroleum in Wyoming, by fields and years, barrels*

[Unless otherwise noted, from reports to the Wyoming State Board of Equalization]

Field	To and including 1912	1913	1914	1915	1916	1917	1918
Big Muddy					12,951	759,458	2,969,826
Dallas Dome	[1] 125,000	29,693	29,055	18,550	24,918	21,148	13,600
Elk Basin (Wyoming only)					656,222	1,340,295	926,578
Elk Basin [2] [3]					701,222	1,440,295	995,578
Garland	[1] 78,000	48,134	84,159	46,250	7,535		11,178
Grass Creek				[2] 99,000	[2] 1,370,000	[2] 2,756,000	[2] 2,951,000
Greybull				[2] 23.470	[1] 35,567	[1] 19,201	16,833
Hamilton Dome							86
Lance Creek							473
Lander				3,600	48,734	8,181	60,706
Lost Soldier						3,554	100,566
Maverick Springs							528
Pilot Butte					3,927	2,500	53,964
Rock River							7,192
Salt Creek [2]	1,209,697	2,254,946	3,379,329	3,936,328	4,000,433	3,840,502	5,512,993
Spring Valley	[1] 113,174	[1] 14,000	[2] 13,387	[2] 7,036	[2] 7,521	[2] 4,234	2,850
Torchlight				[2] 57,526	[1] 94,495	[1] 18,605	8,507
Warm Springs						713	36,894
Others [4]	[2] 104,446	[1] 7,068	[1] 9,714	[1] 7,083		3,500	
Total	1,630,317	2,353,841	3,515,644	4,198,843	6,262,303	8,777,891	12,673,774

Field	1919	1920	1921	1922	1923	1924	1925
Big Muddy	3,606,606	2,077,587	1,889,845	1,494,073	1,492,378	1,325,870	1,206,517
Black Mountain							6,842
Bolton Creek		1,340	5,235	3,472			18,311
Dallas Dome	15,185	45,047	68,321	85,871	48,771	36,362	47,238
Derby Dome				27,425	22,607	10,936	10,265
Elk Basin (Wyoming only)	740,669	804,728	730,285	731,130	646,781	407,330	298,508
Elk Basin [2] [3]	830,669	901,728	805,463	778,141	674,866	431,349	319,794
Ferris	[2] 2,390	[2] 10,088	18,060	18,597	62,130	32,574	27,678
Garland	17,590	42,442	52,053	50,542	33,929	20,997	19,810
GP	4,465	13,163	68,532	22,425	15,088	5,303	4,905
Grass Creek	[2] 2,049,000	[2] 1,573,000	[2] 1,435,000	[2] 1,784,000	[2] 1,589,000	[2] 1,113,000	1,287,964
Greybull	28,497	20,337	24,839	16,461	13,460	10,685	8,958
Hamilton Dome	4,350	83,743	51,735	105,625	197,785	252,996	261,058
Kirby Creek	4,971	2,298		1,171	292		
LaBarge							5,730
Lance Creek	464,490	257,994	342,702	224,473	361,299	754,593	361,395
Lander	73,336	53,173	54,322	39,222	58,654	42,065	51,136
Lost Soldier	174,431	206,902	380,811	695,402	1,538,468	1,902,183	1,849,864
Mahoney Dome				368	191	142	
Maverick Springs	2,719		2,192	20,134	1,595		14,035
Mule Creek	12,083	183,249	63,973	165,363	1,770	187,215	122,690
Naval Reserve No 3				37,243	[2] 1,136,948	1,003,757	632,702
Notches Dome					48,092	23,827	38,923
Osage [2]		21,192	167,526	141,707	193,564	150,226	142,424
Pilot Butte	125,931	67,634	39,906	38,770	29,435	28,742	24,930
Poison Spider				2,193	309	13,920	24,483
Rex Lake						2,307	16,644
Rock River	288,641	1,420,082	1,628,855	1,725,265	1,428,518	1,174,184	1,085,398
Salt Creek [2]	6,208,716	10,255,410	12,378,689	19,261,116	35,301,607	30,831,704	21,590,606
Simpson Ridge							21,281
Spring Valley	2,164	1,880	2,551	1,897	2,243	792	878
South Casper Creek					86,010	175,917	176,834
Torchlight	5,621	3,784	3,005	1,568			
Warm Springs	74,747	42,914	46,083	33,634	6,576		
Wertz			5,191	2,729	495	552	
Others [4]	1,078	1,492	5,084	4,920	3,150		1,078
Total	13,907,680	17,189,479	19,464,795	26,736,796	44,321,145	39,508,179	29,359,085

See footnotes at end of table.

TABLE 7.—*Production of petroleum in Wyoming, by fields and years, barrels*—Con.

Field	1926	1927	1928	1929	1930	1931	1932
Badger Basin						10,016	17,339
Big Muddy	1,194,993	1,063,659	956,208	799,506	708,486	647,801	622,382
Black Mountain	5,688	7,581	516	1,988			
Bolton Creek	6,021	1,803	2,694				
Byron				7,252	29,855	1,602	44,661
Dallas Dome	37,004	75,394	85,662	64,463	89,996	153,150	156,029
Derby Dome	13,295	9,284	9,678	10,750	33,498	66,003	55,690
Dutton Creek		7,390	13,851	11,945	21,457	28,625	16,967
Elk Basin (Wyoming only)	222,599	223,084	251,895	260,556	259,883	229,912	170,277
Elk Basin [2 3]	241,053	240,284	269,769	279,398	275,922	246,000	183,448
Ferris	17,115	15,163	16,105	11,211	9,717	8,536	8,607
Frannie				75,509	120,935	253,006	199,391
Garland	14,131	19,555	12,787	12,639	11,894	28,314	275,025
GP	7,228	6,925	5,192	3,004	3,773	1,468	1,492
Grass Creek	1,079,201	972,545	860,168	782,708	728,613	741,174	780,052
Greybull	7,496	6,482	4,648	3,552	2,989	4,267	4,129
Hamilton Dome	289,008	323,154	295,059	329,480	250,909	100,131	281,512
Hidden Dome							516
Iron Creek	8,944					1,660	
Kirby Creek							356
LaBarge	31,053	328,229	464,845	792,987	744,714	481,524	387,344
Lance Creek	537,296	265,353	199,750	84,226	59,596	93,938	34,030
Lander	79,052	129,218	112,547	94,512	103,126	132,142	162,982
Lost Soldier	1,982,474	1,294,188	1,402,584	1,261,515	1,224,333	1,318,492	874,456
Mahoney Dome					1,706	1,474	
Maverick Springs	968	455	2,298				
Midway							27,489
Mule Creek	563	186,399	141,340	135,434	23,171		1,558
Mule Creek (West)						6,480	11,012
Naval Reserve No. 3	425,685	[2] 312,892	4,400	9,880	9,150	7,220	6,645
Notches Dome	33,600	24,108					
Oregon Basin		5,122	823,934	1,519,390	1,247,579	395,057	131,381
Osage [2]	124,944	121,419	146,216	182,629	385,000	419,000	394,000
Pilot Butte	18,815	17,423	16,642	15,550	15,662	13,338	11,261
Poison Spider	2,413	21,480	33,022	79,563	84,775	73,152	73,093
Rex Lake	53,084	43,546	17,677	36,125	5,580		1,316
Rock River	1,020,900	972,177	921,844	834,270	769,910	675,883	473,073
Salt Creek [2]	17,974,624	14,352,791	14,041,031	11,312,094	10,514,845	8,845,372	7,890,973
Shoshone		1,700	1,399	2,505	7,892	665	228
Simpson Ridge	57,117	24,477	23,936	20,566	16,990	4,994	
Spring Valley	2,160	918	[1] 1,500	[1] 1,500	[1] 1,500	[1] 1,500	[1] 1,500
South Casper Creek	246,651	218,994	313,831	326,112	180,191	120,223	30,636
Torchlight		757	1,452	2,130	1,051	783	
Warm Springs				13,891	30,470	4,809	2,685
Others [4]	12,269	9,835	18,854	2,656	3,588	8,563	2,496
Total	25,506,391	21,063,500	21,203,565	19,102,098	17,702,834	14,880,274	13,152,583

Field	1933	1934	1935	1936	1937	Total	[5] 1938
Badger Basin	15,998	14,381	12,408	16,032	65,278	151,452	50,491
Big Muddy	648,835	630,415	569,075	520,418	486,392	25,683,281	440,920
Black Mountain		[2] 48,998	[2] 72,290	[2] 42,485	[2] 47,718	234,106	[2] 39,369
Bolton Creek		1,837			2,622	43,335	
Byron	14,856	112,847	373,946	[2] 291,095	[2] 405,371	1,281,485	[2] 540,633
Dallas Dome	163,691	165,543	186,117	118,577	183,962	2,088,347	181,463
Derby Dome	45,333	38,920	35,754	32,189	30,553	452,180	28,706
Dutton Creek	32,447	25,754	20,889	18,968	18,512	216,805	18,503
Elk Basin (Wyoming only)	191,708	186,126	105,708	170,151	114,240	9,668,665	93,486
Elk Basin [2 3]	208,940	202,393	113,891	181,830	123,234	10,445,267	100,716
Ferris	5,928	5,656	6,454	5,491	190	281,690	
Frannie	88,582	600,185	167,699	428,691	449,954	2,383,950	526,596
Garland	220,048	318,074	566,332	547,113	909,363	3,447,894	762,346
GP	1,488	1,579	2,188	1,710	1,326	171,254	1,717
Grass Creek	274,501	366,304	729,916	568,768	653,968	26,544,882	511,277
Greybull	4,151	3,734	3,781	3,286	2,927	269,750	2,522
Hamilton Dome	226,312	304,479	434,614	374,008	418,935	4,684,979	[2] 277,823
Hidden Dome	3,193	643	14,493	51,031	115,961	185,837	40,404
Iron Creek	767	2,990	1,916	3,204	1,752	21,233	5,674
Kirby Creek	1,485	2,068	2,554	2,650	2,410	20,255	3,690
LaBarge	348,942	444,155	454,935	420,911	379,372	5,284,741	352,397
Lance Creek	77,871	125,696	751,225	1,973,060	4,240,311	11,209,771	4,938,935
Lander	118,469	106,794	[2] 112,890	[2] 107,605	[2] 112,778	1,865,244	[2] 96,548
Lost Soldier	613,071	577,599	549,862	461,318	456,654	18,868,727	618,979
Mahoney Dome						3,881	19,998
Maverick Springs	11	14	14	28	5,499	50,490	28
Medicine Bow				163,129	1,190,965	1,354,094	1,016,972
Midway	26,287	21,063	17,644	10,791	6,171	112,445	11,316
Mule Creek	995	8,550	7,538	9,470	29,954	1,281,315	71,602
Mule Creek (West)	8,331	8,527	9,112	11,711	10,578	65,751	8,918

See footnotes at end of table.

TABLE 7.—*Production of petroleum in Wyoming, by fields and years, barrels*—Con.

Field	1933	1934	1935	1936	1937	Total	[5] 1938
Naval Reserve No. 3	6,037	5,378	5,280	4,840	3,840	3,611,897	4,100
Notches Dome						168,550	
Oregon Basin	268,442	776,171	1,134,179	936,115	1,438,065	8,675,435	1,142,274
Osage [2]	297,000	264,000	288,000	268,400	282,777	3,990,024	290,200
Pilot Butte	5,072	3,723	4,215	359	9,163	546,962	9,200
Poison Spider	69,003	49,938	47,033	78,471	87,322	740,170	78,039
Quealy Dome				80,147	268,499	348,646	270,879
Rex Lake	3,943	9,036	10,647	1,164	5,270	206,339	1,499
Rock River	458,683	540,400	544,165	606,444	724,267	17,300,151	635,231
Salt Creek [2]	7,154,059	6,566,075	6,318,958	6,020,102	5,915,683	276,868,683	5,683,908
Shoshone	842	632	372	285	189	16,709	12,561
Simpson Ridge				[2] 6,200	[2] 3,800	179,361	[2] 372
Spring Valley	[1] 1,500	[1] 1,500	[1] 1,500	[1] 1,500	[1] 1,500	192,685	[1] 1,500
South Casper Creek	114,717	132,440	95,321	116,412	136,653	2,470,942	74,711
Torchlight						199,284	
Warm Springs			28,538	13,817	12,899	348,670	37,963
Waugh			83,821	15,974	89,991	189,786	2,825
Wertz					96,732	105,699	388,811
Others [4]	553			375	10,657	218,459	35,461
Total	11,513,151	12,472,222	13,771,383	14,504,495	19,434,023	434,206,291	19,330,846

[1] Estimated.
[2] Data from other sources.
[3] Wyoming and Montana production (not included in totals).
[4] Includes: Alkali Butte, Ant Hills, Circle Ridge, Cole Creek, Dewey Dome, Douglas, Fourbear, Lake Creek, Moorcroft, North Casper Creek, Pine Mountain, Plunkett, Rocky Ford, Shannon, Spindletop, Sunshine (North and South), and Upton-Thornton.
[5] Added after completion of manuscript and not included in totals.

TABLE 8.—*Production of natural gas in Wyoming, by fields and years, M cubic feet*

[Unless otherwise noted, from reports to the Wyoming State Board of Equalization]

Field	To and including 1912	1913	1914	1915	1916	1917	1918
Elk Basin							54,744
Garland					[1] 75,000	169,165	4,114,484
Grass Creek							18,774
Greybull [3]	221,807	24,784	30,567	21,448			
Lamb			[2] 18,757	[2] 78,827	[2] 632,626	[2] 600,424	183,000
Salt Creek [2]	1,189,900	2,229,500	3,331,800	3,896,900	3,921,200	3,788,400	5,441,200
Total	1,411,707	2,254,284	3,381,124	3,997,175	4,628,826	4,557,989	9,812,202

Field	1919	1920	1921	1922	1923	1924	1925
Baxter Basin (South)						[2] 58,537	[2] 127,793
Big Muddy				25,697	11,424	14,531	11,509
Big Sand Draw		1,062	7,944	188,049	2,368,468	2,381,349	2,209,571
Boone Dome					21,626	329,514	434,331
Byron		278,995	85,865				199,936
Elk Basin	135,852	246,734	299,221	1,173,807	969,937	575,418	750,157
Ferris and Middle Ferris		810,000	657,661	1,178,528	[2] 686,804	372,899	549,798
Ferris (West)				327,987	1,588,512	3,463,042	1,323,853
Garland	5,882,192	5,176,781	950,637	869,473	[2] 837,184	565,497	780,566
Golden Eagle		85,000	154,000	405,933	804,510	770,415	178,748
Grass Creek	109,214	61,273	48,260	44,259	349,563	155,660	140,513
Hatfield Dome						1,017,716	1,572,024
Hidden Dome		662,831	1,842,954	4,796,421	4,103,470	3,698,284	2,821,264
Lamb	223,378	82,199					
Lance Creek				661,047	815,594	813,859	587,846
Little Buffalo Basin					549,045	378,901	368,842
Little Grass Creek							7,394
Lost Soldier				[1] 360,000	[1] 720,000	[1] 1,080,000	[1] 1,080,000
Mahoney Dome				1,811,507	5,369,022	3,365,356	3,731,832
Naval Reserve No. 3 [3]				93,760	1,714,530	1,062,874	708,905
Osage [1]		60,000	260,000	200,000	150,000	290,000	240,000
Poison Spider		114,784	1,157,194	2,340,350	999,025	598,592	275,354
Polecat (Big)			14,717	4,769			
Rock River			804,529	1,056,837	848,574	727,504	869,122
Salt Creek [2]	6,126,300	11,921,300	14,714,160	24,835,650	52,520,300	60,942,433	51,741,816
South Casper Creek		285,419	4,212,694	3,918,140	2,065,556	353,986	564,132
Wertz			115,129	5,415,772	4,789,641	5,451,540	5,679,559
Others [3]		46,805	113,430	127,685	113,557	39,100	140
Total	12,476,936	19,833,183	25,438,395	49,835,671	82,396,342	88,507,007	76,955,005

See footnotes at end of table.

TABLE 8.—*Production of natural gas in Wyoming, by fields and years, M cubic feet*—Con.

Field	1926	1927	1928	1929	1930	1931	1932
Baxter Basin (North)			144,583	15,164	518,258	633,184	978,744
Baxter Basin (South)	[2] 193,702	[2] 268,237	[2] 354,699	501,175	758,236	1,150,946	1,642,674
Big Muddy	11,509	11,509	10,481	8,772	6,888	8,103	5,170
Big Sand Draw	4,257,227	4,606,649	4,366,006	3,168,496	2,569,897	2,137,027	2,242,916
Billy Creek					30,937	89,277	201,122
Boone Dome	30,941	35,218	2,419	53,933	1,277	938	76,489
Byron	27,824	153,711	187,345	193,425	244,049	191,237	138,975
Elk Basin	1,029,341	1,098,980	1,130,330	1,442,697	943,434	1,212,064	1,396,204
Ferris and Middle Ferris	659,744	630,271	128,885	101,584	74,967	73,569	22,087
Ferris (West)	3,191,124	3,940,443	3,346,476	2,617,629	1,340,405	909,192	843,102
Garland	803,037	793,988	476,537	309,861	623,765	489,310	464,273
Golden Eagle	50,179	8,272	[2] 16,664	[2] 17,515	[2] 19,966	[2] 11,348	[2] 12,495
Grass Creek	127,051	96,227	319,770	370,425	345,909	360,220	242,060
Hatfield Dome	925,544	311,895	380,146	133,249	89,444	50,842	
Hiawatha (Wyoming only)				195,174	1,310,443	1,368,238	1,382,963
Hiawatha and West Hiawatha [3 4]				483,119	2,747,653	2,986,996	2,970,754
Hidden Dome	1,696,517	998,901	427,727	332,452	279,850	286,288	186,896
LaBarge							12,790
Lance Creek	[2] 308,429	[2] 2,735,816	3,124,804	3,585,819	3,663,312	4,279,522	3,537,447
Little Buffalo Basin	261,565	1,318,890	1,568,657	1,693,677	1,594,621	1,843,674	993,483
Little Grass Creek	97,500	120,108	117,617	134,203	132,813	121,001	108,029
Lost Soldier	[1] 1,080,000	[1] 1,080,000	[1] 1,080,000	[1] 900,000	[1] 900,000	[1] 900,000	856,744
Mahoney Dome	6,647,318	5,033,305	6,966,184	5,628,510	3,686,997	2,749,413	1,744,726
Muskrat				7,125	256,551	379,450	669,378
Naval Reserve No. 3 [3]	2,903,096	1,570,166					
Oregon Basin	18,303	380,697	466,739	697,570	353,390	158,973	140,519
Osage [1]	340,000	300,000	360,000	460,000	1,000,000	1,030,000	960,000
Poison Spider	6,598	7,398					
Polecat (Big)							2,902
Polecat (Little)					[2] 8,625	[2] 95,570	105,015
Rock River	877,249	947,545	906,866	697,701	684,978	577,677	518,184
Salt Creek [2]	37,858,531	28,559,530	28,191,122	21,604,467	18,715,350	16,075,172	14,635,378
South Casper Creek	5,838	1,370					
Wertz	[2] 3,585,410	3,288,049	3,821,864	4,144,202	4,821,791	4,446,388	3,905,774
Others [3]	13,575						
Total	66,197,152	58,297,175	57,895,921	49,014,825	44,976,153	41,628,623	38,026,539

Field	1933	1934	1935	1936	1937	Total	[5] 1938
Allen Lake	24,527	87,542	733,612	753,563	123,120	1,722,364	32,225
Baxter Basin (North)	1,184,051	1,516,095	2,394,892	2,790,620	2,172,035	12,347,626	1,787,680
Baxter Basin (South)	1,941,341	2,218,343	2,675,317	3,446,456	4,278,119	19,615,575	3,663,649
Big Muddy						125,593	
Big Sand Draw	2,368,276	2,284,031	2,790,200	3,246,088	4,250,961	45,444,217	4,156,652
Billy Creek	219,688	243,406	315,878	347,033	442,461	1,889,802	421,112
Boone Dome	79,848	72,461	56,999	18,269	23,258	1,237,521	1,145
Byron	124,746	133,433	265,443	379,002	279,258	2,883,244	227,467
Dutton Creek	79,630	185,424	164,602	85,668	82,568	597,892	82,876
Elk Basin	1,350,398	1,273,272	1,505,835	1,730,955	1,842,762	20,162,142	1,626,726
Ferris and Middle Ferris	12,793	[1] 14,000	24,028	25,547	7,894	6,031,059	2,514
Ferris (West)	560,183	644,556	1,398,880	1,025,708	689,354	27,210,446	302,092
Garland	718,629	648,377	661,588	1,107,699	840,404	27,358,447	656,875
Golden Eagle	[2] 10,497					2,545,542	
Grass Creek	36,092	114,474	114,757	70,899	18,098	3,143,498	15,914
Greybull [2]						298,606	
Hatfield Dome	41,557	85,346	74,844	97,619	120,197	4,900,423	80,244
Hiawatha (Wyoming only)	1,056,988	838,019	597,962	553,437	358,515	7,661,739	263,418
Hiawatha and West Hiawatha [3 4]	2,437,569	2,284,693	2,948,248	3,339,203	2,853,233	23,051,468	1,577,390
Hidden Dome			13,071			22,146,926	1,706
LaBarge	9,720	6,739	9,877	10,075	7,777	56,978	4,528
Lamb						1,819,211	
Lance Creek	2,852,742	2,660,320	2,756,701	3,440,332	4,944,711	40,768,301	3,517,551
Little Buffalo Basin	738,156	768,951	1,114,041	1,354,396	1,646,792	16,193,691	1,390,084
Little Grass Creek	110,603	130,924	135,675	97,692	92,042	1,405,601	84,195
Lost Soldier	901,841	941,540	852,156	964,661	836,073	14,533,015	707,554
Mahoney Dome	1,201,832	865,543	731,376	604,064	484,947	50,621,932	184,872
Medicine Bow				239,436	971,177	1,210,613	3,265,035
Muskrat	632,389	452,371	397,390	757,968	1,099,233	4,651,855	2,215,722
Naval Reserve No. 3 [3]						7,243,331	
Oregon Basin	131,979	164,658	155,633	228,572	276,139	3,173,172	228,545
Osage [1]	760,000	700,000	360,000	200,000	180,000	7,850,000	180,000
Poison Spider						5,499,295	
Polecat (Big)	2,927	3,022	5,267	9,286	30,918	73,808	121,152
Polecat (Little)	93,742	96,977	156,599	134,715	136,950	828,193	76,454
Rock River	385,821	338,887	273,981	218,543	78,556	10,812,554	51,918
Salt Creek [3]	11,718,133	11,315,099	11,083,432	10,297,596	10,354,252	467,008,921	9,913,316
South Casper Creek						11,407,135	
Wertz	2,893,815	3,457,003	2,676,006	3,021,311	1,096,992	62,610,246	353,604
Others [3]						454,292	
Total	32,242,944	32,260,813	34,496,042	37,257,210	37,765,563	915,544,806	35,616,825

[1] Estimated.
[2] Data from other sources.
[3] Includes Alkali Butte, Bison Basin, Iron Creek, and Spring Valley.
[4] Colorado and Wyoming production (not included in totals).
[5] Added after completion of manuscript and not included in totals.

Sample 28139 [1]

FREMONT COUNTY: ALKALI BUTTE FIELD, MUDDY SAND, NW¼ SEC. 1, T. 33 N., R. 95 W.

Well 1; depth, 3,960–3,970 feet; Texas Production Co.

General characteristics

A. P. I. gravity, 34.1
Sulfur, trace
Saybolt Universal viscosity at 100° F., 60 sec.

Distillation

DRY DISTILLATION. FIRST DROP, 147° F.

Temperature, ° F.	Percent cut	Sum, percent	° A. P. I. of cut
Up to 215	5.0	5.0	50.1
215 to 392	7.0	12.0	
392 to 482	7.33	19.33	41.1
482 to 527	9.00	28.33	37.2

VACUUM DISTILLATION AT 40 MM.

Up to 392	5.0	5.0	
392 to 482	12.0	17.0	
482 to 527	8.66	25.66	
527 to 582	7.0	32.66	

Residuum, 39.0 percent.

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 37L–4

NIOBRARA COUNTY: ANT HILLS FIELD, MUDDY SAND, NE¼ SEC. 25, T. 37 N., R. 63 W.

Delahoyde lease; depth, 3,951–3,958 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.883; A. P. I. gravity, 28.7°
Sulfur, percent, 0.14; pour point, 95° F.
Saybolt Universal viscosity at 130° F., 89 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 586 MM. FIRST DROP, 164° C. (327° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125							212 to 257.
125 to 150							257 to 302.
150 to 175	0.6	0.6	0.770	52.3			302 to 347.
175 to 200	1.8	2.4	.776	50.8			347 to 392.
200 to 225	4.2	6.6	.793	46.9			392 to 437.
225 to 250	5.6	12.2	.808	43.6			437 to 482.
250 to 275	7.9	20.1	.819	41.3			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	0.9	0.9	0.830	39.0	42	40	Up to 392.
200 to 225	9.5	10.4	.833	38.4	44	50	392 to 437.
225 to 250	9.2	19.6	.843	36.4	53	75	437 to 482.
250 to 275	7.4	27.0	.851	34.8	67	90	482 to 527.
275 to 300	9.3	36.3	.862	32.7	[1]41	105	527 to 572.

Carbon residue of residuum, 6.1 percent; carbon residue of crude, 2.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	2.4	0.775	51.1	
Kerosene distillate	17.7	.810	43.2	
Gas oil	12.1	.833	38.4	
Nonviscous lubricating distillate	12.4	.840–.853	37.0–34.4	50 to 100.
Medium lubricating distillate	3.9	.853–.858	34.4–33.4	100 to 200.
Viscous lubricating distillate	7.9	.858–.868	33.4–31.5	Above 200.
Residuum	42.9	.935	19.8	
Distillation loss	.7			

[1] At 212°F.

Sample 30–10

UINTA COUNTY: ASPEN FIELD, BEAR RIVER FORMATION, NW¼ SEC. 10, T. 14 N., R. 118 W.

Johnson No. 1; depth, 911 feet; Pacific Oil Co.

General characteristics

Specific gravity, 0.921; A. P. I. gravity, 22.1°
Sulfur, percent, 0.25; pour point, below 5°F.
Saybolt Universal viscosity at 100°F., 760 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 581 MM. FIRST DROP, 50° C. (122°F.)

Temperature, °C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, °F.	Temperature, °F.
Up to 50							Up to 122.
50 to 75	0.6	0.6	0.758	55.2			122 to 167.
75 to 100	.9	1.5					167 to 212.
100 to 125	.6	2.1					212 to 257.
125 to 150	.3	2.4	.782	49.5			257 to 302.
150 to 175	1.5	3.9					302 to 347.
175 to 200	2.1	6.0	.813	42.6			347 to 392.
200 to 225	4.1	10.1	.840	37.0			392 to 437.
225 to 250	5.3	15.4	.859	33.2			437 to 482.
250 to 275	7.3	22.7	.872	30.8			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	1.3	1.3	0.888	27.9	45	Below 5	Up to 392.
200 to 225	5.3	6.6	.896	26.4	54	15	392 to 437.
225 to 250	4.0	10.6	.906	24.7	75	25	437 to 482.
250 to 275	6.4	17.0	.912	23.7	120	45	482 to 527.
275 to 300	8.3	25.3	.917	22.8	210	60	527 to 572.

Carbon residue of residuum, 13.1 percent; carbon residue of crude, 7.1 percent.

Approximate summary

	Percent	Specific gravity	°A. P. I.	Viscosity
Light gasoline	1.5	0.758	55.2	
Total gasoline and naphtha	6.0	0.787	48.3	
Kerosene distillate				
Gas oil	19.3	.864	32.3	
Nonviscous lubricating distillate	8.9	.893–.910	27.0–24.0	50 to 100.
Medium lubricating distillate	8.9	.910–.917	24.0–22.8	100 to 200.
Viscous lubricating distillate	4.9	.917–.920	22.8–22.3	Above 200.
Residuum	51.8	.953	17.0	
Distillation loss	.2			

Sample 37L–15

PARK COUNTY: BADGER BASIN FIELD, FRONTIER FORMATION, SW¼ SEC. 16, T. 57 N., R. 101 W.

State No. 1; depth, 8,250–8,591 feet; Resolute Oil Co.

General characteristics

Specific gravity,0.785; A. P. I. gravity, 48.7°
Sulfur, percent, less than 0.1; pour point, below 0°F.
Saybolt Universal viscosity at 70°F., 33 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 586 MM. FIRST DROP, 21°C. (69°F.)

Temperature, °C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, °F.	Temperature, °F.
Up to 50	7.3	7.3	0.650	86.2			Up to 122.
50 to 75	6.2	13.5	.686	74.8			122 to 167.
75 to 100	10.7	24.2	.730	62.4			167 to 212.
100 to 125	9.1	33.3	.752	56.7			212 to 257.
125 to 150	6.5	39.8	.773	51.5			257 to 302.
150 to 175	5.8	45.6	.788	48.1			302 to 347.
175 to 200	5.2	50.8	.799	45.6			347 to 392.
200 to 225	5.3	56.1	.818	41.5			392 to 437.
225 to 250	5.5	61.6	.833	38.4			437 to 482.
250 to 275	5.6	67.2	.843	36.4			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	2.5	2.5	0.854	34.2	42	30	Up to 392.
200 to 225	6.2	8.7	.860	33.0	49	50	392 to 437.
225 to 250	4.8	13.5	.874	30.4	68	65	437 to 482.
250 to 275	4.2	17.7	.887	28.0	118	80	482 to 527.
275 to 300	2.6	20.3	.903	25.2	255	85	527 to 572.

Carbon residue of residuum, 3.5 percent; carbon residue of crude, 0.31 percent.

Approximate summary

	Percent	Specific gravity	°A. P. I.	Viscosity
Light gasoline	24.2	0.695	72.1	
Total gasoline and naphtha	50.8	0.736	60.7	
Kerosene distillate	5.3	.818	41.5	
Gas oil	16.9	.844	36.2	
Nonviscous lubricating distillate	8.1	.861–.882	32.8–28.9	50 to 100.
Medium lubricating distillate	3.7	.882–.896	28.9–26.4	100 to 200.
Viscous lubricating distillate	2.7	.896–.909	26.4–24.2	Above 200.
Residuum	7.3	.942	18.7	
Distillation loss	5.2			

Sample 285

CONVERSE COUNTY: BIG MUDDY FIELD, SHANNON SAND, T. 33 N., R. 76 W.

Composite sample; depth, 1,000-1,150 feet

General characteristics

Specific gravity, 0.861; A. P. I. gravity, 32.8°
Sulfur, percent, 0.25
Saybolt Universal viscosity at 100° F., 54 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 745 MM. FIRST DROP, 28° C. (82° F.)

Temperature, °C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Tempera-ture, ° F.
Up to 50	1.3	1.3	0.687	74.5			Up to 122.
50 to 75	1.6	2.9					122 to 167.
75 to 100	3.8	6.7	.708	68.4			167 to 212.
100 to 125	5.2	11.9	.737	60.5			212 to 257.
125 to 150	4.2	16.1	.758	55.2			257 to 302.
150 to 175	4.1	20.2	.777	50.6			302 to 347.
175 to 200	4.2	24.4	.795	46.5			347 to 392.
200 to 225	3.9	28.3	.813	42.6			392 to 437.
225 to 250	4.3	32.6	.825	40.0			437 to 482.
250 to 275	6.0	38.6	.838	37.4			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	3.7	3.7	0.861	32.8	40		Up to 392.
200 to 225	6.0	9.7	.866	31.9	50	25	392 to 437.
225 to 250	5.0	14.7	.875	30.2	61	45	437 to 482.
250 to 275	5.8	20.5	.885	28.4	90	65	482 to 527.
275 to 300	6.8	27.3	.893	27.0	160	85	527 to 572.

Carbon residue of residuum, 5.5 percent; carbon residue of crude, 1.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	6.7	0.698	71.2	
Total gasoline and naphtha	24.4	0.746	58.2	
Kerosene distillate	8.2	.818	41.5	
Gas oil	12.7	.850	35.0	
Nonviscous lubricating distillate	12.8	.860-.889	33.0-27.7	50 to 100.
Medium lubricating distillate	7.5	.889-.911	27.7-23.8	100 to 200.
Viscous lubricating distillate	.3	.911-.913	23.8-23.5	Above 200.
Residuum	31.1			
Distillation loss	3.0			

Sample 37L-6

CONVERSE COUNTY: BIG MUDDY FIELD, WALL CREEK SAND, NW¼ SEC. 8, T. 33 N., R. 76 W.

A. E. Humphry No. 33; depth, 3,069-3,180 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.847; A. P. I. gravity, 35.6°
Sulfur, percent, 0.10; pour point, 50° F.
Saybolt Universal viscosity at 100° F., 52 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 583 MM. FIRST DROP, 27° C. (80° F.)

Temperature, °C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, °F.	Tempera-ture, °F.
Up to 50	2.0	2.0	0.680	76.6			Up to 122.
50 to 75	4.0	6.0	.698	71.2			122 to 167.
75 to 100	3.0	9.0	.734	61.3			167 to 212.
100 to 125	3.7	12.7	.757	55.4			212 to 257.
125 to 150	4.5	17.2	.769	52.5			257 to 302.
150 to 175	4.4	21.6	.789	47.8			302 to 347.
175 to 200	3.7	25.3	.807	43.8			347 to 392.
200 to 225	4.4	29.7	.821	40.8			392 to 437.
225 to 250	5.1	34.8	.833	38.4			437 to 482.
250 to 275	6.2	41.0	.843	36.4			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	0.3	0.3	0.856	33.8	46	30	Up to 392.
200 to 225	4.2	4.5					392 to 437.
225 to 250	5.9	10.4	.863	32.5	54	50	437 to 482.
250 to 275	6.4	16.8	.876	30.0	81	70	482 to 527.
275 to 300	7.6	24.4	.888	27.8	185	95	527 to 572.

Carbon residue of residuum, 5.1 percent; carbon residue of crude, 1.6 percent.

Approximate summary

	Percent	Specific gravity	°A. P. I.	Viscosity
Light gasoline	9.0	0.706	68.9	
Total gasoline and naphtha	25.3	0.754	56.2	
Kerosene distillate	4.4	.821	40.8	
Gas oil	16.3	.844	36.2	
Nonviscous lubricating distillate	10.0	.860-.878	33.0-29.7	50 to 100.
Medium lubricating distillate	6.7	.878-.890	29.7-27.5	100 to 200.
Viscous lubricating distillate	2.7	.890-.895	27.5-26.6	Above 200.
Residuum	29.5	.935	19.8	
Distillation loss	5.1			

Sample 37L–7

CONVERSE COUNTY: BIG MUDDY FIELD, DAKOTA SAND, NE¼ SEC. 8, T. 33 N., R. 76 W.

A. E. Humphry No. 32; depth, 4,298–4,312 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.841; A. P. I. gravity, 36.8°
Sulfur, percent, 0.12; pour point, 60° F.
Saybolt Universal viscosity at 100° F., 48 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 583 MM. FIRST DROP, 26° C. (79° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.9	1.9	0.671	79.4			Up to 122.
50 to 75	1.9	3.8	.677	77.5			122 to 167.
75 to 100	4.7	8.5	.721	64.7			167 to 212.
100 to 125	5.3	13.8	.748	57.7			212 to 257.
125 to 150	3.9	17.7	.766	53.2			257 to 302.
150 to 175	4.1	21.8	.783	49.2			302 to 347.
175 to 200	4.9	26.7	.799	45.6			347 to 392.
200 to 225	3.4	30.1	.812	42.8			392 to 437.
225 to 250	4.8	34.9	.824	40.2			437 to 482.
250 to 275	7.5	42.4	.835	38.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.1	1.1	0.840	37.0	41	35	Up to 392.
200 to 225	5.5	6.6	.848	35.4	46	45	392 to 437.
225 to 250	6.7	13.3	.858	33.4	57	65	437 to 482.
250 to 275	7.0	20.3	.869	31.3	85	85	482 to 527.
275 to 300	7.9	28.2	.887	28.0	[1] 44	105	527 to 572.

Carbon residue of residuum, 6.5 percent; carbon residue of crude, 1.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	8.5	0.700	70.6	
Total gasoline and naphtha	26.7	0.746	58.2	
Kerosene distillate	8.2	.819	41.3	
Gas oil	13.5	.843	36.4	
Nonviscous lubricating distillate	11.9	.852–.872	34.6–30.8	50 to 100.
Medium lubricating distillate	7.5	.872–.891	30.8–27.3	100 to 200.
Viscous lubricating distillate	2.8	.891–.898	27.3–26.1	Above 200.
Residuum	26.4	.944	18.4	
Distillation loss	3.0			

[1] At 212° F.

Sample 37L–8

CONVERSE COUNTY: BIG MUDDY FIELD, LAKOTA SAND, NE¼ SEC. 9, T. 33 N., R. 76 W.

B. B. Whiteside No. 60; depth, 4,362–4,406 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.869; A. P. I. gravity, 31.3°
Sulfur, percent, 0.15; pour point, 55° F.
Saybolt Universal viscosity at 100° F., 66 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 52° C. (125° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	1.3	1.3	0.680	76.6			122 to 167.
75 to 100	3.0	4.3	.719	65.3			167 to 212.
100 to 125	4.9	9.2	.740	59.7			212 to 257.
125 to 150	4.5	13.7	.758	55.2			257 to 302.
150 to 175	4.1	17.8	.778	50.4			302 to 347.
175 to 200	4.4	22.2	.796	46.3			347 to 392.
200 to 225	4.9	27.1	.811	43.0			392 to 437.
225 to 250	6.3	33.4	.830	39.0			437 to 482.
250 to 275	6.1	39.5	.840	37.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.7	0.7	0.855	34.0	46	35	Up to 392.
200 to 225	6.5	7.2				40	392 to 437.
225 to 250	6.7	13.9	.864	32.3	56	60	437 to 482.
250 to 275	6.5	20.4	.876	30.0	78	80	482 to 527.
275 to 300	7.5	27.9	.883	28.7	135	100	527 to 572.

Carbon residue of residuum, 10.8 percent; carbon residue of crude, 3.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.3	0.707	68.7	
Total gasoline and naphtha	22.2	0.755	55.9	
Kerosene distillate	4.9	.811	43.0	
Gas oil	18.9	.841	36.8	
Nonviscous lubricating distillate	13.4	.859–.876	33.2–30.0	50 to 100.
Medium lubricating distillate	8.0	.876–.886	30.0–28.2	100 to 200.
Viscous lubricating distillate				
Residuum	32.5	.966	15.0	
Distillation loss	.1			

Sample 30–24

HOT SPRINGS COUNTY: BLACK MOUNTAIN FIELD, EMBAR LIME AND TENSLEEP SANDSTONE, T. 43 N., RS. 90 AND 91 W.

Composite of 6 wells; depth, 2,900–3,400 feet; Utah Oil & Refining Co.

General characteristics

Specific gravity, 0.908; A. P. I. gravity, 24.3°
Sulfur, percent, 2.93; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 115 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 586 MM. FIRST DROP, 47° C.(116° F.)

Temperature, ° C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Tempera-ture, ° F.
Up to 50	0.3	0.3	0.699	70.9			Up to 122.
50 to 75	1.3	1.6					122 to 167.
75 to 100	2.6	4.2					167 to 212.
100 to 125	3.2	7.4	.741	59.5			212 to 257.
125 to 150	4.0	11.4	.766	53.2			257 to 302.
150 to 175	3.9	15.3	.788	48.1			302 to 347.
175 to 200	3.1	18.4	.805	44.3			347 to 392.
200 to 225	4.7	23.1	.820	41.1			392 to 437.
225 to 250	4.7	27.8	.836	37.8			437 to 482.
250 to 275	5.4	33.2	.855	34.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.8	1.8	0.872	30.8	41	Below 5	Up to 392.
200 to 225	6.2	8.0	.875	30.2	46	10	392 to 437.
225 to 250	5.8	13.8	.877	29.9	55	20	437 to 482.
250 to 275	6.4	20.2	.894	26.8	92	40	482 to 527.
275 to 300	8.1	28.3	.911	23.8	155	60	527 to 572.

Carbon residue of residuum, 14.8 percent; carbon residue of crude, 6.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.2	0.699	70.9	
Total gasoline and naphtha	18.4	0.757	55.4	
Kerosene distillate	4.7	.820	41.1	
Gas oil	17.7	.858	33.4	
Nonviscous lubricating distillate	10.4	.876–.896	30.0–26.4	50 to 100.
Medium lubricating distillate	10.3	.896–.921	26.4–22.1	100 to 200.
Viscous lubricating distillate				
Residuum	38.1	1.006		
Distillation loss	.4			

Sample 30–31

NATRONA COUNTY: BOLTON CREEK FIELD, SUNDANCE FORMATION, SE¼ SEC. 4, T. 29 N., R. 81 W.

Wells 1 and 8; depth, approximately 1,100 feet; Iowa Wyoming Oil Co.

General characteristics

Specific gravity, 0.924; A. P. I. gravity, 21.6°
Sulfur, percent, 2.31; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 330 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 582 MM. FIRST DROP, 75° C. (166° F.)

Temperature, ° C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Tempera-ture, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	0.7	0.7	0.715	66.4			167 to 212.
100 to 125	1.2	1.9	.722	64.5			212 to 257.
125 to 150	2.2	4.1	.746	58.2			257 to 302.
150 to 175	2.8	6.9	.769	52.5			302 to 347.
175 to 200	3.3	10.2	.789	47.8			347 to 392.
200 to 225	4.1	14.3	.808	43.6			392 to 437.
225 to 250	5.3	19.6	.823	40.4			437 to 482.
250 to 275	6.1	25.7	.839	37.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.3	2.3	0.863	32.5	43	Below 5	Up to 392.
200 to 225	6.7	9.0	.865	32.1	46	15	392 to 437.
225 to 250	5.8	14.8	.883	28.8	56	30	437 to 482.
250 to 275	7.5	22.3	.899	25.9	82	50	482 to 527.
275 to 300	8.2	30.5	.912	23.7	150	65	527 to 572.

Carbon residue of residuum, 21.0 percent; carbon residue of crude, 10.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.7	0.715	66.4	
Total gasoline and naphtha	10.2	0.761	54.4	
Kerosene distillate	9.4	.816	41.9	
Gas oil	14.3	.853	34.4	
Nonviscous lubricating distillate	12.5	.872–.903	30.8–25.2	50 to 100.
Medium lubricating distillate	9.8	.903–.919	25.2–22.5	100 to 200.
Viscous lubricating distillate				
Residuum	43.6	1.019		
Distillation loss	.2			

Sample 30–32

NATRONA COUNTY: BOLTON CREEK FIELD, EMBAR LIME, SE¼ SEC. 4, T. 29 N., R. 81 W.

Well 9; depth, approximately 2,000 feet; Iowa Wyoming Oil Co.

General characteristics

Specific gravity, 0.868; A. P. I. gravity, 31.5°
Sulfur, percent, 2.87; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 52 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 587 MM. FIRST DROP, 32° C. (90° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.3	2.3	0.664	81.6			Up to 122.
50 to 75	3.3	5.6	.669	80.0			122 to 167.
75 to 100	3.7	9.3	.704	69.5			167 to 212.
100 to 125	4.1	13.4	.729	62.6			212 to 257.
125 to 150	4.2	17.6	.752	56.7			257 to 302.
150 to 175	4.1	21.7	.775	51.1			302 to 347.
175 to 200	3.7	25.4	.794	46.7			347 to 392.
200 to 225	4.3	29.7	.808	43.6			392 to 437.
225 to 250	4.9	34.6	.824	40.2			437 to 482.
250 to 275	5.7	40.3	.840	37.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.4	1.4	0.863	32.5	41	10	Up to 392.
200 to 225	5.9	7.3	.868	31.5	43	20	392 to 437.
225 to 250	5.3	12.6	.882	28.9	52	40	437 to 482.
250 to 275	5.9	18.5	.897	26.3	73	60	482 to 527.
275 to 300	7.5	26.0	.911	23.8	130	80	527 to 572.

Carbon residue of residuum, 16.3 percent; carbon residue of crude, 5.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.3	0.682	76.0	
Total gasoline and naphtha	25.4	0.732	61.8	
Kerosene distillate	9.2	.817	41.7	
Gas oil	14.4	.855	34.0	
Nonviscous lubricating distillate	10.1	.879–.904	29.5–25.0	50 to 100.
Medium lubricating distillate	7.2	.904–.918	25.0–22.6	100 to 200
Viscous lubricating distillate				
Residuum	30.0	1.003		
Distillation loss	3.7			

Sample 38L–5

BIG HORN COUNTY: BYRON FIELD, EMBAR LIME, SE¼ SEC. 25, T. 56 N., R. 97 W.

Well 1; depth, 5,252–5,366 feet; Taylor Oil Co.

General characteristics

Specific gravity, 0.937; A. P. I. gravity, 19.5°
Sulfur, percent, 2.97; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 660 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 583 MM. FIRST DROP, 36° C. (96° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.4	0.4	0.675	78.1			Up to 122.
50 to 75	.4	.8					122 to 167.
75 to 100	1.2	2.0	.678	77.2			167 to 212.
100 to 125	1.6	3.6	.713	67.0			212 to 257.
125 to 150	2.2	5.8	.745	58.4			257 to 302.
150 to 175	2.3	8.1	.773	51.6			302 to 347.
175 to 200	2.8	10.9	.797	46.0			347 to 392.
200 to 225	3.5	14.4	.818	41.5			392 to 437.
225 to 250	3.9	18.3	.834	38.2			437 to 482.
250 to 275	6.3	24.6	.852	34.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.8	0.8	0.867	31.7	45	Below 5	Up to 392.
200 to 225	4.7	5.5	.881	29.1	50	10	392 to 437.
225 to 250	5.4	10.9	.894	26.8	69	25	437 to 482.
250 to 275	5.7	16.6	.909	24.2	105	45	482 to 527.
275 to 300	7.6	24.2	.929	20.8	210	60	527 to 572.

Carbon residue of residuum, 18.7 percent; carbon residue of crude, 10.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	2.0	0.677	77.5	
Total gasoline and naphtha	10.9	0.747	57.9	
Kerosene distillate	3.5	.818	41.5	
Gas oil	13.4	.852	34.6	
Nonviscous lubricating distillate	10.1	.879–.908	29.5–24.3	50 to 100.
Medium lubricating distillate	6.7	.908–.928	24.3–21.0	100 to 200.
Viscous lubricating distillate	4.2	.928–.940	21.0–19.0	Above 200.
Residuum	50.3	1.019	7.4	
Distillation loss	.9			

Sample 37L–52

BIG HORN COUNTY: BYRON FIELD, EMBAR LIME AND TENSLEEP SANDSTONE, SE¼ SEC. 23, T. 56 N., R. 97 W.

Sidon Canal No. 2; depth, 5,139–5,272 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.909; A. P. I. gravity, 24.1°
Sulfur, percent, 2.52; pour point, below 5°F.
Saybolt Universal viscosity at 100°F., 150 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 29°C. (85°F.)

Temperature, °C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, °F.	Temperature, °F.
Up to 50	0.7	0.7	0.654	84.9			Up to 122.
50 to 75	1.3	2.0	.658	83.5			122 to 167.
75 to 100	1.8	3.8	.691	73.3			167 to 212.
100 to 125	2.1	5.9	.725	63.7			212 to 257.
125 to 150	2.5	8.4	.753	56.4			257 to 302.
150 to 175	2.9	11.3	.778	50.4			302 to 347.
175 to 200	3.1	14.4	.798	45.8			347 to 392.
200 to 225	4.1	18.5	.821	40.9			392 to 437.
225 to 250	4.2	22.7	.836	37.8			437 to 482.
250 to 275	6.7	29.4	.856	33.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.4	0.4					Up to 392.
200 to 225	5.5	5.9	0.880	29.3	60	25	392 to 437.
225 to 250	7.1	13.0	.893	26.9	68	45	437 to 482.
250 to 275	5.9	18.9	.911	23.8	115	55	482 to 527.
275 to 300	7.8	26.7	.925	21.5	230	70	527 to 572.

Carbon residue of residuum, 13.9 percent; carbon residue of crude, 6.5 percent.

Approximate summary

	Percent	Specific gravity	°A. P. I.	Viscosity
Light gasoline	3.8	0.673	78.7	
Total gasoline and naphtha	14.4	0.743	58.9	
Kerosene distillate	4.1	.821	40.9	
Gas oil	10.9	.848	35.2	
Nonviscous lubricating distillate	14.0	.874–.906	30.4–24.7	50 to 100.
Medium lubricating distillate	7.0	.906–.921	24.7–22.1	100 to 200.
Viscous lubricating distillate	5.7	.921–.933	22.1–20.2	Above 200.
Residuum	43.1	.993	11.0	
Distillation loss	.8			

Sample 288

FREMONT COUNTY: CIRCLE RIDGE FIELD, EMBAR LIME, SE¼ SEC. 1, T. 6 N., R. 3 W.

Well 1A; depth, 230 feet

General characteristics

Specific gravity, 0.912; A. P. I. gravity, **23.7°**
Sulfur, percent, 2.84;
Saybolt Universal viscosity at 100°F., 160 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 745 MM. FIRST DROP, 96°C. (205°F.)

Temperature, °C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, °F.	Temperature, °F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	0.2	0.2	0.717	65.9			167 to 212.
100 to 125	1.5	1.7					212 to 257.
125 to 150	2.9	4.6	.738	60.2			257 to 302.
150 to 175	3.3	7.9	.761	54.4			302 to 347.
175 to 200	3.1	11.0	.783	49.2			347 to 392.
200 to 225	3.9	14.9	.800	45.4			392 to 437.
225 to 250	5.6	20.5	.819	41.3			437 to 482.
250 to 275	6.9	27.4	.841	36.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.4	3.4	0.871	31.0	42		Up to 392.
200 to 225	6.6	10.0	.877	29.9	56	20	392 to 437.
225 to 250	6.9	16.9	.895	26.6	66	45	437 to 482.
250 to 275	6.1	23.0	.914	23.3	99	60	482 to 527.
275 to 300	7.9	30.9	.925	21.5	180	70	527 to 572.

Carbon residue of residuum, 15.1 percent; carbon residue of crude, 5.8 percent.

Approximate summary

	Percent	Specific gravity	°A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	11.0	0.754	56.2	
Kerosene distillate	9.5	.811	43.0	
Gas oil	11.6	.871	31.0	
Nonviscous lubricating distillate	15.4	.874–.914	30.4–23.3	50 to 100.
Medium lubricating distillate	8.3	.914–.927	23.3–21.1	100 to 200.
Viscous lubricating distillate	2.5	.927–.931	21.1–20.5	Above 200.
Residuum	38.7	1.004		
Distillation loss	3.0			

Sample 30–14 [1]

FREMONT COUNTY: DALLAS DOME FIELD, EMBAR LIME, W½ SEC. 13, T. 32 N., R. 99 W.

Composite sample; depth, 900–1,100 feet; Atlantic Pacific Oil Co.

General characteristics

Specific gravity, 0.926; A. P. I. gravity, 21.3°
Sulfur, percent, 2.89; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 290 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 576 MM. FIRST DROP, 61° C. (142° F.)

Temperature, °C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.3	0.3					122 to 167.
75 to 100	.4	.7	0.725	63.9			167 to 212.
100 to 125	1.3	2.0					212 to 257.
125 to 150	1.5	3.5					257 to 302.
150 to 175	2.3	5.8	.761	54.4			302 to 347.
175 to 200	3.5	9.3	.790	47.6			347 to 392.
200 to 225	4.1	13.4	.811	43.0			392 to 437.
225 to 250	4.9	18.3	.828	39.4			437 to 482.
250 to 275	7.5	25.8	.846	35.8			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	0.9	0.9	0.867	31.7	44	10	Up to 392.
200 to 225	6.9	7.8	.875	30.2	50	25	392 to 437.
225 to 250	7.4	15.2	.893	27.0	67	40	437 to 482.
250 to 275	7.0	22.2	.904	25.0	115	60	482 to 527.
275 to 300	11.7	33.9	.925	21.5	200	75	527 to 572.

Carbon residue of residuum, 18.5 percent; carbon residue of crude, 8.0 percent.

Approximate summary

	Percent	Specific gravity	°A. P. I.	Viscosity
Light gasoline	0.7			
Total gasoline and naphtha	9.3	0.764	53.7	
Kerosene distillate	4.1	.811	43.0	
Gas oil	16.8	.847	35.6	
Nonviscous lubricating distillate	12.1	.875–.901	30.2–25.6	50 to 100.
Medium lubricating distillate	11.6	.901–.925	25.6–21.5	100 to 200.
Viscous lubricating distillate	5.8	.925–.938	21.5–19.4	Above 200.
Residuum	39.5	1.015		
Distillation loss	.8			

[1] Sample from storage after dehydration.

Sample 30–15

FREMONT COUNTY: DERBY DOME FIELD, TENSLEEP SANDSTONE, SW¼ SEC. 4, T. 31 N., R. 98 W.

Well 12; depth, 1,266–1,326 feet; Atlantic Pacific Oil Co.

General characteristics

Specific gravity, 0.920; A. P. I. gravity, 22.3°
Sulfur, percent, 2.57; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 220 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 575 MM. FIRST DROP, 41° C. (106° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.0	1.0	0.711	67.5			Up to 122.
50 to 75							122 to 167.
75 to 100	.7	1.7	.720	65.0			167 to 212.
100 to 125	1.7	3.4	.735	61.0			212 to 257.
125 to 150	2.1	5.5	.746	58.2			257 to 302.
150 to 175	2.6	8.1	.760	54.7			302 to 347.
175 to 200	3.1	11.2	.791	47.4			347 to 392.
200 to 225	4.3	15.5	.812	42.8			392 to 437.
225 to 250	4.7	20.2	.828	39.4			437 to 482.
250 to 275	7.1	27.3	.848	35.4			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	1.9	1.9	0.873	30.6	48	15	Up to 392.
200 to 225	7.4	9.3	.879	29.5	50	30	392 to 437.
225 to 250	9.0	18.3	.894	26.8	68	55	437 to 482.
250 to 275	6.7	25.0	.913	23.5	125	70	482 to 527.
275 to 300	8.4	33.4	.924	21.6	220	80	527 to 572.

Carbon residue of residuum, 16.2 percent; carbon residue of crude, 7.1 percent.

Approximate summary

	Percent	Specific gravity	°A. P. I.	Viscosity
Light gasoline	1.7	0.715	66.4	
Total gasoline and naphtha	11.2	0.755	55.9	
Kerosene distillate	4.3	.812	42.8	
Gas oil	17.4	.851	34.8	
Nonviscous lubricating distillate	12.6	.879–.904	29.5–25.0	50 to 100.
Medium lubricating distillate	9.4	.904–.922	25.0–22.0	100 to 200.
Viscous lubricating distillate	5.8	.922–.930	22.0–20.7	Above 200.
Residuum	39.0	1.009		
Distillation loss	.3			

Sample 37L–25

CARBON COUNTY: DUTTON CREEK FIELD, MUDDY SAND, SE¼ SEC. 1, T. 18 N., R. 78 W.

E. A. Eads No. 6X; depth, 4,876–4,905 feet; Mutual Oil Syndicate

General characteristics

Specific gravity, 0.858; A. P. I. gravity, 33.4°
Sulfur, percent, 0.26; pour point, 50° F.
Saybolt Universal viscosity at 100° F., 52 sec.; color, brown

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 24° C. (76° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.9	2.9	0.675	78.1			Up to 122.
50 to 75	3.7	6.6	.685	75.1			122 to 167.
75 to 100	4.5	11.1	.724	63.9			167 to 212.
100 to 125	4.1	15.2	.743	58.9			212 to 257.
125 to 150	4.3	19.5	.763	53.9			257 to 302.
150 to 175	4.3	23.8	.784	49.0			302 to 347.
175 to 200	3.8	27.6	.801	45.1			347 to 392.
200 to 225	4.3	31.9	.815	42.1			392 to 437.
225 to 250	4.4	36.3	.828	39.4			437 to 482.
250 to 275	6.2	42.5	.839	37.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.0	1.0	0.856	33.8	44	35	Up to 392.
200 to 225	6.1	7.1	.859	33.2	48	45	392 to 437.
225 to 250	6.1	13.2	.872	30.8	64	60	437 to 482.
250 to 275	5.2	18.4	.884	28.6	93	80	482 to 527.
275 to 300	7.9	26.3	.899	25.9	190	95	527 to 572.

Carbon residue of residuum, 11.2 percent; carbon residue of crude, 3.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	11.1	0.698	71.2	
Total gasoline and naphtha	27.6	0.742	59.2	
Kerosene distillate	4.3	.815	42.1	
Gas oil	15.4	.842	36.6	
Nonviscous lubricating distillate	11.5	.861–.885	32.8–28.4	50 to 100.
Medium lubricating distillate	6.8	.885–.900	28.4–25.7	100 to 200.
Viscous lubricating distillate	3.2	.900–.908	25.7–24.3	Above 200.
Residuum	28.8	.984	12.3	
Distillation loss	2.4			

Laboratory No. 33–035 [1]

NATRONA COUNTY: EAST TEAPOT FIELD, SHANNON SAND, NE¼ SEC. 2, T. 38 N., R. 78 W.

Well 1; depth, 825–975 feet; Teapot Consolidated Oil Co.

General characteristics

Specific gravity, 0.847; A. P. I. gravity, 35.6°
Sulfur, percent, less than 0.1; pour point, 30°F.
Saybolt Universal viscosity at 100° F., 47 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 641 MM. FIRST DROP, 21° C. (87.8°F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.6	1.6	0.663	81.9			Up to 122.
50 to 75	1.9	3.5	.690	73.6			122 to 167.
75 to 100	3.9	7.4	.710	67.8			167 to 212.
100 to 125	4.5	11.9	.739	60.0			212 to 257.
125 to 150	4.0	15.9	.761	54.4			257 to 302.
150 to 175	4.3	20.2	.781	49.7			302 to 347.
175 to 200	3.9	24.1	.800	45.4			347 to 392.
200 to 225	4.2	28.3	.816	41.9			392 to 437.
225 to 250	4.4	32.7	.828	39.4			437 to 482.
250 to 275	6.3	39.0	.838	37.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.6	3.6	0.848	35.4	41	15	Up to 392.
200 to 225	8.7	12.3	.850	35.0	45	30	392 to 437.
225 to 250	8.8	21.1	.857	33.6	55	55	437 to 482.
250 to 275	6.8	27.9	.873	30.6	77	70	482 to 527.
275 to 300	6.9	34.8	.885	28.4	133	85	527 to 572.

Carbon residue of residuum, 3.76 percent; carbon residue of crude, 0.99 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	7.4	0.695	72.1	
Total gasoline and naphtha	24.1	0.746	58.2	
Kerosene distillate	4.2	.816	41.9	
Gas oil	23.1	.842	36.6	Below 50.
Nonviscous lubricating distillate	15.0	.853–.878	34.4–29.7	50 to 100.
Medium lubricating distillate	7.4	.878–.891	29.7–27.3	100 to 200.
Viscous lubricating distillate				
Residuum	26.1	.936	19.7	
Distillation loss	.1			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 37L–24

PARK COUNTY: ELK BASIN FIELD, PEAY SAND, SW¼ SEC. 19, T. 58 N., R. 99 W.

Elk 6, well 13; depth, 1,515–1,535 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.810; A. P. I. gravity, 43.2°
Sulfur, percent, less than 0.1; pour point, below 0° F.
Saybolt Universal viscosity at 70° F., 37 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 21° C. (70° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	3.4	3.4	0.673	78.7			Up to 122.
50 to 75	3.9	7.3	.675	78.1			122 to 167.
75 to 100	8.1	15.4	.725	63.7			167 to 212.
100 to 125	9.7	25.1	.749	57.4			212 to 257.
125 to 150	7.3	32.4	.770	52.3			257 to 302.
150 to 175	6.9	39.3	.786	48.5			302 to 347.
175 to 200	5.6	44.9	.801	45.1			347 to 392.
200 to 225	7.2	52.1	.817	41.7			392 to 437.
225 to 250	5.1	57.2	.831	38.8			437 to 482.
250 to 275	6.4	63.6	.839	37.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.2	2.2	0.851	34.8	40	25	Up to 392.
200 to 225	6.2	8.4	.856	33.8	45	40	392 to 437.
225 to 250	5.4	13.8	.863	32.5	54	55	437 to 482.
250 to 275	5.1	18.9	.878	29.7	75	70	482 to 527.
275 to 300	4.8	23.7	.891	27.3	145	85	527 to 572.

Carbon residue of residuum, 4.2 percent; carbon residue of crude, 0.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	15.4	0.701	70.3	
Total gasoline and naphtha	44.9	0.748	57.7	
Kerosene distillate	7.2	.817	41.7	
Gas oil	20.1	.844	36.2	
Nonviscous lubricating distillate	9.6	.860–.883	33.0–28.7	50 to 100.
Medium lubricating distillate	5.5	.883–.897	28.7–26.2	100 to 200.
Viscous lubricating distillate				
Residuum	12.7	.941	18.9	
Distillation loss				

Sample 38L–4

PARK COUNTY: ELK BASIN FIELD, PEAY SAND, SW¼ SEC. 32, T. 58 N., R. 99 W.

Well 1; depth, 1,828–1,846 feet; Local Oil Co.

General characieristics

Specific gravity, 0.833; A. P. I. gravity, 38.4°
Sulfur, percent, 0.95; pour point, below 5° F.
Saybolt Universal viscosity at 70° F., 39 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 586 MM. FIRST DROP, 30° C. (86° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.6	1.6	0.659	83.2			Up to 122.
50 to 75	4.5	6.1	.678	77.2			122 to 167.
75 to 100	15.7	21.8	.723	64.2			167 to 212.
100 to 125	8.9	30.7	.749	57.4			212 to 257.
125 to 150	6.7	37.4	.770	52.3			257 to 302.
150 to 175	5.5	42.9	.788	48.1			302 to 347.
175 to 200	3.9	46.8	.806	44.1			347 to 392.
200 to 225	4.1	50.9	.825	40.0			392 to 437.
225 to 250	4.0	54.9	.842	36.6			437 to 482.
250 to 275	4.8	59.7	.854	34.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.3	1.3	0.865	32.1	44	15	Up to 392.
200 to 225	5.5	6.8	.874	30.4	51	35	392 to 437.
225 to 250	3.4	10.2	.886	28.2	66	50	437 to 482.
250 to 275	4.5	14.7	.904	25.0	87	65	482 to 527.
275 to 300	6.2	20.9	.913	23.5	175	85	527 to 572.

Carbon residue of residuum, 12.3 percent; carbon residue of crude, 2.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	21.8	0.709	68.1	
Total gasoline and naphtha	46.8	0.743	58.9	
Kerosene distillate	4.1	.825	40.0	
Gas oil	12.4	.854	34.2	
Nonviscous lubricating distillate	10.0	.873–.905	30.6–24.9	50 to 100.
Medium lubricating distillate	7.3	.905–.915	24.9–23.1	100 to 200.
Viscous lubricating distillate				
Residuum	17.7	.988	11.7	
Distillation loss	1.7			

Sample 294

CARBON COUNTY: FERRIS FIELD, MOWRY AND THERMOPOLIS SHALES, SEC. 25, T. 26 N., R. 87 W.

Composite sample; depth, 1,700–1,800 feet

General characteristics

Specific gravity, 0.843; A. P. I. gravity, 36.4°
Sulfur, percent, 0.23; pour point, 15° F.
Saybolt Universal viscosity at 100° F., 48 sec.; color, dark green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 745 MM. FIRST DROP, 38° C. (100° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.7	0.7	0.690	73.6			Up to 122.
50 to 75	2.3	3.0					122 to 167.
75 to 100	4.8	7.8	.721	64.8			167 to 212.
100 to 125	8.8	16.6	.741	59.5			212 to 257.
125 to 150	5.2	21.8	.761	54.4			257 to 302.
150 to 175	5.3	27.1	.778	50.4			302 to 347.
175 to 200	4.1	31.2	.794	46.7			347 to 392.
200 to 225	4.0	35.2	.809	43.4			392 to 437.
225 to 250	5.0	40.2	.820	41.1			437 to 482.
250 to 275	6.4	46.6	.829	39.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	4.5	4.5	0.839	37.2	40		Up to 392.
200 to 225	5.4	9.9	.843	36.4	45	45	392 to 437.
225 to 250	8.0	17.9	.852	34.6	56	65	437 to 482.
250 to 275	5.2	23.1	.864	32.3	82	80	482 to 527.
275 to 300	6.2	29.3	.877	29.9	140	95	527 to 572.

Carbon residue of residuum, 3.9 percent; carbon residue of crude, 0.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	7.8	0.709	68.1	
Total gasoline and naphtha	31.2	0.752	56.7	
Kerosene distillate	9.0	.815	42.1	
Gas oil	16.4	.836	37.8	
Nonviscous lubricating distillate	12.3	.847–.868	35.6–31.5	50 to 100.
Medium lubricating distillate	7.0	.868–.884	31.5–28.6	100 to 200.
Viscous lubricating distillate				
Residuum	21.1			
Distillation loss	3.0			

Sample 30–20

PARK COUNTY: FOURBEAR FIELD, TENSLEEP SANDSTONE, NE¼ SEC. 29, T. 48 N., R. 103 W.

Well 2; depth, 3,260–3,278 feet; Honolulu Oil Corp.

General characteristics

Specific gravity, 0.976; A. P. I. gravity, **13.5°**
Sulfur, percent, 3.88; pour point, 45° F.
Saybolt Universal viscosity at 100° F., over 6,000 sec.; **color, brownish black**

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 569 MM. FIRST DROP, 105° C. (220° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125							212 to 257.
125 to 150							257 to 302.
150 to 175	0.9	0.9	0.784	49.0			302 to 347.
175 to 200	1.4	2.3					347 to 392.
200 to 225	2.4	4.7	.801	45.2			392 to 437.
225 to 250	3.3	8.0	.828	39.4			437 to 482.
250 to 275	6.7	14.7	.850	35.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.6	0.6	0.890	27.5	57	Below 5	Up to 392.
200 to 225	4.0	4.6					392 to 437.
225 to 250	6.3	10.9	.902	25.4	74	25	437 to 482.
250 to 275	6.7	17.6	.922	22.0	135	40	482 to 527.
275 to 300	11.5	29.1	.938	19.4	260	60	527 to 572.

Carbon residue of residuum, 22.3 percent; carbon residue of crude, 13.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	2.3	0.784	49.0	
Kerosene distillate	2.4	.801	45.2	
Gas oil	10.6	.846	35.8	
Nonviscous lubricating distillate	10.0	.886–.911	28.2–23.8	50 to 100.
Medium lubricating distillate	8.5	.911–.930	23.8–20.7	100 to 200.
Viscous lubricating distillate	10.0	.930–.948	20.7–17.8	Above 200.
Residuum	55.9	1.040		
Distillation loss	.3			

Sample 30–2

PARK COUNTY: FRANNIE FIELD, TENSLEEP SANDSTONE, T. 58 N., R. 98 W.

Composite sample; depth, 2,600–2,825 feet

General characteristics

Specific gravity, 0.889; A. P. I. gravity, 27.7°
Sulfur, percent, 2.44; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 72 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 576 MM. FIRST DROP, 29° C. (84° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.6	1.6	0.672	79.1			Up to 122.
50 to 75	2.0	3.6					122 to 167.
75 to 100	3.1	6.7	.714	66.7			167 to 212.
100 to 125	3.9	10.6	.744	58.7			212 to 257.
125 to 150	4.0	14.6	.769	52.5			257 to 302.
150 to 175	3.9	18.5	.789	47.8			302 to 347.
175 to 200	3.9	22.4	.808	43.6			347 to 392.
200 to 225	4.7	27.1	.824	40.2			392 to 437.
225 to 250	5.2	32.3	.841	36.8			437 to 482.
250 to 275	6.3	38.6	.863	32.5			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.5	0.5	0.884	28.6	51	20	Up to 392.
200 to 225	6.6	7.1					392 to 437.
225 to 250	6.6	13.7	.899	25.9	70	40	437 to 482.
250 to 275	6.8	20.5	.916	23.0	125	55	482 to 527.
275 to 300	7.8	28.3	.926	21.3	230	65	527 to 572.

Carbon residue of residuum, 12.8 percent; carbon residue of crude, 4.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	6.7	0.691	73.3	
Total gasoline and naphtha	22.4	0.752	56.7	
Kerosene distillate	4.7	.824	40.2	
Gas oil	14.9	.859	33.2	
Nonviscous lubricating distillate	10.8	.883–.908	28.8–24.3	50 to 100.
Medium lubricating distillate	8.2	.908–.923	24.3–21.8	100 to 200.
Viscous lubricating distillate	5.9	.923–.932	21.8–20.2	Above 200.
Residuum	32.3	.996	10.6	
Distillation loss	.8			

Sample 30–3

PARK COUNTY: FRANNIE FIELD, MADISON LIMESTONE, NW¼ SEC. 25, T. 58 N., R. 98 W.

Rosenburg well 36; depth, 2,925–3,013 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.949; A. P. I. gravity, 17.6°
Sulfur, percent, 3.16; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 870 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 576 MM. FIRST DROP, 135° C. (275° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125							212 to 257.
125 to 150	0.3	0.3	0.785	48.8			257 to 302.
150 to 175	1.3	1.6					302 to 347.
175 to 200	1.9	3.5					347 to 392.
200 to 225	3.0	6.5	.813	42.6			392 to 437.
225 to 250	4.4	10.9	.831	38.8			437 to 482.
250 to 275	6.7	17.6	.849	35.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.3	0.3	0.880	29.3	53	10	Up to 392.
200 to 225	6.6	6.9					392 to 437.
225 to 250	7.3	14.2	.896	26.4	72	25	437 to 482.
250 to 275	8.8	23.0	.918	22.6	135	40	482 to 527.
275 to 300	9.5	32.5	.932	20.3	240	55	527 to 572.

Carbon residue of residuum, 17.1 percent; carbon residue of crude, 9.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	3.5	0.785	48.8	
Kerosene distillate	3.0	.813	42.6	
Gas oil	13.6	.848	35.4	
Nonviscous lubricating distillate	11.7	.878–.906	29.7–24.7	50 to 100.
Medium lubricating distillate	10.1	.906–.926	24.7–21.3	100 to 200.
Viscous lubricating distillate	8.2	.926–.940	21.3–19.0	Above 200.
Residuum	49.5	1.017		
Distillation loss	.4			

Laboratory No. 37-011 [1]

PARK COUNTY: GARLAND FIELD, FRONTIER FORMATION, SE¼ SEC. 33, T. 56 N., R. 97 W.

Wells 22, 23, and 29; depth, 450-700 feet; Jones Bros.

General characteristics

Specific gravity, 0.822; A. P. I. gravity, 40.6°
Sulfur, percent, less than 0.1; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 36 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 642 MM. FIRST DROP, 48° C. (118° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	2.9	2.9	0.703	69.8			122 to 167.
75 to 100	7.2	10.1	.721	64.8			167 to 212.
100 to 125	11.2	21.3	.751	56.9			212 to 257.
125 to 150	9.6	30.9	.777	50.6			257 to 302.
150 to 175	7.0	37.9	.797	46.0			302 to 347.
175 to 200	5.5	43.4	.810	43.2			347 to 392.
200 to 225	5.4	48.8	.820	41.1			392 to 437.
225 to 250	7.1	55.9	.834	38.2			437 to 482.
250 to 275	7.9	63.8	.843	36.4			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	4.7	4.7	0.863	32.5	43	Below 5	Up to 392.
200 to 225	5.9	10.6	.867	31.7	47	20	392 to 437.
225 to 250	4.8	15.4	.873	30.6	57	40	437 to 482.
250 to 275	4.2	19.6	.880	29.3	76	60	482 to 527.
275 to 300	4.7	24.3	.888	27.9	118	75	527 to 572.

Carbon residue of residuum, 1.31 percent; carbon residue of crude, 0.16 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	10.1	0.716	66.1	
Total gasoline and naphtha	43.4	0.763	54.0	
Kerosene distillate	5.4	.820	41.1	
Gas oil	24.4	.849	35.2	Below 50.
Nonviscous lubricating distillate	10.7	.869-.885	31.3-28.4	50 to 100.
Medium lubricating distillate	4.2	.885-.892	28.4-27.1	100 to 200.
Viscous lubricating distillate				
Residuum	10.8	.911	23.8	
Distillation loss	1.1			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 37L-18

PARK COUNTY: GARLAND FIELD, TENSLEEP SANDSTONE, NE¼ SEC. 24, T. 56 N., R. 98 W.

Lease 043977-78, well 3; depth, 4,235-4,323 feet; Kinney Coastal Oil Co.

General characteristics

Specific gravity, 0.928; A. P. I. gravity, 21.0°
Sulfur, percent, 2.84; pour point, below 0° F.
Saybolt Universal viscosity at 100° F., 270 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 109° C. (228° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	0.5	0.5	0.751	56.9			212 to 257.
125 to 150	1.6	2.1					257 to 302.
150 to 175	3.4	5.5	.767	53.0			302 to 347.
175 to 200	4.2	9.7	.788	48.1			347 to 392.
200 to 225	5.8	15.5	.809	43.4			392 to 437.
225 to 250	5.5	21.0	.829	39.2			437 to 482.
250 to 275	12.1	33.1	.850	35.0			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200							Up to 392.
200 to 225	2.5	2.5	0.882	28.9	54	35	392 to 437.
225 to 250	8.3	10.8	.898	26.1	72	45	437 to 482.
250 to 275	7.8	18.6	.916	23.0	131	70	482 to 527.
275 to 300	9.2	27.8	.931	20.5	330	75	527 to 572.

Carbon residue of residuum, 20.8 percent; carbon residue of crude, 8.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	9.7	0.773	51.6	
Kerosene distillate	5.8	.809	43.4	
Gas oil	17.6	.843	36.4	
Nonviscous lubricating distillate	10.5	.878-.907	29.7-24.5	50 to 100.
Medium lubricating distillate	7.0	.907-.921	24.5-22.1	100 to 200.
Viscous lubricating distillate	10.3	.921-.939	22.1-19.2	Above 200.
Residuum	38.3	1.030	5.9	
Distillation loss	.8			

Sample 37L–51

BIG HORN COUNTY: GARLAND FIELD, MADISON LIMESTONE, SE¼ SEC. 33, T. 56 N., R. 97 W.

V. Smith well 1; depth, 3,994–4,100 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.931; A. P. I. gravity, 20.5°
Sulfur, percent, 3.03; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 300 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 60° C. (140° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.4	0.4	0.676	77.8			122 to 167.
75 to 100	1.4	1.8					167 to 212.
100 to 125	2.1	3.9	.713	67.0			212 to 257.
125 to 150	2.7	6.6	.740	59.7			257 to 302.
150 to 175	2.8	9.4	.764	53.7			302 to 347.
175 to 200	3.2	12.6	.787	48.3			347 to 392.
200 to 225	4.0	16.6	.805	44.3			392 to 437.
225 to 250	4.5	21.1	.826	39.8			437 to 482.
250 to 275	6.1	27.2	.847	35.6			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	3.4	3.4	0.874	30.4	44	Below 5	Up to 392.
200 to 225	5.1	8.5	.885	28.4	52	20	392 to 437.
225 to 250	6.2	14.7	.902	25.4	73	35	437 to 482.
250 to 275	6.8	21.5	.917	22.8	125	55	482 to 527.
275 to 300	8.8	30.3	.941	18.9	330	80	527 to 572.

Carbon residue of residuum, 21.0 percent; carbon residue of crude, 9.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.8	0.676	77.8	
Total gasoline and naphtha	12.7	0.743	58.9	
Kerosene distillate	4.0	.805	44.3	
Gas oil	15.5	.850	35.0	
Nonviscous lubricating distillate	12.5	.882–.916	28.9–23.0	50 to 100.
Medium lubricating distillate	3.6	.916–.927	23.0–21.1	100 to 200.
Viscous lubricating distillate	9.2	.927–.955	21.1–16.7	Above 200.
Residuum	42.2	1.035	5.2	
Distillation loss	.3			

Sample 37L–38

PARK COUNTY: GOOSEBERRY FIELD, EMBAR LIME AND TENSLEEP SANDSTONE, NW¼ SEC. 33, T. 47 N., R. 100 W.

Government well 1; depth, 5,668–5,993 feet; General Petroleum Corp.

General characteristics

Specific gravity, 0.925; A. P. I. gravity, 21.5°
Sulfur, percent, 2.52; pour point, below 10° F.
Saybolt Universal viscosity at 100° F., 257 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 44° C. (112° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.3	0.3	0.660	82.9			Up to 122.
50 to 75	1.6	1.9	.686	74.7			122 to 167.
75 to 100	.9	2.8	.693	72.7			167 to 212.
100 to 125	1.4	4.2	.716	66.1			212 to 257.
125 to 150	2.3	6.5	.743	58.9			257 to 302.
150 to 175	3.1	9.6	.769	52.5			302 to 347.
175 to 200	2.7	12.3	.791	47.4			347 to 392.
200 to 225	4.2	16.5	.814	42.3			392 to 437.
225 to 250	5.0	21.5	.834	38.2			437 to 482.
250 to 275	9.9	31.4	.855	34.0			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	0.2	0.2	0.882	28.9	51	25	Up to 392.
200 to 225	3.2	3.4					392 to 437.
225 to 250	5.7	9.1	.898	26.1	70	40	437 to 482.
250 to 275	7.5	16.6	.914	23.3	114	60	482 to 527.
275 to 300	7.7	24.3	.927	21.1	243	75	527 to 572.

Carbon residue of residuum, 18.7 percent; carbon residue of crude, 9.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	2.8	0.685	75.1	
Total gasoline and naphtha	12.3	0.744	58.7	
Kerosene distillate	4.2	.805	44.3	
Gas oil	16.1	.850	35.0	
Nonviscous lubricating distillate	9.6	.880–.909	29.3–24.2	50 to 100.
Medium lubricating distillate	7.1	.909–.923	24.2–21.8	100 to 200.
Viscous lubricating distillate	6.4	.923–.935	21.8–19.8	Above 200.
Residuum	44.2	1.012	8.3	
Distillation loss	.1			

Sample 37L–26

CARBON COUNTY: GP FIELD, GP SAND, NW¼ SEC. 16, T. 25 N., R. 86 W.

State 1; depth, 3,116–3,131 feet; Indian Petroleum Co.

General characteristics

Specific gravity, 0.868; A. P. I. gravity, 31.5°
Sulfur, percent, 0.22; pour point, 40° F.
Saybolt Universal viscosity at 100°F., 54 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 59° C. (138° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.6	0.6	0.728	62.9			122 to 167.
75 to 100	2.1	2.7	.730	62.3			167 to 212.
100 to 125	3.7	6.4	.748	57.7			212 to 257.
125 to 150	5.3	11.7	.765	53.5			257 to 302.
150 to 175	5.4	17.1	.782	49.4			302 to 347.
175 to 200	5.8	22.9	.800	45.4			347 to 392.
200 to 225	5.1	28.0	.812	42.8			392 to 437.
225 to 250	6.9	34.9	.821	40.8			437 to 482.
250 to 275	7.5	42.4	.831	38.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.4	1.4	0.846	35.8	43	30	Up to 392.
200 to 225	7.7	9.1	.851	34.8	48	40	392 to 437.
225 to 250	7.7	16.8	.861	32.8	62	60	437 to 482.
250 to 275	7.4	24.2	.876	30.0	98	75	482 to 527.
275 to 300	8.1	32.3	.892	21.1	190	90	527 to 572.

Carbon residue of residuum, 5.2 percent; carbon residue of crude, 1.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	2.7	0.730	62.3	
Total gasoline and naphtha	22.9	0.771	52.0	
Kerosene distillate	12.0	.817	41.7	
Gas oil	13.9	.839	37.2	
Nonviscous lubricating distillate	14.3	.852–.877	34.6–29.8	50 to 100.
Medium lubricating distillate	8.5	.877–.894	29.8–26.8	100 to 200.
Viscous lubricating distillate	3.1	.894–.900	26.8–25.7	Above 200.
Residuum	25.2	.949	17.6	
Distillation loss	.1			

Sample 37L–22

HOT SPRINGS COUNTY: GRASS CREEK FIELD, FRONTIER FORMATION, NE¼ SEC. 19, T. 46 N., R. 98 W.

Meeteetse 17, well 12; depth, 775–1,110 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.798; A. P. I. gravity, 45.8°
Sulfur, percent, less than 0.1; pour point, 0° F.
Saybolt Universal viscosity at 100°F., 34 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 22° C. (71° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	5.6	5.6	0.658	83.5			Up to 122.
50 to 75	7.2	12.8	.686	74.8			122 to 167.
75 to 100	8.2	21.0	.729	62.6			167 to 212.
100 to 125	9.0	30.0	.751	56.9			212 to 257.
125 to 150	6.8	36.8	.771	52.0			257 to 302.
150 to 175	6.2	43.0	.786	48.5			302 to 347.
175 to 200	5.8	48.8	.799	45.6			347 to 392.
200 to 225	5.1	53.9	.813	42.5			392 to 437.
225 to 250	5.8	59.7	.828	39.4			437 to 482.
250 to 275	5.7	65.4	.837	37.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.1	2.1	0.846	35.8	42	30	Up to 392.
200 to 225	6.5	8.6	.850	35.0	47	45	392 to 437.
225 to 250	4.7	13.3	.863	32.5	58	70	437 to 482.
250 to 275	4.2	17.5	.873	30.6	85	85	482 to 527.
275 to 300	4.9	22.4	.887	28.0	[1]47	100	527 to 572.

Carbon residue of residuum, 3.3 percent; carbon residue of crude, 0.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	21.0	0.695	72.1	
Total gasoline and naphtha	48.8	0.740	59.7	
Kerosene distillate	5.1	.813	42.5	
Gas oil	15.7	.836	37.8	
Nonviscous lubricating distillate	12.7	.849–.878	35.2–29.7	50 to 100.
Medium lubricating distillate	5.5	.878–.897	29.7–26.2	100 to 200.
Viscous lubricating distillate				
Residuum	10.6	.937	19.5	
Distillation loss	1.6			

[1]At 212° F.

Laboratory No. 37–012 [1]

HOT SPRINGS COUNTY: GRASS CREEK FIELD, EMBAR LIME, SE¼ SEC. 19, T. 46 N., R. 98 W.

Ridgley 20–E; depth, 3,962–3,980 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.907; A. P. I. gravity, 24.5°
Sulfur, percent, 2.54; pour point, below 5° F.
Saybolt Universal viscosity at 100°F., 110 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 647 MM. FIRST DROP, 44° C. (111° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.4	0.4	0.701	70.4			Up to 122.
50 to 75	1.6	2.0					122 to 167.
75 to 100	2.3	4.3	.711	67.5			167 to 212.
100 to 125	2.7	7.0	.720	65.0			212 to 257.
125 to 150	2.9	9.9	.732	61.8			257 to 302.
150 to 175	3.0	12.9	.752	56.7			302 to 347.
175 to 200	3.2	16.1	.774	51.3			347 to 392.
200 to 225	3.4	19.5	.796	46.3			392 to 437.
225 to 250	4.1	23.6	.809	43.4			437 to 482.
250 to 275	5.8	29.4	.829	39.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.9	1.9	0.869	31.3	42	Below 5	Up to 392.
200 to 225	6.3	8.2	.876	30.0	46	10	392 to 437.
225 to 250	5.5	13.7	.892	27.1	58	30	437 to 482.
250 to 275	5.5	19.2	.911	23.8	89	55	482 to 527.
275 to 300	6.1	25.3	.925	21.5	160	70	527 to 572.

Carbon residue of residuum, 7.94 percent; carbon residue of crude, 3.82 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.3	0.706	68.9	
Total gasoline and naphtha	16.1	0.735	61.0	
Kerosene distillate	7.5	.803	44.7	
Gas oil	13.0	.853	34.4	Below 50.
Nonviscous lubricating distillate	10.2	.881–.913	29.1–23.5	50 to 100.
Medium lubricating distillate	7.9	.913–.932	23.5–20.3	100 to 200.
Viscous lubricating distillate				
Residuum	45.0	1.008		
Distillation loss	.3			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 37L–48

HOT SPRINGS COUNTY: GRASS CREEK FIELD, EMBAR LIME AND TENSLEEP SANDSTONE, NW¼ SEC. 19, T. 46 N., R. 98 W.

L. G. Phelps No. 10; depth, 3,755–4,225 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.905; A. P. I. gravity, 24.8°
Sulfur, percent, 2.67; pour point, below 5° F.
Saybolt Universal viscosity at 100°F., 125 sec.; color brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 582 MM. FIRST DROP, 28° C. (82° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.4	1.4	0.658	83.5			Up to 122.
50 to 75	1.6	3.0	.662	82.2			122 to 167.
75 to 100	2.1	5.1	.699	70.9			167 to 212.
100 to 125	2.8	7.9	.717	65.8			212 to 257.
125 to 150	2.9	10.8	.749	57.4			257 to 302.
150 to 175	3.5	14.3	.771	52.0			302 to 347.
175 to 200	3.7	18.0	.794	46.7			347 to 392.
200 to 225	4.1	22.1	.810	43.2			392 to 437.
225 to 250	4.8	26.9	.829	39.2			437 to 482.
250 to 275	8.0	34.9	.850	35.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.8	1.8	0.869	31.3	42	15	Up to 392.
200 to 225	3.6	5.4	.881	29.1	52	30	392 to 437.
225 to 250	5.8	11.2	.893	26.9	64	40	437 to 482.
250 to 275	6.3	17.5	.911	23.8	98	60	482 to 527.
275 to 300	7.9	25.4	.926	21.3	240	75	527 to 572.

Carbon residue of residuum, 15.6 percent; carbon residue of crude, 6.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	5.1	0.676	77.8	
Total gasoline and naphtha	18.0	0.737	60.5	
Kerosene distillate	4.1	.810	43.2	
Gas oil	15.8	.848	35.4	
Nonviscous lubricating distillate	11.4	.879–.911	29.5–23.8	50 to 100.
Medium lubricating distillate	5.0	.911–.921	23.8–22.1	100 to 200.
Viscous lubricating distillate	6.0	.921–.934	22.1–20.0	Above 200.
Residuum	39.5	1.007	9.0	
Distillation loss	.2			

169597°—41——10

Sample 37L–23

BIG HORN COUNTY: GREYBULL FIELD, GREYBULL SAND, SW¼ SEC. 17, T. 52 N., R. 93 W.

Tom Alford Nos. 9, 11, and 12; depth, 1,115–1,265 feet; C. E. Carlson

General characteristics

Specific gravity, 0.786; A. P. I. gravity, 48.5°
Sulfur, percent, less than 0.1; pour point, 50° F.
Saybolt Universal viscosity at 100° F., 34 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 23° C. (74° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	4.7	4.7	0.669	80.0			Up to 122.
50 to 75	6.0	10.7	.677	77.5			122 to 167.
75 to 100	8.7	19.4	.717	65.8			167 to 212.
100 to 125	8.7	28.1	.740	59.7			212 to 257.
125 to 150	5.9	34.0	.753	56.4			257 to 302.
150 to 175	5.9	39.9	.766	53.2			302 to 347.
175 to 200	5.2	45.1	.778	50.4			347 to 392.
200 to 225	5.5	50.6	.791	47.4			392 to 437.
225 to 250	5.7	56.3	.825	44.3			437 to 482.
250 to 275	6.9	63.2	.813	42.5			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.4	1.4	0.819	41.3	39	40	Up to 392.
200 to 225	5.7	7.1	.823	40.4	42	50	392 to 437.
225 to 250	6.2	13.3	.834	38.2	49	70	437 to 482.
250 to 275	6.9	20.2	.843	36.4	80	90	482 to 527.
275 to 300	5.2	25.4	.857	33.6	[1]41	105	527 to 572.

Carbon residue of residuum, 1.8 percent; carbon residue of crude, 0.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	19.4	0.693	72.7	
Total gasoline and naphtha	45.1	0.729	62.6	
Kerosene distillate	18.1	.804	44.5	
Gas oil	10.4	.825	40.0	
Nonviscous lubricating distillate	15.0	.834–.863	38.2–32.5	50 to 100.
Medium lubricating distillate				
Viscous lubricating distillate				
Residuum	11.1	.912	23.6	
Distillation loss	.3			

[1] At 212° F.

Sample 37L–42

HOT SPRINGS COUNTY: HAMILTON DOME FIELD, CURTIS SAND, SW¼ SEC. 14, T. 44 N., R. 98 W.

Well 1; depth, 1,745–1,760 feet; Empire State Oil Co.

General characteristics

Specific gravity, 0.928; A. P. I. gravity, 21.0°
Sulfur, percent, 3.05; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 380 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 592 MM. FIRST DROP, 71° C. (160° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.5	0.5	0.692	73.0			122 to 167.
75 to 100	.8	1.3	.701	70.3			167 to 212.
100 to 125	1.3	2.6	.715	66.4			212 to 257.
125 to 150	2.2	4.8	.734	61.3			257 to 302.
150 to 175	3.0	7.8	.759	54.9			302 to 347.
175 to 200	3.3	11.1	.778	50.4			347 to 392.
200 to 225	3.9	15.0	.802	44.9			392 to 437.
225 to 250	4.7	19.7	.821	40.9			437 to 482.
250 to 275	6.3	26.0	.840	37.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.3	1.3	0.869	31.3	40	Below 5	Up to 392.
200 to 225	5.3	6.6	.874	30.4	48	25	392 to 437.
225 to 250	6.7	13.3	.889	27.7	63	40	437 to 482.
250 to 275	7.6	20.9	.907	24.5	100	65	482 to 527.
275 to 300	9.0	29.9	.921	22.1	195	80	527 to 572.

Carbon residue of residuum, 19.7 percent; carbon residue of crude, 9.5 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.3	0.698	71.2	
Total gasoline and naphtha	11.1	0.747	57.9	
Kerosene distillate	8.6	.812	42.8	
Gas oil	10.8	.853	34.4	
Nonviscous lubricating distillate	12.6	.875–.907	30.2–24.5	50 to 100.
Medium lubricating distillate	8.6	.907–.922	24.5–22.0	100 to 200.
Viscous lubricating distillate	4.2	.922–.929	22.0–20.8	Above 200.
Residuum	43.8	1.023	6.8	
Distillation loss	.3			

Sample 30–16

HOT SPRINGS COUNTY: HAMILTON DOME FIELD, EMBAR LIME, SW¼ SEC. 13, T. 44 N., R. 98 W.

Wells 13 and 15; depth, 2,462–2,488 feet; Argo Oil Co.

General characteristics

Specific gravity, 0.901; A. P. I. gravity, 25.6°
Sulfur, percent, 2.39; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 105 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 587 MM. FIRST DROP, 28° C. (82° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.8	0.8	0.693	72.7			Up to 122.
50 to 75	1.2	2.0					122 to 167.
75 to 100	1.9	3.9					167 to 212.
100 to 125	2.7	6.6	.733	61.5			212 to 257.
125 to 150	3.5	10.1	.758	55.2			257 to 302.
150 to 175	3.9	14.0	.778	50.4			302 to 347.
175 to 200	3.9	17.9	.796	46.3			347 to 392.
200 to 225	4.4	22.3	.813	42.6			392 to 437.
225 to 250	5.0	27.3	.831	38.8			437 to 482.
250 to 275	7.1	34.4	.852	34.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.1	2.1	0.874	30.4	47	15	Up to 392.
200 to 225	7.5	9.6	.879	29.5	51	30	392 to 437.
225 to 250	7.1	16.7	.899	25.9	77	55	437 to 482.
250 to 275	6.2	22.9	.914	23.3	145	70	482 to 527.
275 to 300	7.1	30.0	.924	21.6	250	85	527 to 572.

Carbon residue of residuum, 17.0 percent; carbon residue of crude, 6.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	3.9	0.693	72.7	
Total gasoline and naphtha	17.9	0.753	56.4	
Kerosene distillate	4.4	.813	42.6	
Gas oil	16.9	.853	34.4	
Nonviscous lubricating distillate	10.7	.878–.904	29.7–25.0	50 to 100.
Medium lubricating distillate	7.9	.904–.920	25.0–22.3	100 to 200.
Viscous lubricating distillate	6.6	.920–.929	22.3–20.8	Above 200.
Residuum	35.3	1.006		
Distillation loss	.3			

Sample 30–17

HOT SPRINGS COUNTY: HAMILTON DOME FIELD, EMBAR LIME, NW¼ SEC. 14, T. 44 N., R. 98 W.

Well 1; depth, 2,863–2,889 feet; Phebus Oil Co.

General characteristics

Specific gravity, 0.955; A. P. I. gravity, 16.7°
Sulfur, percent, 3.49; pour point, 15° F.
Saybolt Universal viscosity at 100° F., 1,330 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 62° C. (144° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.3	0.3	0.747	57.9			122 to 167.
75 to 100	.1	.4					167 to 212.
100 to 125	.4	.8					212 to 257.
125 to 150	1.0	1.8					257 to 302.
150 to 175	1.5	3.3	.771	52.0			302 to 347.
175 to 200	2.0	5.3	.794	46.7			347 to 392.
200 to 225	3.1	8.4	.819	41.3			392 to 437.
225 to 250	3.6	12.0	.838	37.4			437 to 482.
250 to 275	7.1	19.1	.859	33.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.7	0.7	0.883	28.8	50	Below 5	Up to 392.
200 to 225	5.5	6.2	.890	27.5	54	10	392 to 437.
225 to 250	5.9	12.1	.908	24.3	76	20	437 to 482.
250 to 275	5.8	17.9	.923	21.8	120	30	482 to 527.
275 to 300	9.3	27.2	.935	19.8	240	45	527 to 572.

Carbon residue of residuum, 18.5 percent; carbon residue of crude, 10.5 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.4			
Total gasoline and naphtha	5.3	0.771	51.8	
Kerosene distillate	3.1	.819	41.3	
Gas oil	11.1	.853	34.4	
Nonviscous lubricating distillate	12.0	.883–.915	28.8–23.1	50 to 100.
Medium lubricating distillate	7.7	.915–.931	23.1–20.5	100 to 200.
Viscous lubricating distillate	7.1	.931–.942	20.5–18.7	Above 200.
Residuum	53.1	1.022		
Distillation loss	.6			

Sample 36L–3

MOFFAT COUNTY: HIAWATHA FIELD, WASATCH FORMATION, NE¼ SEC. 22, T. 12 N., R. 100 W.

Wilson 1; depth, 2,020–2,220 feet; Mountain Fuel Supply Co.

General characteristics

Specific gravity, 0.850; A. P. I. gravity, 35.0°
Sulfur, percent, 0.21; pour point, 75° F.
Saybolt Universal viscosity at 100° F., 43 sec.; color, medium green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 587 MM. FIRST DROP, 51° C. (123° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	1.7	1.7	0.724	64.0			122 to 167.
75 to 100	2.6	4.3	.752	56.7			167 to 212.
100 to 125	5.1	9.4	.771	52.0			212 to 257.
125 to 150	5.2	14.6	.800	45.4			257 to 302.
150 to 175	5.2	19.8	.822	40.6			302 to 347.
175 to 200	3.8	23.6	.835	38.0			347 to 392.
200 to 225	4.1	27.7	.841	36.8			392 to 437.
225 to 250	6.0	33.7	.844	36.2			437 to 482.
250 to 275	8.2	41.9	.846	35.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.5	3.5	0.843	36.4	44	40	Up to 392.
200 to 225	8.9	12.4	.846	35.8	46	50	392 to 437.
225 to 250	7.3	19.7	.856	33.8	53	80	437 to 482.
250 to 275	7.8	27.5	.858	33.4	[1] 37	100	482 to 527.
275 to 300	9.0	36.5	.862	31.9	[1] 40	115	527 to 572.

Carbon residue of residuum, 5.9 percent; carbon residue of crude, 1.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.3	0.741	59 4	
Total gasoline and naphtha	19.8	0.785	48.7	
Kerosene distillate				
Gas oil	35.4	.843	36.4	
Nonviscous lubricating distillate	16.6	.853–.861	34.4–32.8	50 to 100.
Medium lubricating distillate	6.6	.861–.864	32.8–32.3	100 to 200.
Viscous lubricating distillate				
Residuum	18.9	.941	18.9	
Distillation loss	2.7			

[1] At 212° F.

Sample 37L–20

WASHAKIE COUNTY: HIDDEN DOME FIELD, FRONTIER FORMATION, SW¼ SEC. 30, T. 48 N., R. 90 W.

Buffalo 018320 A, well 2; depth, 1,538–1,543 feet; Bruce Teeters

General characteristics

Specific gravity, 0.808; A. P. I. gravity, 43.6°
Sulfur, percent, less than 0.1; pour point, below 0° F.
Saybolt Universal viscosity at 70° F., 33 sec.; color, NPA 2½

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 589 MM. FIRST DROP, 22° C. (71° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.9	1.9	0.669	80.4			Up to 122.
50 to 75	3.2	5.1	.704	69.5			122 to 167.
75 to 100	6.5	11.6	.722	64.5			167 to 212.
100 to 125	10.9	22.5	.759	54.9			212 to 257.
125 to 150	14.4	36.9	.782	49.5			257 to 302.
150 to 175	11.8	48.7	.803	44.7			302 to 347.
175 to 200	9.1	57.8	.824	40.2			347 to 392.
200 to 225	8.7	66.5	.844	36.2			392 to 437.
225 to 250	8.3	74.8	.853	34.4			437 to 482.
250 to 275	8.2	83.0	.856	33.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.6	1.6	0.855	34.0	42	25	Up to 392.
200 to 225	5.0	6.6	.857	33.6	46	40	392 to 437.
225 to 250	3.4	10.0	.860	33.0	55	55	437 to 482.
250 to 275	2.0	12.0	.867	31.7	75	80	482 to 527.
275 to 300	1.6	13.6	.875	30.2	115	95	527 to 572.

Carbon residue of residuum, 1.6 percent; carbon residue of crude, less than 0.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	11.6	0.708	68.4	
Total gasoline and naphtha	57.8	0.774	51.3	
Kerosene distillate				
Gas oil	31.2	.852	34.6	
Nonviscous lubricating distillate	6.2	.858–.872	33.4–30.8	50 to 100.
Medium lubricating distillate	1.4	.872–.878	30.8–29.7	100 to 200.
Viscous lubricating distillate				
Residuum	1.6	.919	22.5	
Distillation loss	1.8			

Sample 24706

NATRONA COUNTY: IRON CREEK FIELD, DAKOTA SAND, W½ SEC. 11, T. 32 N., R. 82 W.

Composite sample; depth, 800–825 feet; New York Oil Co.

General characteristics

Specific gravity, 0.887; A. P. I. gravity, 28.0°
Sulfur, percent, 0.21; pour point, 20° F.
Saybolt Universal viscosity at 100° F., 120 sec.

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 749 MM. FIRST DROP, 125° C. (255° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125							212 to 257.
125 to 150	1.5	1.5	0.792	47.2			257 to 302.
150 to 175	2.6	4.1					302 to 347.
175 to 200	2.5	6.6					347 to 392.
200 to 225	4.6	11.2	.821	40.9			392 to 437.
225 to 250	4.2	15.4	.834	38.2			437 to 482.
250 to 275	7.0	22.4	.843	36.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	6.0	6.0	0.862	32.7	44		Up to 392.
200 to 225	8.1	14.1	.862	32.7	48		392 to 437.
225 to 250	6.5	20.6	.874	30.4	84	44	437 to 482.
250 to 275	4.4	25.0	.886	28.2	87	62	482 to 527.
275 to 300							527 to 572.

Carbon residue of residuum 4.1 percent; carbon residue of crude, 2.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	6.6	0.792	47.2	
Kerosene distillate	4.6	.821	40.9	
Gas oil	21.7	.850	35.0	
Nonviscous lubricating distillate	14.5	.862–.898	32.8–26.1	50 to 100.
Medium lubricating distillate				100 to 200.
Viscous lubricating distillate				Above 200.
Residuum	52.8	.917	22.8	
Distillation loss				

Sample 37L–21

HOT SPRINGS COUNTY: KIRBY CREEK FIELD, FRONTIER FORMATION, NE¼ SEC. 21, T. 43 N., R. 92 W.

Eagle No. 1, well 2; depth, 405 feet; A. L. and Fred Freudenthal

General characteristics

Specific gravity, 0.825; A. P. I. gravity, 40.0°
Sulfur, percent, less than 0.1; pour point, below 0° F.
Saybolt Universal viscosity at 100° F., 38 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 587 MM. FIRST DROP, 26° C. (79° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	3.5	3.5	0.686	74.8			Up to 122.
50 to 75	3.4	6.9	.713	66.9			122 to 167.
75 to 100	6.5	13.4	.717	65.8			167 to 212.
100 to 125	6.7	20.1	.744	58.7			212 to 257.
125 to 150	6.1	26.2	.768	52.7			257 to 302.
150 to 175	6.2	32.4	.793	46.9			302 to 347.
175 to 200	4.4	36.8	.804	44.5			347 to 392.
200 to 225	5.3	42.1	.817	41.7			392 to 437.
225 to 250	5.7	47.8	.831	38.8			437 to 482.
250 to 275	6.2	54.0	.841	36.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.8	2.8	0.855	34.0	43	25	Up to 392.
200 to 225	5.1	7.9	.858	33.4	47	40	392 to 437.
225 to 250	5.8	13.7	.865	32.1	59	60	437 to 482.
250 to 275	6.4	20.1	.875	30.2	83	80	482 to 527.
275 to 300	6.4	26.5	.886	28.2	155	95	527 to 572.

Carbon residue of residuum, 4.0 percent; carbon residue of crude, 0.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	13.4	0.708	68.4	
Total gasoline and naphtha	36.8	0.750	57.2	
Kerosene distillate	5.3	.817	41.7	
Gas oil	18.7	.843	36.4	
Nonviscous lubricating distillate	11.6	.860–.878	33.0–29.7	50 to 100.
Medium lubricating distillate	8.1	.878–.892	29.7–27.1	100 to 200.
Viscous lubricating distillate				Above 200.
Residuum	17.8	.934	20.0	
Distillation loss	1.7			

Laboratory No. 33–08 [1]

SUBLETTE COUNTY: LABARGE FIELD, ALMY FORMATION, NW¼ SEC. 27, T. 27 N., R. 113 W.

Well 1; depth, 1,231–1,236 and 1,249–1,292 feet; Reese Oil Co.

General characteristics

Specific gravity, 0.798; A. P. I. gravity, 45.8°
Sulfur, percent, 0.20; pour point, 65° F.
Saybolt Universal viscosity at 100° F., 33 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 639 MM. FIRST DROP, 25° C. (77° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	4.1	4.1	0.648	86.9			Up to 122.
50 to 75	3.6	7.7	.673	78.8			122 to 167.
75 to 100	7.7	15.4	.715	66.4			167 to 212.
100 to 125	9.2	24.6	.754	56.2			212 to 257.
125 to 150	6.4	31.0	.774	51.3			257 to 302.
150 to 175	5.9	36.9	.788	48.1			302 to 347.
175 to 200	4.3	41.2	.796	46.3			347 to 392.
200 to 225	4.9	46.1	.805	44.3			392 to 437.
225 to 250	6.5	52.6	.820	41.1			437 to 482.
250 to 275	6.7	59.3	.834	38.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	4.1	4.1	0.845	36.0	40	40	Up to 392.
200 to 225	7.3	11.4	.848	35.4	44	55	392 to 437.
225 to 250	5.7	17.1	.852	34.6	53	80	437 to 482.
250 to 275	6.0	23.1	.856	33.8	68	95	482 to 527.
275 to 300	5.1	28.2	.860	33.0	87	110	527 to 572.

Carbon residue of residuum, 2.50 percent; carbon residue of crude, 0.26 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	15.4	0.687	74.5	
Total gasoline and naphtha	41.2	0.741	59.5	
Kerosene distillate	11.4	.814	42.3	
Gas oil	18.7	.842	36.6	Below 50.
Nonviscous lubricating distillate	16.2	.851–.863	34.8–32.5	50 to 100.
Medium lubricating distillate				
Viscous lubricating distillate				
Residuum	9.1	.907	24.5	
Distillation loss	3.4			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 30–11

SUBLETTE COUNTY: LABARGE FIELD, ALMY FORMATION, NE¼ SEC. 34, T. 27 N., R. 113 W.

Well 7D; depth, 787–817 feet; Texas Co.

General characteristics

Specific gravity, 0.863; A. P. I. gravity, 32.5°
Sulfur, percent, less than 0.1; pour point, 35° F.
Saybolt Universal viscosity at 100° F., 42 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 587 MM. FIRST DROP, 28° C. (82° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.7	1.7	0.724	63.9			Up to 122.
50 to 75	2.5	4.2					122 to 167.
75 to 100	5.5	9.7	.747	57.9			167 to 212.
100 to 125	3.3	13.0	.771	52.0			212 to 257.
125 to 150	3.2	16.2	.794	46.7			257 to 302.
150 to 175	4.1	20.3	.819	41.3			302 to 347.
175 to 200	3.7	24.0	.839	37.2			347 to 392.
200 to 225	4.7	28.7	.856	33.8			392 to 437.
225 to 250	7.1	35.8	.872	30.8			437 to 482.
250 to 275	8.6	44.4	.882	28.9			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	6.7	6.7	0.889	27.7	41	15	Up to 392.
200 to 225	7.2	13.9	.890	27.5	46	34	392 to 437.
225 to 250	7.6	21.5	.893	27.0	63	52	437 to 482.
250 to 275	6.5	28.0	.898	26.1	75	70	482 to 527.
275 to 300	9.3	37.3	.903	25.2	135	90	527 to 572.

Carbon residue of residuum, 3.0 percent; carbon residue of crude, 0.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.7	0.737	60.5	
Total gasoline and naphtha	20.3	0.768	52.7	
Kerosene distillate				
Gas oil	36.3	.874	30.4	
Nonviscous lubricating distillate	16.0	.891–.900	27.3–25.7	50 to 100.
Medium lubricating distillate	9.1	.900–.906	25.7–24.7	100 to 200.
Viscous lubricating distillate				
Residuum	17.2	.940	19.0	
Distillation loss	1.1			

Sample 30431

LINCOLN COUNTY: LABARGE FIELD, ALMY FORMATION, NW¼ SEC. 3, T. 26 N., R. 113 W.

Composite sample, wells 2G, 3G, 2I, 3I, 3F, and 3H; depth, 800–1,000 feet; Texas Co.

General characteristics

Specific gravity, 0.919; A. P. I. gravity, 22.5°
Sulfur, percent, 0.14; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 780 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 745 MM. FIRST DROP, 38° C. (100° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.4	0.4					Up to 122.
50 to 75	.1	.5					122 to 167.
75 to 100	.3	.8	0.782	49.5			167 to 212.
100 to 125	.3	1.1					212 to 257.
125 to 150	.3	1.4					257 to 302.
150 to 175	2.1	3.5					302 to 347.
175 to 200	4.8	8.3	.836	37.8			347 to 392.
200 to 225	6.5	14.8	.863	32.5			392 to 437.
225 to 250	7.9	22.7	.884	28.6			437 to 482.
250 to 275	11.7	34.4	.903	25.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	6.3	6.3	0.923	21.8	45	10	Up to 392.
200 to 225	8.9	15.2	.935	19.8	57	20	392 to 437.
225 to 250	8.5	23.7	.944	18.4	89	30	437 to 482.
250 to 275	7.3	31.0	.948	17.8	175	40	482 to 527.
275 to 300	8.4	39.4	.949	17.6	410	50	527 to 572.

Carbon residue of residuum, 5.2 percent; carbon residue of crude, 1.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.8			
Total gasoline and naphtha	3.5	0.782	49.5	
Kerosene distillate				
Gas oil	37.3	.887	28.0	
Nonviscous lubricating distillate	14.1	.928–.945	21.0–18.2	50 to 100.
Medium lubricating distillate	8.0	.945–.948	18.2–17.8	100 to 200.
Viscous lubricating distillate	10.9	.948–.950	17.8–17.5	Above 200.
Residuum	26.0	.952	17.1	
Distillation loss	.2			

Sample 30–23

HOT SPRINGS COUNTY: LAKE CREEK FIELD, EMBAR LIME, NW¼ SEC. 34, T. 43 N., R. 91 W.

Union well 1; depth, 3,705–3,720 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.920; A. P. I. gravity, 22.3°
Sulfur, percent, 3.17; pour point, below 5°F.
Saybolt Universal viscosity at 100°F., 175 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 580 MM. FIRST DROP, 69°C. (155°F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.4	0.4					122 to 167.
75 to 100	.9	1.3	0.741	59.5			167 to 212.
100 to 125	1.8	3.1					212 to 257.
125 to 150	3.9	7.0	.769	52.5			257 to 302.
150 to 175	3.8	10.8	.792	47.2			302 to 347.
175 to 200	4.7	15.5	.811	43.0			347 to 392.
200 to 225	6.1	21.6	.825	40.0			392 to 437.
225 to 250	4.5	26.1	.843	36.4			437 to 482.
250 to 275	6.5	32.6	.857	33.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.7	0.7	0.884	28.6	50	25	Up to 392.
200 to 225	7.3	8.0					392 to 437.
225 to 250	7.7	15.7	.901	25.6	66	40	437 to 482.
250 to 275	6.1	21.8	.917	22.8	105	55	482 to 527.
275 to 300	8.2	30.0	.925	21.5	180	70	527 to 572.

Carbon residue of residuum, 16.4 percent; carbon residue of crude, 6.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.3			
Total gasoline and naphtha	15.5	0.782	49.5	
Kerosene distillate	6.1	.825	40.0	
Gas oil	15.4	.859	33.2	
Nonviscous lubricating distillate	13.5	.883–.915	28.8–23.1	50 to 100.
Medium lubricating distillate	9.9	.915–.927	23.1–21.1	100 to 200.
Viscous lubricating distillate	2.2	.927–.930	21.1–20.7	Above 200.
Residuum	37.3	1.012		
Distillation loss	.1			

Sample 38L–12

NIOBRARA COUNTY: LANCE CREEK FIELD, DAKOTA SAND, SE¼ SEC. 5, T. 35 N., R. 65 W.

Lamb Account 2, well 4; depth, 3,495–3,511 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.824; A. P. I. gravity, 40.2°
Sulfur, percent, less than 0.1; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 37 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 587 MM. FIRST DROP, 50° C. (122° F.)

Temperature, ° C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Tempera-ture, ° F.
Up to 50							Up to 122.
50 to 75	2.5	2.5	0.669	80.0			122 to 167.
75 to 100	7.0	9.5	.716	66.1			167 to 212.
100 to 125	8.6	18.1	.744	58.7			212 to 257.
125 to 150	6.8	24.9	.767	53.0			257 to 302.
150 to 175	6.0	30.9	.787	48.3			302 to 347.
175 to 200	4.4	35.3	.800	45.4			347 to 392.
200 to 225	5.1	40.4	.812	42.8			392 to 437.
225 to 250	5.8	46.2	.824	40.2			437 to 482.
250 to 275	7.1	53.3	.835	38.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.8	2.8	0.845	36.0	43	10	Up to 392.
200 to 225	6.1	8.9	.849	35.2	49	30	392 to 437.
225 to 250	6.3	15.2	.854	34.2	61	50	437 to 482.
250 to 275	6.4	21.6	.866	31.9	80	75	482 to 527.
275 to 300	7.2	28.8	.872	30.8	125	90	527 to 572.

Carbon residue of residuum, 1.4 percent; carbon residue of crude, 0.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.5	0.704	69.5	
Total gasoline and naphtha	35.3	0.752	56.7	
Kerosene distillate	10.9	.818	41.5	
Gas oil	13.6	.841	36.8	
Nonviscous lubricating distillate	15.0	.849–.869	35.2–31.3	50 to 100.
Medium lubricating distillate	7.3	.869–.877	31.3–29.9	100 to 200.
Viscous lubricating distillate				
Residuum	16.8	.904	25.0	
Distillation loss	1.1			

Sample 36L–7

NIOBRARA COUNTY: LANCE CREEK FIELD, UPPER SUNDANCE SAND, SW¼ SEC. 32, T. 36 N., R 65 W.

Richards & Comstock No. 2; depth, 3,615–3,632 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.812; A. P. I. gravity, 42.8°
Sulfur, percent, less than 0.1; pour point, 10° F.
Saybolt Universal viscosity at 70°F., 46 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 592 MM. FIRST DROP, 29° C. (84° F.)

Temperature, ° C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Tempera-ture, ° F.
Up to 50	4.9	4.9	0.645	87.9			Up to 122.
50 to 75	3.4	8.3	.675	78.1			122 to 167.
75 to 100	5.7	14.0	.711	67.5			167 to 212.
100 to 125	6.3	20.3	.734	61.3			212 to 257.
125 to 150	6.2	26.5	.752	56.7			257 to 302.
150 to 175	5.3	31.8	.769	52.5			302 to 347.
175 to 200	4.4	36.2	.782	49.4			347 to 392.
200 to 225	5.2	41.4	.797	46.0			392 to 437.
225 to 250	5.1	46.5	.809	43.4			437 to 482.
250 to 275	8.2	54.7	.823	40.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.7	1.7	0.836	37.8	42	35	Up to 392.
200 to 225	6.0	7.7	.841	36.8	45	45	392 to 437.
225 to 250	5.6	13.3	.854	34.2	56	60	437 to 482.
250 to 275	4.7	18.0	.865	32.1	72	80	482 to 527.
275 to 300	5.8	23.8	.876	30.0	130	100	527 to 572.

Carbon residue of residuum, 10.6 percent; carbon residue of crude, 2.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	14.0	0.679	76.9	
Total gasoline and naphtha	36.2	0.727	63.1	
Kerosene distillate	18.5	.812	42.8	
Gas oil	7.4	.840	37.0	
Nonviscous lubricating distillate	10.9	.847–.870	35.6–31.1	50 to 100.
Medium lubricating distillate	5.5	.870–.882	31.1–28.9	100 to 200.
Viscous lubricating distillate				
Residuum	17.9	.952	17.1	
Distillation loss	3.6			

Sample 36L–8

NIOBRARA COUNTY: LANCE CREEK FIELD, BASAL SUNDANCE SAND, NE¼ SEC. 5, T. 35 N., R. 65 W.

Lamb No. 7; depth, 3,854–3,907 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.782; A. P. I. gravity, 49.4°
Sulfur, percent, less than 0.1; pour point, below 5° F.
Saybolt Universal viscosity at 70° F., 34 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 593 MM. FIRST DROP, 26° C. (79° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	4.5	4.5	0.653	85.2			Up to 122.
50 to 75	6.3	10.8	.663	81.9			122 to 167.
75 to 100	8.3	19.1	.703	69.8			167 to 212.
100 to 125	8.5	27.6	.733	61.5			212 to 257.
125 to 150	6.9	34.5	.754	56.2			257 to 302.
150 to 175	7.1	41.6	.772	51.8			302 to 347.
175 to 200	4.6	46.2	.783	49.2			347 to 392.
200 to 225	5.4	51.6	.796	46.3			392 to 437.
225 to 250	5.5	57.1	.810	43.2			437 to 482.
250 to 275	6.7	63.8	.824	40.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.3	3.3	0.834	38.2	42	30	Up to 392.
200 to 225	5.3	8.6	.843	36.4	46	45	392 to 437.
225 to 250	4.6	13.2	.854	34.2	57	65	437 to 482.
250 to 275	3.7	16.9	.864	32.3	78	80	482 to 527.
275 to 300	6.2	23.1	.877	29.8	140	95	527 to 572.

Carbon residue of residuum, 4.2 percent; carbon residue of crude, 0.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	19.1	0.678	77.2	
Total gasoline and naphtha	46.2	0.724	63.9	
Kerosene distillate	17.6	.811	43.0	
Gas oil	7.8	.839	37.2	
Nonviscous lubricating distillate	8.9	.847–.868	35.6–31.5	50 to 100.
Medium lubricating distillate	6.4	.868–.885	31.5–28.4	100 to 200.
Viscous lubricating distillate				
Residuum	8.8	.928	20.9	
Distillation loss	4.3			

Sample 38L–7

NIOBRARA COUNTY: LANCE CREEK FIELD, CONVERSE SAND, SW¼ SEC. 32, T. 36 N., R. 65 W.

Converse Sheep well 5; depth, 4,394–4,434 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.818; A. P. I. gravity, 41.5°
Sulfur, percent, less than 0.10; pour point, 65° F.
Saybolt Universal viscosity at 100° F., 54 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 590 MM. FIRST DROP, 29° C. (84° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.1	2.1	0.658	83.6			Up to 122.
50 to 75	2.6	4.7	.661	82.6			122 to 167.
75 to 100	5.8	10.5	.697	71.5			167 to 212.
100 to 125	7.3	17.8	.726	63.4			212 to 257.
125 to 150	6.4	24.2	.745	58.4			257 to 302.
150 to 175	5.6	29.8	.763	54.0			302 to 347.
175 to 200	5.4	35.2	.778	50.4			347 to 392.
200 to 225	5.6	40.8	.794	46.7			392 to 437.
225 to 250	5.3	46.1	.808	43.6			437 to 482.
250 to 275	6.4	52.5	.820	41.1			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.5	2.5	0.832	38.6	41	30	Up to 392.
200 to 225	6.2	8.7	.837	37.6	46	50	392 to 437.
225 to 250	5.8	14.5	.856	33.8	58	65	437 to 482.
250 to 275	6.0	20.5	.863	32.5	78	85	482 to 527.
275 to 300	4.9	25.4	.882	28.9	[1]130	105	527 to 572.

Carbon residue of residuum, 4.9 percent; carbon residue of crude, 1.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	10.5	0.679	76.9	
Total gasoline and naphtha	35.2	0.730	62.3	
Kerosene distillate	17.3	.808	43.6	
Gas oil	7.6	.835	38.0	
Nonviscous lubricating distillate	14.6	.843–.879	36.4–29.5	50 to 100.
Medium lubricating distillate	3.2	.879–.890	29.5–27.5	100 to 200.
Viscous lubricating distillate				
Residuum	20.5	.938	19.4	
Distillation loss	1.6			

[1] Estimated from A. S. T. M. Temperature-Viscosity Chart.

Sample 38L–13

NIOBRARA COUNTY: LANCE CREEK FIELD, LEO SAND, SW¼ SEC. 5, T. 35 N., R. 65 W.

Dielman well 3; depth, 5,344–5,404 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.810; A. P. I. gravity, 43.2°
Sulfur, percent, less than 0.1; pour point, 40° F.
Saybolt Universal viscosity at 77° F., 47 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 590 MM. FIRST DROP, 26° C. (78° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.1	2.1	0.652	85.5			Up to 122.
50 to 75	3.6	5.7	.657	83.9			122 to 167.
75 to 100	5.9	11.6	.698	71.2			167 to 212.
100 to 125	7.5	19.1	.727	63.1			212 to 257.
125 to 150	6.2	25.3	.747	57.9			257 to 302.
150 to 175	6.0	31.3	.765	53.5			302 to 347.
175 to 200	4.7	36.0	.779	50.1			347 to 392.
200 to 225	5.4	41.4	.793	46.9			392 to 437.
225 to 250	5.8	47.2	.807	43.8			437 to 482.
250 to 275	6.4	53.6	.820	41.1			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.2	3.2	0.829	39.2	41	20	Up to 392.
200 to 225	5.1	8.3	.836	37.8	46	35	392 to 437.
225 to 250	5.8	14.1	.846	35.8	57	60	437 to 482.
250 to 275	5.0	19.1	.861	32.8	76	80	482 to 527.
275 to 300	5.5	24.6	.871	31.0	117	90	527 to 572.

Carbon residue of residuum, 4.3 percent; carbon residue of crude, 1.0 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	11.6	0.677	77.5	
Total gasoline and naphtha	36.0	0.727	63.1	
Kerosene distillate	17.6	.807	43.8	
Gas oil	7.8	.833	38.4	
Nonviscous lubricating distillate	12.0	.841–.867	36.8–31.7	50 to 100.
Medium lubricating distillate	4.8	.867–.876	31.7–30.0	100 to 200.
Viscous lubricating distillate				
Residuum	19.2	.931	20.5	
Distillation loss	2.6			

Sample 30–13

FREMONT COUNTY: LANDER FIELD, EMBAR LIME, SE¼ SEC. 13, T. 2 S., R. 1 E.

Well 8; depth, 1,800 feet; Woodson Oil Co.

General characteristics

Specific gravity, 0.910; A. P. I. gravity, 24.0°
Sulfur, percent, 2.98; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 160 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 583 MM. FIRST DROP, 25° C. (76° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.1	0.1	0.716	66.1			Up to 122.
50 to 75	.3	.4					122 to 167.
75 to 100	.9	1.3					167 to 212.
100 to 125	1.3	2.6					212 to 257.
125 to 150	2.0	4.6	.755	55.9			257 to 302.
150 to 175	2.6	7.2					302 to 347.
175 to 200	3.8	11.0	.791	47.4			347 to 392.
200 to 225	4.9	15.9	812	42.8			392 to 437.
225 to 250	4.8	20.7	.828	39.4			437 to 482.
250 to 275	6.9	27.6	.843	36.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.9	0.9	0.864	32.3	45	10	Up to 392.
200 to 225	7.3	8.2	.870	31.1	51	30	392 to 437.
225 to 250	7.3	15.5	.889	27.7	64	45	437 to 482.
250 to 275	7.3	22.8	.908	24.3	110	60	482 to 527.
275 to 300	8.9	31.7	.923	21.8	190	80	527 to 572.

Carbon residue of residuum, 14.2 percent; carbon residue of crude, 6.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.3	0.716	66.1	
Total gasoline and naphtha	11.0	0.763	54.0	
Kerosene distillate	4.9	.812	42.8	
Gas oil	15.7	.844	36.2	
Nonviscous lubricating distillate	13.6	.869–.904	31.3–25.0	50 to 100.
Medium lubricating distillate	10.7	.904–.925	25.0–21.5	100 to 200.
Viscous lubricating distillate	3.4	.925–.931	21.5–20.5	Above 200.
Residuum	39.2	1.002		
Distillation loss	1.5			

Sample 37L–16

FREMONT COUNTY: LANDER FIELD, TENSLEEP SANDSTONE, SE¼ SEC. 24, T. 2 S., R. 1 E.

Trust patented well 7; depth, 1,715–1,840 feet; Hudson Oil Co.

General characteristics

Specific gravity, 0.914; A. P. I. gravity, 23.3°
Sulfur, percent, 2.85; pour point, below 0°F.
Saybolt Universal viscosity at 100°F., 185 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 581 MM. FIRST DROP, 92° C. (198° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	0.2	0.2	0.716	66.1			167 to 212.
100 to 125	1.1	1.3					212 to 257.
125 to 150	2.2	3.5	.737	60.5			257 to 302.
150 to 175	2.5	6.0	.760	54.7			302 to 347.
175 to 200	3.6	9.6	.784	49.0			347 to 392.
200 to 225	4.8	14.4	.805	44.3			392 to 437.
225 to 250	4.9	19.3	.820	41.1			437 to 482.
250 to 275	9.7	29.0	.843	36.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.3	0.3	0.875	30.2	51	30	Up to 392.
200 to 225	9.1	9.4					392 to 437.
225 to 250	7.2	16.6	.885	28.4	57	50	437 to 482.
250 to 275	7.7	24.3	.913	23.5	120	70	482 to 527.
275 to 300	8.1	32.4	.928	21.0	230	85	527 to 572.

Carbon residue of residuum, 14.5 percent; carbon residue of crude, 6.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	9.6	0.758	55.2	
Kerosene distillate	9.7	.813	42.5	
Gas oil	13.5	.851	34.8	
Nonviscous lubricating distillate	14.6	.874–.904	30.4–25.0	50 to 100.
Medium lubricating distillate	7.8	.904–.924	25.0–21.6	100 to 200.
Viscous lubricating distillate	6.2	.924–.936	21.6–19.7	Above 200.
Residuum	38.6	1.003	9.6	
Distillation loss				

Sample 37L–33

SWEETWATER COUNTY: LOST SOLDIER FIELD, SECOND WALL CREEK SAND, NE¼ SEC. 10, T. 26 N., R. 90 W.

Well 25; depth, 373–604 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.874; A. P. I. gravity, 30.4°
Sulfur, percent, 0.11; pour point, below 5°F.
Saybolt Universal viscosity at 100° F., 52 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 64° C. (147° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.8	0.8	0.750	57.2			122 to 167.
75 to 100	2.4	3.2	.758	55.2			167 to 212.
100 to 125	3.7	6.9	.781	49.7			212 to 257.
125 to 150	3.9	10.8	.799	45.6			257 to 302.
150 to 175	3.8	14.6	.818	41.5			302 to 347.
175 to 200	3.5	18.1	.832	38.6			347 to 392.
200 to 225	4.8	22.9	.848	35.4			392 to 437.
225 to 250	6.7	29.6	.855	34.0			437 to 482.
250 to 275	8.5	38.1	.857	33.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.8	2.8	0.863	32.5	42	35	Up to 392.
200 to 225	11.4	14.2	.864	32.3	47	40	392 to 437.
225 to 250	9.2	23.4	.874	30.4	62	55	437 to 482.
250 to 275	8.7	32.1	.883	28.7	88	75	482 to 527.
275 to 300	7.6	39.7	.897	26.2	170	90	527 to 572

Carbon residue of residuum, 5.9 percent; carbon residue of crude, 1.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	3.2	0.756	55.7	
Total gasoline and naphtha	14.6	0.790	47.6	
Kerosene distillate				
Gas oil	34.2	.855	34.0	
Nonviscous lubricating distillate	18.3	.866–.885	31.9–28.4	50 to 100.
Medium lubricating distillate	9.7	.885–.901	28.4–25.6	100 to 200.
Viscous lubricating distillate	1.0	.901–.903	25.6–25.2	Above 200.
Residuum	22.2	.951	17.3	
Distillation loss				

Sample 37L–32

SWEETWATER COUNTY: LOST SOLDIER FIELD, DAKOTA SAND, SE¼ SEC. 3, T. 26 N., R. 90 W.

Well 39; depth, 2,098–2,128 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.870; A. P. I. gravity, 31.1°
Sulfur, percent, less than 0.1; pour point, 75° F.
Saybolt Universal viscosity at 100°F., 66 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 75°C. (167°F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	2.7	2.7	0.742	59.2			167 to 212.
100 to 125	2.6	5.3	.757	55.4			212 to 257.
125 to 150	2.4	7.7	.772	51.8			257 to 302.
150 to 175	2.5	10.2	.792	47.2			302 to 347.
175 to 200	2.9	13.1	.813	42.5			347 to 392.
200 to 225	4.6	17.7	.833	38.4			392 to 437.
225 to 250	6.1	23.8	.848	35.4			437 to 482.
250 to 275	9.1	32.9	.850	35.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.5	1.5	0.850	35.0	42	25	Up to 392.
200 to 225	12.9	14.4	.852	34.6	46	50	392 to 437.
225 to 250	9.1	23.5	.862	32.7	56	60	437 to 482.
250 to 275	8.8	32.3	.872	30.8	78	85	482 to 527.
275 to 300	9.2	41.5	.885	28.4	140	95	527 to 572.

Carbon residue of residuum, 6.0 percent; carbon residue of crude, 1.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	2.7	0.742	59.2	
Total gasoline and naphtha	13.1	0.776	50.8	
Kerosene distillate				
Gas oil	32.3	.848	35.4	
Nonviscous lubricating distillate	18.7	.856–.877	33.8–29.8	50 to 100.
Medium lubricating distillate	10.3	.877–.892	29.8–27.1	100 to 200.
Viscous lubricating distillate				
Residuum	25.6	.944	18.4	
Distillation loss				

Sample 37L–31

SWEETWATER COUNTY: LOST SOLDIER FIELD, LAKOTA SAND, SE¼ SEC. 3, T. 26 N., R. 90 W.

Well 42; depth, 1,897–1,905 and 1,930–1,950 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.878; A. P. I. gravity, 29.7°
Sulfur, percent, 0.10; pour point, 75° F.
Saybolt Universal viscosity at 100°F., 77 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 87°C. (188°F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	3.4	3.4	0.769	52.5			167 to 212.
100 to 125	1.4	4.8	.776	50.8			212 to 257.
125 to 150	1.4	6.2	.780	49.9			257 to 302.
150 to 175	2.0	8.2	.797	46.0			302 to 347.
175 to 200	2.8	11.0	.822	40.6			347 to 392.
200 to 225	4.6	15.6	.842	36.6			392 to 437.
225 to 250	5.9	21.5	.852	34.6			437 to 482.
250 to 275	8.2	29.7	.856	33.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.0	3.0	0.856	33.8	43	30	Up to 392.
200 to 225	12.5	15.5	.858	33.4	47	45	392 to 437.
225 to 250	11.0	26.5	.865	32.1	59	65	437 to 482.
250 to 275	10.7	37.2	.875	30.2	89	85	482 to 527.
275 to 300	9.1	46.3	.881	29.1	[1]46	105	527 to 572.

Carbon residue of residuum, 6.4 percent; carbon residue of crude, 1.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	3.4	0.769	52.5	
Total gasoline and naphtha	8.2	0.779	50.1	
Kerosene distillate	2.8	.822	40.6	
Gas oil	31.2	.854	34.2	
Nonviscous lubricating distillate	25.1	.860–.878	33.0–29.7	50 to 100.
Medium lubricating distillate	8.7	.878–.884	29.7–28.6	100 to 200.
Viscous lubricating distillate				
Residuum	23.4	.951	17.3	
Distillation loss	.6			

[1] At 212° F.

Sample 37L–30

SWEETWATER COUNTY: LOST SOLDIER FIELD, MORRISON FORMATION, NE¼ SEC. 10, T. 26 N., R. 90 W.

Well 50; depth, 1,950–1,954 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.883; A. P. I. gravity, 28.7°
Sulfur, percent, 0.11; pour point, 75° F.
Saybolt Universal viscosity at 100° F., 99 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 589 MM. FIRST DROP, 89° C. (192° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	0.6	0.6	0.760	54.7			167 to 212.
100 to 125	.7	1.3	.773	51.5			212 to 257.
125 to 150	1.6	2.9	.781	49.7			257 to 302.
150 to 175	1.8	4.7	.806	44.1			302 to 347.
175 to 200	2.7	7.4	.830	39.0			347 to 392.
200 to 225	4.6	12.0	.849	35.2			392 to 437.
225 to 250	5.5	17.5	.857	33.6			437 to 482.
250 to 275	8.8	26.3	.858	33.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.8	3.8	0.858	33.4	43	30	Up to 392.
200 to 225	13.0	16.8	.860	33.0	48	45	392 to 437.
225 to 250	11.6	28.4	.868	31.5	61	65	437 to 482.
250 to 275	8.4	36.8	.877	29.8	116	85	482 to 527.
275 to 300	9.1	45.9	.896	26.4	185	95	527 to 572.

Carbon residue of residuum, 6.5 percent; carbon residue of crude, 2.0 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.6	0.760	54.7	
Total gasoline and naphtha	4.7	0.787	48.3	
Kerosene distillate				
Gas oil	33.8	.855	34.0	
Nonviscous lubricating distillate	17.5	.861–.874	32.8–30.4	50 to 100.
Medium lubricating distillate	13.6	.874–.900	30.4–25.7	100 to 200.
Viscous lubricating distillate	2.6	.900–.906	25.7–24.7	Above 200.
Residuum	27.8	.951	17.3	
Distillation loss				

Sample 37L–29

SWEETWATER COUNTY: LOST SOLDIER FIELD, SUNDANCE FORMATION, NW¼ SEC. 11, T. 26 N., R. 90 W.

Well 49; depth, 1,975–2,068 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.879; A. P. I. gravity, 29.5°
Sulfur, percent, 0.10; pour point, 75° F.
Saybolt Universal viscosity at 100° F., 79 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 591 MM. FIRST DROP, 72° C. (162° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	1.1	1.1	0.733	61.5			122 to 167.
75 to 100	3.4	4.5					167 to 212.
100 to 125	1.2	5.7	.776	50.8			212 to 257.
125 to 150	1.5	7.2	.785	48.7			257 to 302.
150 to 175	1.7	8.9	.802	44.9			302 to 347.
175 to 200	2.5	11.4	.829	39.2			347 to 392.
200 to 225	5.0	16.4	.843	36.4			392 to 437.
225 to 250	6.7	23.1	.853	34.4			437 to 482.
250 to 275	8.6	31.7	.856	33.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.9	0.9	0.859	33.2	46	30	Up to 392.
200 to 225	11.1	12.0	.861	32.8	47	40	392 to 437.
225 to 250	11.2	23.2	.866	31.9	57	60	437 to 482.
250 to 275	8.7	31.9	.872	30.8	80	80	482 to 527.
275 to 300	8.8	40.7	.883	28.8	130	95	527 to 572.

Carbon residue of residuum, 6.1 percent; carbon residue of crude, 1.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.5	0.733	61.5	
Total gasoline and naphtha	11.4	0.776	50.8	
Kerosene distillate				
Gas oil	30.3	.855	34.0	
Nonviscous lubricating distillate	23.5	.862–.880	32.7–29.3	50 to 100.
Medium lubricating distillate	7.2	.880–.888	29.3–27.8	100 to 200.
Viscous lubricating distillate				
Residuum	27.3	.944	18.4	
Distillation loss	.3			

Sample 37L–40

SWEETWATER COUNTY: LOST SOLDIER FIELD, TENSLEEP SANDSTONE, NW¼ SEC. 11, T. 26 N., R. 90 W.

Well 75; depth, 3,942–4,009 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.854; A. P. I. gravity, 34.2°
Sulfur, percent, 1.23; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 43 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 586 MM. FIRST DROP, 27° C. (81° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.9	1.9	0.649	86.5			Up to 122.
50 to 75	3.2	5.1	.666	81.0			122 to 167.
75 to 100	4.4	9.5	.698	71.2			167 to 212.
100 to 125	5.1	14.6	.729	62.6			212 to 257.
125 to 150	5.6	20.2	.756	55.7			257 to 302.
150 to 175	5.2	25.4	.775	51.1			302 to 347.
175 to 200	4.8	30.2	.790	47.6			347 to 392.
200 to 225	5.5	35.7	.806	44.1			392 to 437.
225 to 250	6.2	41.9	.824	40.2			437 to 482.
250 to 275	6.3	48.2	.843	36.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.3	2.3	0.869	31.3	44	Below 5	Up to 392.
200 to 225	6.8	9.1	.872	30.8	46	15	392 to 437.
225 to 250	6.8	15.9	.886	28.2	61	45	437 to 482.
250 to 275	5.6	21.5	.901	25.5	93	65	482 to 527.
275 to 300	6.2	27.7	.912	23.6	185	80	527 to 572.

Carbon residue of residuum, 11.8 percent; carbon residue of crude, 3.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.5	0.677	77.5	
Total gasoline and naphtha	30.2	0.735	61.0	
Kerosene distillate	11.7	.816	41.9	
Gas oil	13.8	.858	33.4	
Nonviscous lubricating distillate	11.7	.876–.902	30.0–25.4	50 to 100.
Medium lubricating distillate	6.2	.902–.914	25.4–23.3	100 to 200.
Viscous lubricating distillate	2.3	.914–.919	23.3–22.5	Above 200.
Residuum	23.3	.982	12.6	
Distillation loss	.8			

Sample 39L–1

CARBON COUNTY: MAHONEY DOME FIELD, TENSLEEP SANDSTONE, NW¼ SEC. 34, T. 26 N., R. 88 W.

Mahoney No. F–3; depth, 4,233–4,486 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.854; A. P. I. gravity, 34.2°
Sulfur, percent, 1.25; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 45 sec.; color, greenish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 580 MM. FIRST DROP, 59° C. (138° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	1.3	1.3	0.685	75.1			122 to 167.
75 to 100	3.6	4.9	.688	74.2			167 to 212.
100 to 125	5.3	10.2	.712	67.2			212 to 257.
125 to 150	5.8	16.0	.735	61.0			257 to 302.
150 to 175	6.1	22.1	.756	55.7			302 to 347.
175 to 200	4.9	27.0	.776	50.9			347 to 392.
200 to 225	6.2	33.2	.796	46.3			392 to 437.
225 to 250	6.3	39.5	.813	42.6			437 to 482.
250 to 275	7.7	47.2	.832	38.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.9	2.9	0.858	33.4	41	10	Up to 392.
200 to 225	6.5	9.4	.864	32.3	49	25	392 to 437.
225 to 250	7.0	16.4	.878	29.7	58	45	437 to 482.
250 to 275	6.6	23.0	.901	25.6	86	65	482 to 527.
275 to 300	6.8	29.8	.914	23.3	182	80	527 to 572.

Carbon residue of residuum, 11.2 percent; carbon residue of crude, 2.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.9	0.687	74.5	
Total gasoline and naphtha	27.0	0.734	61.3	
Kerosene distillate	12.5	.805	44.3	
Gas oil	14.9	.846	35.8	
Nonviscous lubricating distillate	13.5	.866–.903	31.9–25.2	50 to 100.
Medium lubricating distillate	7.0	.903–.916	25.2–23.0	100 to 200.
Viscous lubricating distillate	2.1	.916–.920	23.0–22.3	Above 200.
Residuum	22.4	.981	12.7	
Distillation loss	.6			

Sample 37L–41

FREMONT COUNTY: MAVERICK SPRINGS FIELD, EMBAR LIME. NW¼ SEC. 15, T. 6 N., R. 2 W.

Well 7; depth, 1,634–1,649 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.923; A. P. I. gravity, 21.8°
Sulfur, percent, 2.91; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 260 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 586 MM. FIRST DROP, 117° C. (242° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	0.5	0.5	0.731	62.1			212 to 257.
125 to 150	2.0	2.5	.743	59.0			257 to 302.
150 to 175	2.8	5.3	.764	53.7			302 to 347.
175 to 200	3.2	8.5	.785	48.8			347 to 392.
200 to 225	4.5	13.0	.807	43.8			392 to 437.
225 to 250	5.2	18.2	.822	40.6			437 to 482.
250 to 275	7.4	25.6	.840	37.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.3	1.3	0.865	32.1	44	10	Up to 392.
200 to 225	6.5	7.8	.873	30.6	49	25	392 to 437.
225 to 250	8.3	16.1	.889	27.7	62	35	437 to 482.
250 to 275	7.3	23.4	.907	24.5	101	50	482 to 527.
275 to 300	10.5	33.9	.920	22.3	180	70	527 to 572.

Carbon residue of residuum, 15.5 percent; carbon residue of crude, 6.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	8.5	0.765	53.5	
Kerosene distillate	9.7	.815	42.1	
Gas oil	12.7	.852	34.6	
Nonviscous lubricating distillate	14.2	.874–.907	30.4–24.5	50 to 100.
Medium lubricating distillate	11.5	.907–.923	24.5–21.8	100 to 200.
Viscous lubricating distillate	2.9	.923–.928	21.8–21.0	Above 200.
Residuum	40.3	1.011	8.4	
Distillation loss	.2			

Sample 37L–35

CARBON COUNTY: MEDICINE BOW FIELD, FIRST SUNDANCE SAND, SE¼ SEC. 23, T. 21 N., R. 79 W.

U. P.-Johnson No. 3; depth, 5,526–5,577 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.740; A. P. I. gravity, 59.7°
Sulfur, percent, less than 0.1; pour point, below 5° F.
Saybolt Universal viscosity at 100°F., 29 sec.; color, N. P. A. 2½

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 591 MM. FIRST DROP, 26° C. (79° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	11.4	11.4	0.650	86.2			Up to 122.
50 to 75	11.7	23.1	.674	78.4			122 to 167.
75 to 100	14.5	37.6	.716	66.1			167 to 212.
100 to 125	13.3	50.9	.743	58.9			212 to 257.
125 to 150	10.0	60.9	.760	54.7			257 to 302.
150 to 175	7.3	68.2	.776	50.8			302 to 347.
175 to 200	5.9	74.1	.790	47.6			347 to 392.
200 to 225	6.2	80.3	.802	44.9			392 to 437.
225 to 250	4.7	85.0	.814	42.3			437 to 482.
250 to 275	4.3	89.3	.825	40.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.3	0.3	0.844	36.2	41	30	Up to 392.
200 to 225	1.9	2.2	.846	35.8	44	35	392 to 437.
225 to 250	1.5	3.7	.854	34.2	55	55	437 to 482.
250 to 275	1.2	4.9	.866	31.9	74	75	482 to 527.
275 to 300	1.1	6.0	.872	30.8	150	95	527 to 572.

Carbon residue of residuum, 4.6 percent; carbon residue of crude, less than 0.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	37.6	0.683	75.7	
Total gasoline and naphtha	74.1	0.722	64.5	
Kerosene distillate	15.2	.812	42.8	
Gas oil	2.2	.846	35.8	
Nonviscous lubricating distillate	2.5	.850–.868	35.0–31.5	50 to 100.
Medium lubricating distillate	1.3	.868–.869	31.5–31.3	100 to 200.
Viscous lubricating distillate				
Residuum	.9	.948	17.8	
Distillation loss	3.8			

Sample 37L–37

CARBON COUNTY: MEDICINE BOW FIELD, SECOND SUNDANCE SAND, NE¼ SEC. 26, T. 21 N., R. 79 W.

Kyle No. 1; depth, 5,299–5,397 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.728; A. P. I. gravity, 62.9°
Sulfur, percent, less than 0.1; pour point, below 5° F.
Saybolt Universal viscosity at 70° F., 30 sec.; color, N. P. A. 3½

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 590 MM. FIRST DROP, 22° C. (72° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	15.5	15.5	0.644	88.2			Up to 122.
50 to 75	12.3	27.8	.688	74.2			122 to 167.
75 to 100	12.0	39.8	.724	63.9			167 to 212.
100 to 125	11.2	51.0	.742	59.2			212 to 257.
125 to 150	8.1	59.1	.762	54.2			257 to 302.
150 to 175	6.2	65.3	.778	50.4			302 to 347.
175 to 200	4.9	70.2	.790	47.6			347 to 392.
200 to 225	4.6	74.8	.802	44.9			392 to 437.
225 to 250	3.5	78.3	.815	42.1			437 to 482.
250 to 275	4.1	82.4	.827	39.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.6	0.6	0.840	37.0	41	30	Up to 392.
200 to 225	1.9	2.5	.845	36.0	45	40	392 to 437.
225 to 250	1.4	3.9	.852	34.6	53	55	437 to 482.
250 to 275	.6	4.5	.862	32.7	63	70	482 to 527.
275 to 300	1.3	5.8	.884	28.6	145	90	527 to 572.

Carbon residue of residuum, 6.6 percent; carbon residue of crude, less than 0.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	39.8	0.682	76.0	
Total gasoline and naphtha	70.2	0.717	65.8	
Kerosene distillate	8.1	.808	43.6	
Gas oil	6.8	.834	38.2	
Nonviscous lubricating distillate	2.1	.850–.877	35.0–29.8	50 to 100.
Medium lubricating distillate	1.0	.877–.901	29.8–25.5	100 to 200.
Viscous lubricating distillate				
Residuum	.9	.972	14.1	
Distillation loss	10.9			

Sample 37L–17

NATRONA COUNTY: MIDWAY FIELD, SECOND WALL CREEK SAND, NE¼ SEC. 23, T. 35 N., R. 79 W.

Boyer 11A; depth, 5,156–5,186 feet; Mutual Oil Syndicate

General characteristics

Specific gravity, 0.879; A. P. I. gravity, 29.5°
Sulfur, percent, 0.34; pour point, 80° F.
Saybolt Universal viscosity at 100° F., 160 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 584 MM. FIRST DROP, 62° C. (144° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	1.8	1.8	0.716	66.1			122 to 167.
75 to 100	2.0	3.8	.730	62.3			167 to 212.
100 to 125	3.2	7.0	.750	57.2			212 to 257.
125 to 150	3.4	10.4	.767	53.0			257 to 302.
150 to 175	3.5	13.9	.788	48.1			302 to 347.
175 to 200	3.1	17.0	.802	44.9			347 to 392.
200 to 225	5.3	22.3	.819	41.3			392 to 437.
225 to 250	2.9	25.2	.831	38.8			437 to 482.
250 to 275	5.7	30.9	.836	37.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.9	0.9	0.841	36.8	42	30	Up to 392.
200 to 225	7.0	7.9	.845	36.0	46	40	392 to 437.
225 to 250	6.2	14.1	.862	32.7	59	60	437 to 482.
250 to 275	5.2	19.3	.874	30.4	86	80	482 to 527.
275 to 300	7.3	26.6	.886	28.2	140	95	527 to 572.

Carbon residue of residuum, 7.4 percent; carbon residue of crude, 3.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	3.8	0.723	64.2	
Total gasoline and naphtha	17.0	0.765	53.5	
Kerosene distillate	5.3	.819	41.3	
Gas oil	15.1	.838	37.4	
Nonviscous lubricating distillate	11.7	.850–.877	35.0–29.8	50 to 100.
Medium lubricating distillate	8.4	.877–.893	29.8–26.9	100 to 200.
Viscous lubricating distillate				
Residuum	42.0	.954	16.8	
Distillation loss	.5			

Sample 37L–9

NIOBRARA COUNTY: MULE CREEK FIELD, LAKOTA SAND, SW¼ SEC. 19, T. 39 N., R. 60 W.

We Hope So No. 1, wells 4, 5, 6, 8; average depth, 1,355 feet; Argo Oil Co.

General characteristics

Specific gravity, 0.868; A. P. I. gravity, 31.5°
Sulfur, percent, 0.12; pour point, 60° F.
Saybolt Universal viscosity at 100° F., 77 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 75° C. (167° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	1.4	1.4	0.728	62.9			167 to 212.
100 to 125	1.1	2.5	.741	59.4			212 to 257.
125 to 150	3.1	5.6	.756	55.7			257 to 302.
150 to 175	3.6	9.2	.775	51.1			302 to 347.
175 to 200	3.9	13.1	.795	46.5			347 to 392.
200 to 225	4.8	17.9	.811	43.0			392 to 437.
225 to 250	6.4	24.3	.824	40.2			437 to 482.
250 to 275	6.0	30.3	.832	38.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.9	1.9	0.848	35.4	42	35	Up to 392.
200 to 225	8.0	9.9	.852	34.6	46	40	392 to 437.
225 to 250	8.1	18.0	.861	32.8	57	60	437 to 482.
250 to 275	8.4	26.4	.872	30.8	82	80	482 to 527.
275 to 300	8.9	35.3	.886	28.2	155	90	527 to 572.

Carbon residue of residuum, 2.4 percent; carbon residue of crude, 0.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.4	0.728	62.9	
Total gasoline and naphtha	13.1	0.769	52.5	
Kerosene distillate	11.2	.818	41.5	
Gas oil	15.0	.843	36.4	
Nonviscous lubricating distillate	15.4	856–.876	33.8–30.0	50 to 100.
Medium lubricating distillate	10.9	.876–.892	30.0–27.1	100 to 200.
Viscous lubricating distillate				
Residuum	34.4	.932	20.3	
Distillation loss				

Sample 30–35

NIOBRARA COUNTY: MULE CREEK FIELD, MINNELUSA SANDSTONE, NW¼ SEC. 19, T. 39 N., R. 60 W.

Well 7; depth, 3,145–3,184 feet; Argo Oil Co.

General characteristics

Specific gravity, 0.901; A. P. I. gravity, 25.6°
Sulfur, percent, 2.40; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 68 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 584 MM. FIRST DROP, 32° C. (90° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.0	1.0					Up to 122.
50 to 75	1.5	2.5	0.704	69.5			122 to 167.
75 to 100	2.5	5.0					167 to 212.
100 to 125	3.9	8.9	.746	58.2			212 to 257.
125 to 150	4.1	13.0	.770	52.3			257 to 302.
150 to 175	4.2	17.2	.790	47.6			302 to 347.
175 to 200	4.2	21.4	.811	43.0			347 to 392.
200 to 225	5.7	27.1	.829	39.2			392 to 437.
225 to 250	5.5	32.6	.845	36.0			437 to 482.
250 to 275	7.7	40.3	.865	32.1			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.9	1.9	0.885	28.4	44	Below 5	Up to 392.
200 to 225	6.8	8.7	.892	27.1	50	10	392 to 437.
225 to 250	6.6	15.3	.907	24.5	68	30	437 to 482.
250 to 275	6.9	22.2	.924	21.6	135	50	482 to 527.
275 to 300	7.7	29.9	.938	19.4	310	65	527 to 572.

Carbon residue of residuum, 14.4 percent; carbon residue of crude, 4.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	5.0	0.704	69.5	
Total gasoline and naphtha	21.4	0.762	54.2	
Kerosene distillate				
Gas oil	24.2	.857	33.6	
Nonviscous lubricating distillate	10.0	.892–.915	27.1–23.1	50 to 100.
Medium lubricating distillate	6.3	.915–.930	23.1–20.7	100 to 200.
Viscous lubricating distillate	8.3	.930–.945	20.7–18.2	Above 200.
Residuum	29.7	1.012		
Distillation loss	.1			

Sample 31–1

NIOBRARA COUNTY: MULE CREEK FIELD (WEST), DAKOTA SAND, SW¼ SEC. 36, T. 40 N., R. 61 W.

Composite sample; depth, 220–240 feet; Interstate Oil Co.

General characteristics

Specific gravity, 0.852; A. P. I. gravity, 34.6°
Sulfur, percent, 0.13; pour point, 10° F.
Saybolt Universal viscosity at 100° F., 56 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 86° C. (188° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	1.1	1.1	0.717	65.9			167 to 212.
100 to 125	3.1	4.2	.730	62.3			212 to 257.
125 to 150	4.3	8.5	.749	57.4			257 to 302.
150 to 175	4.7	13.2	.767	53.0			302 to 347.
175 to 200	4.5	17.7	.784	49.0			347 to 392.
200 to 225	5.9	23.6	.802	44.9			392 to 437.
225 to 250	5.9	29.5	.813	42.6			437 to 482.
250 to 275	8.3	37.8	.824	40.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.4	3.4	0.843	36.4	43	30	Up to 392.
200 to 225	8.3	11.7	.846	35.8	47	45	392 to 437.
225 to 250	7.9	19.6	.857	33.6	57	56	437 to 482.
250 to 275	8.5	28.1	.868	31.5	78	80	482 to 527.
275 to 300	7.7	35.8	.883	28.8	140	95	527 to 572.

Carbon residue of residuum, 3.7 percent; carbon residue of crude, 1.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.1	0.717	65.9	
Total gasoline and naphtha	17.7	0.757	55.4	
Kerosene distillate	20.1	.814	42.3	
Gas oil	10.0	.845	36.0	
Nonviscous lubricating distillate	16.8	.849–.874	35.2–30.4	50 to 100.
Medium lubricating distillate	9.0	.874–.890	30.4–27.5	100 to 200.
Viscous lubricating distillate				
Residuum	26.3	.927	21.1	
Distillation loss	.1			

Sample 37L–10

NIOBRARA COUNTY: MULE CREEK FIELD (WEST), MINNELUSA SANDSTONE, SW¼ SEC. 2, T. 39 N., R. 61 W.

Morrell C–1; depth, 2,820–2,830 feet; Interstate Oil Co.

General characteristics

Specific gravity, 0.870; A. P. I. gravity, 31.1°
Sulfur, percent, 1.01; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 48 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 586 MM. FIRST DROP, 26° C. (79° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.5	2.5	0.652	85.5			Up to 122.
50 to 75	2.1	4.6	.675	78.1			122 to 167.
75 to 100	4.5	9.1	.713	66.9			167 to 212.
100 to 125	4.3	13.4	.738	60.2			212 to 257.
125 to 150	4.5	17.9	.760	54.7			257 to 302.
150 to 175	5.7	23.6	.780	49.9			302 to 347.
175 to 200	5.9	29.5	.798	45.8			347 to 392.
200 to 225	6.8	36.3	.818	41.5			392 to 437.
225 to 250	6.2	42.5	.837	37.6			437 to 482.
250 to 275	7.3	49.8	.851	34.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.1	1.1	0.872	30.8	45	45	Up to 392.
200 to 225	6.4	7.5	.880	29.3	50	45	392 to 437.
225 to 250	6.1	13.6	.895	26.6	68	50	437 to 482.
250 to 275	5.2	18.8	.912	23.6	125	55	482 to 527.
275 to 300	7.2	26.0	.933	20.2	280	65	527 to 572.

Carbon residue of residuum, 5.7 percent; carbon residue of crude, 1.5 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.1	0.687	74.5	
Total gasoline and naphtha	29.5	0.746	58.2	
Kerosene distillate	6.8	.818	41.5	
Gas oil	17.8	.852	34.6	
Nonviscous lubricating distillate	9.5	.880–.905	29.3–24.8	50 to 100.
Medium lubricating distillate	5.4	.905–.922	24.8–22.0	100 to 200.
Viscous lubricating distillate	6.8	.922–.945	22.0–18.2	
Residuum	22.9	1.009	8.8	
Distillation loss	1.3			

Sample 37062 [1]

FREMONT COUNTY: MUSKRAT FIELD, EMBAR LIME, NW¼ SEC. 1, T. 33 N., R. 92 W.

Well C-2; depth, 7,268-7,286 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.876; A. P. I. gravity, 30.0°
Sulfur, percent, 2.27; pour point, 30° F.
Saybolt Universal viscosity at 100° F., —sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 641 MM. FIRST DROP, 68° C. (154° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.4	0.4	0.721	64.8			122 to 167.
75 to 100	2.4	2.8					167 to 212.
100 to 125	4.3	7.1	.743	58.9			212 to 257.
125 to 150	5.5	12.6	.764	53.7			257 to 302.
150 to 175	4.8	17.4	.783	49.2			302 to 347.
175 to 200	4.7	22.1	.798	45.8			347 to 392.
200 to 225	4.6	26.7	.811	43.0			392 to 437.
225 to 250	5.8	32.5	.823	40.4			437 to 482.
250 to 275	6.5	39.0	.838	37.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	5.0	5.0	0.869	31.3	43	10	Up to 392.
200 to 225	6.4	11.4	.877	29.9	48	30	392 to 437.
225 to 250	6.8	18.2	.890	27.5	60	45	437 to 482.
250 to 275	5.7	23.9	.903	25.2	89	65	482 to 527.
275 to 300	7.2	31.1	.911	23.8	144	80	527 to 572.

Carbon residue of residuum, 14.1 percent; carbon residue of crude, 4.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	2.8	0.721	64.8	
Total gasoline and naphtha	22.1	0.766	53.2	
Kerosene distillate	10.4	.818	41.5	
Gas oil	15.9	.858	33.4	Below 50.
Nonviscous lubricating distillate	13.0	.879-.904	29.5-25.0	50 to 100.
Medium lubricating distillate	8.7	.904-.915	25.0-23.1	100 to 200.
Viscous lubricating distillate				
Residuum	28.2	.985	12.2	
Distillation loss	1.6			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 318

NATRONA COUNTY: NAVAL RESERVE NO. 3 FIELD, SECOND WALL CREEK SAND, Tps. 38 AND 39 N., R. 78 W.

General characteristics

Specific gravity, 0.848; A. P. I. gravity, 35.4°
Sulfur, percent, 0.20; pour point, 50° F.
Saybolt Universal viscosity at 100° F., 46 sec.; color, dark green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 745 MM. FIRST DROP, 33° C. (91° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.7	0.7	0.660	82.9			Up to 122.
50 to 75	1.5	2.2	.685	75.1			122 to 167.
75 to 100	4.7	6.9	.733	61.5			167 to 212.
100 to 125	7.1	14.0	.756	55.7			212 to 257.
125 to 150	5.7	19.7	.778	50.4			257 to 302.
150 to 175	4.2	23.9	.794	46.7			302 to 347.
175 to 200	4.1	28.0	.812	42.8			347 to 392.
200 to 225	4.0	32.0	.825	40.0			392 to 437.
225 to 250	4.5	36.5	.837	37.6			437 to 482.
250 to 275	6.4	42.9	.848	35.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	5.7	5.7	0.857	33.6	40		Up to 392.
200 to 225	5.4	11.1	.861	32.8	46	40	392 to 437.
225 to 250	4.1	15.2	.870	31.1	57	50	437 to 482.
250 to 275	4.8	20.0	.879	29.5	73	70	482 to 527.
275 to 300	6.9	26.9	.887	28.0	105	85	527 to 572.

Carbon residue of residuum, 6.2 percent; carbon residue of crude, 1.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	6.9	0.716	66.1	
Total gasoline and naphtha	28.0	0.765	53.5	
Kerosene distillate	4.0	.825	40.0	
Gas oil	21.1	.851	34.8	
Nonviscous lubricating distillate	12.1	.864-.885	32.3-28.4	50 to 100.
Medium lubricating distillate	4.6	.885-.892	28.4-27.1	100 to 200.
Viscous lubricating distillate				
Residuum	27.2			
Distillation loss	3.0			

Sample 30–26

NATRONA COUNTY: NORTH CASPER CREEK FIELD, TENSLEEP SANDSTONE, SE¼ SEC. 36, T. 37 N., R. 82 W.

Well 3; depth, 3,300 feet; All States Oil Co.

General characteristics

Specific gravity, 0.933; A. P. I. gravity, 20.2°
Sulfur, percent, 2.82; pour point, 15° F.
Saybolt Universal viscosity at 100° F., 340 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 582 MM. FIRST DROP, 98° C. (208° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	0.5	0.5					167 to 212.
100 to 125	.3	.8					212 to 257.
125 to 150	.8	1.6	0.763	54.0			257 to 302.
150 to 175	2.5	4.1					302 to 347.
175 to 200	3.1	7.2	.782	49.5			347 to 392.
200 to 225	4.5	11.7	.801	45.2			392 to 437.
225 to 250	5.0	16.7	.817	41.7			437 to 482.
250 to 275	6.9	23.6	.834	38.2			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	2.0	2.0	0.859	33.2	46	15	Up to 392.
200 to 225	7.0	9.0	.864	32.3	50	30	392 to 437.
225 to 250	7.9	16.9	.877	29.9	61	45	437 to 482.
250 to 275	8.8	25.7	.897	26.3	94	65	482 to 527.
275 to 300	7.9	33.6	.910	24.0	170	85	527 to 572.

Carbon residue of residuum, 19.0 percent; carbon residue of crude, 9.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.5			
Total gasoline and naphtha	7.2	0.771	52.0	
Kerosene distillate	9.5	.809	43.4	
Gas oil	12.4	.846	35.8	
Nonviscous lubricating distillate	16.5	.864–.898	32.3–26.1	50 to 100.
Medium lubricating distillate	11.0	.898–.915	26.1–23.1	100 to 200.
Viscous lubricating distillate	.6	.915–.916	23.1–23.0	Above 200.
Residuum	42.6	1.011		
Distillation loss	.2			

Sample 30–25

NATRONA COUNTY: NOTCHES DOME FIELD, TENSLEEP SANDSTONE, SW¼ SEC. 3, T. 37 N., R. 85 W.

Well 2; depth, 2,754–2,797 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.922; A. P. I. gravity, 22.0°
Sulfur, percent, 1.70; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 280 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 580 MM. FIRST DROP, 91° C. (196° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	0.5	0.5					212 to 257.
125 to 150	1.4	1.9	0.776	50.9			257 to 302.
150 to 175	2.3	4.2					302 to 347.
175 to 200	2.9	7.1	.805	44.3			347 to 392.
200 to 225	4.2	11.3	.824	40.2			392 to 437.
225 to 250	5.5	16.8	.840	37.0			437 to 482.
250 to 275	7.5	24.3	.853	34.4			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	0.8	0.8	0.873	30.6		Below 5	Up to 392.
200 to 225	10.2	11.0	.877	29.9	52	10	392 to 437.
225 to 250	7.2	18.2	.893	27.0	74	20	437 to 482.
250 to 275	7.7	25.9	.907	24.5	125	45	482 to 527.
275 to 300	9.4	35.3	.918	22.6	220	60	527 to 572.

Carbon residue of residuum, 16.1 percent; carbon residue of crude, 7.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	7.1	0.788	48.1	
Kerosene distillate	4.2	.824	40.2	
Gas oil	18.1	.855	34.0	
Nonviscous lubricating distillate	13.4	.877–.900	29.9–25.7	50 to 100.
Medium lubricating distillate	10.3	.900–.916	25.7–23.0	100 to 200.
Viscous lubricating distillate	6.5	.916–.924	23.0–22.6	Above 200.
Residuum	40.2	.999	10.1	
Distillation loss	.2			

Sample 38L–3

PARK COUNTY: OREGON BASIN FIELD, EMBAR LIME, NE¼ SEC. 29, T. 51 N., R. 100 W.

Well 1; depth, 3,508–3,636 feet; Stock Oil Co.

General characteristics

Specific gravity, 0.929; A. P. I. gravity, 20.8°
Sulfur, percent, 3.28; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 360 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 28° C. (82° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.7	0.7	0.679	76.9			Up to 122.
50 to 75	1.6	2.3					122 to 167.
75 to 100	2.5	4.8	.701	70.4			167 to 212.
100 to 125	2.4	7.2	.725	63.7			212 to 257.
125 to 150	2.7	9.9	.757	55.4			257 to 302.
150 to 175	3.1	13.0	.774	51.3			302 to 347.
175 to 200	3.1	16.1	.799	45.6			347 to 392.
200 to 225	3.0	19.1	.819	41.3			392 to 437.
225 to 250	4.1	23.2	.835	38.0			437 to 482.
250 to 275	6.3	29.5	.859	33.2			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	1.0	1.0	0.877	29.9	44	Below 5	Up to 392.
200 to 225	4.0	5.0	.888	27.9	52	20	392 to 437.
225 to 250	5.2	10.2	.902	25.4	69	35	437 to 482.
250 to 275	5.3	15.5	.917	22.8	100	50	482 to 527.
275 to 300	7.5	23.0	.940	19.0	220	70	527 to 572.

Carbon residue of residuum, 19.4 percent; carbon residue of crude, 9.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.8	0.690	73.6	
Total gasoline and naphtha	16.1	0.744	58.7	
Kerosene distillate	3.0	.819	41.3	
Gas oil	12.9	.855	34.0	
Nonviscous lubricating distillate	10.0	.886–.916	28.2–23.0	50 to 100.
Medium lubricating distillate	5.9	.916–.937	23.0–19.5	100 to 200.
Viscous lubricating distillate	4.6	.937–.953	19.5–17.0	Above 200.
Residuum	45.2	1.028	6.2	
Distillation loss	2.3			

Sample 36L–19

PARK COUNTY: OREGON BASIN FIELD, EMBAR LIME AND TENSLEEP SANDSTONE, T. 51 N., R. 100 W.

Composite sample; depth, 3,500–4,100 feet

General characteristics

Specific gravity, 0.926; A. P. I. gravity, 21.3°
Sulfur, percent, 3.37; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 300 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 37° C. (99° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.8	0.8	0.657	83.9			Up to 122.
50 to 75	1.0	1.8	.662	82.2			122 to 167.
75 to 100	2.2	4.0	.695	72.1			167 to 212.
100 to 125	2.8	6.8	.728	62.9			212 to 257.
125 to 150	3.1	9.9	.753	56.4			257 to 302.
150 to 175	3.0	12.9	.786	48.5			302 to 347.
175 to 200	2.9	15.8	.798	45.8			347 to 392.
200 to 225	3.4	19.2	.816	41.9			392 to 437.
225 to 250	4.1	23.3	.836	37.8			437 to 482.
250 to 275	6.6	29.9	.860	33.0			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	0.2	0.2	0.886	28.2	48	15	Up to 392.
200 to 225	4.0	4.2					392 to 437.
225 to 250	6.8	11.0	.900	25.7	63	40	437 to 482.
250 to 275	5.9	16.9	.917	22.8	105	55	482 to 527.
275 to 300	8.0	24.9	.933	20.2	220	75	527 to 572.

Carbon residue of residuum, 14.8 percent; carbon residue of crude, 7.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.0	0.679	76.9	
Total gasoline and naphtha	15.8	0.745	58.4	
Kerosene distillate	3.4	.816	41.9	
Gas oil	13.5	.858	33.4	
Nonviscous lubricating distillate	9.9	.888–.907	27.8–24.5	50 to 100.
Medium lubricating distillate	7.4	.907–.931	24.5–20.5	100 to 200.
Viscous lubricating distillate	4.9	.931–.942	20.5–18.7	Above 200.
Residuum	44.4	1.023	6.8	
Distillation loss	.7			

Sample 36L–17

WESTON COUNTY: OSAGE FIELD, NEWCASTLE SANDSTONE, SE¼ SEC. 18, T. 46 N., R. 63 W.

Dornacher well; depth, 1,125 feet; D. D. Oil Co.

General characteristics

Specific gravity, 0.837; A. P. I. gravity, 37.6°
Sulfur, percent, less than 0.1; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 50 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 579 MM. FIRST DROP, 23° C. (73° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.1	2.1	0.686	74.8			Up to 122.
50 to 75	3.3	5.4					122 to 167.
75 to 100	6.6	12.0	.729	62.6			167 to 212.
100 to 125	7.6	19.6	.763	54.0			212 to 257.
125 to 150	6.4	26.0	.784	49.0			257 to 302.
150 to 175	5.8	31.8	.792	47.2			302 to 347.
175 to 200	4.6	36.4	.805	44.3			347 to 392.
200 to 225	5.3	41.1	.820	41.1			392 to 437.
225 to 250	5.6	47.3	.836	37.8			437 to 482.
250 to 275	6.5	53.8	.844	36.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.7	1.7	0.852	34.6	44	30	Up to 392.
200 to 225	5.3	7.0	.855	34.0	47	40	392 to 437.
225 to 250	7.1	14.1	.861	32.8	59	60	437 to 482.
250 to 275	6.0	20.1	.874	30.4	84	80	482 to 527.
275 to 300	5.9	26.0	.888	27.9	165	95	527 to 572.

Carbon residue of residuum, 4.8 percent; carbon residue of crude, 1.0 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	12.0	0.710	67.8	
Total gasoline and naphtha	36.4	0.759	54.9	
Kerosene distillate	5.3	.820	41.1	
Gas oil	17.8	.845	36.0	
Nonviscous lubricating distillate	12.5	.857–.876	33.6–30.0	50 to 100.
Medium lubricating distillate	7.8	.876–.895	30.0–26.6	100 to 200.
Viscous lubricating distillate				
Residuum	18.6	.918	22.6	
Distillation loss	1.6			

Laboratory No. 34-010 [1]

WESTON COUNTY: PEDRO FIELD, GRANEROS SHALE, SW¼ SEC. 31, T. 46 N., R. 62 W.

Well 4; depth, 270 feet; I. C. Covert

General characteristics

Specific gravity, 0.879; A. P. I. gravity, 29.5°
Sulfur, percent, 0.22; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 95 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 641 MM. FIRST DROP, 103° C. (217.4° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	1.1	1.1	0.743	58.9			212 to 257.
125 to 150	2.2	3.3	.756	55.7			257 to 302.
150 to 175	3.0	6.3	.769	52.5			302 to 347.
175 to 200	3.5	9.8	.787	48.3			347 to 392.
200 to 225	4.5	14.3	.800	45.4			392 to 437.
225 to 250	5.7	20.0	.815	42.1			437 to 482.
250 to 275	6.6	26.6	.828	39.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	4.3	4.3	0.851	34.8	44	5	Up to 392.
200 to 225	8.1	12.4	.857	33.6	48	10	392 to 437.
225 to 250	6.8	19.2	.871	31.0	64	30	437 to 482.
250 to 275	7.1	26.3	.885	28.4	100	45	482 to 527.
275 to 300	8.6	34.9	.898	26.1	179	50	527 to 572.

Carbon residue of residuum, 5.7 percent; carbon residue of crude, 2.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	9.8	0.770	52.3	
Kerosene distillate	10.2	.808	43.6	
Gas oil	16.0	.843	36.4	Below 50.
Nonviscous lubricating distillate	13.4	.858–.884	33.4–28.6	50 to 100.
Medium lubricating distillate	12.1	.884–.906	28.6–24.7	100 to 200.
Viscous lubricating distillate				
Residuum	38.5	.941	18.9	
Distillation loss				

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 37L–14

FREMONT COUNTY: PILOT BUTTE FIELD, STEELE SHALE, SW¼ SEC. 22, T. 3 N., R. 1 W.

Hoffman No. 4; depth, approximately 950 feet; H. Kenyon Burch

General characteristics

Specific gravity, 0.831; A. P. I. gravity, 38.8°
Sulfur, percent, less than 0.1; pour point, below 0° F.
Saybolt Universal viscosity at 70 °F., 47 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 592 MM. FIRST DROP, 23° C. (73° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.2	1.2	0.673	78.7			Up to 122.
50 to 75	2.8	4.0	.680	76.6			122 to 167.
75 to 100	6.5	10.5	.721	64.7			167 to 212.
100 to 125	6.7	17.2	.742	59.2			212 to 257.
125 to 150	5.8	23.0	.761	54.4			257 to 302.
150 to 175	6.1	29.1	.776	50.8			302 to 347.
175 to 200	5.4	34.5	.792	47.2			347 to 392.
200 to 225	5.9	40.4	.805	44.3			392 to 437.
225 to 250	6.1	46.5	.817	41.7			437 to 482.
250 to 275	6.3	52.8	.826	39.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.9	2.9	0.842	36.6	43	25	Up to 392.
200 to 225	7.5	10.4	.848	35.4	47	40	392 to 437.
225 to 250	6.3	16.7	.860	33.0	60	60	437 to 482.
250 to 275	5.9	22.6	.875	30.2	91	75	482 to 527.
275 to 300	5.4	28.0	.888	27.8	178	90	527 to 572.

Carbon residue of residuum, 4.6 percent; carbon residue of crude, 1.0 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	10.5	0.705	69.2	
Total gasoline and naphtha	34.5	0.748	57.7	
Kerosene distillate	12.0	.811	43.0	
Gas oil	14.6	.837	37.6	
Nonviscous lubricating distillate	11.9	.851–.876	34.8–30.0	50 to 100.
Medium lubricating distillate	6.6	.876–.890	30.0–27.5	100 to 200.
Viscous lubricating distillate	1.2	.890–.894	27.5–26.8	Above 200.
Residuum	18.8	.945	18.2	
Distillation loss	.4			

Sample 30–34

PARK COUNTY: PITCHFORK FIELD, EMBAR LIME AND TENSLEEP SANDSTONE, NE¼ SEC. 14, T. 48 N., R. 102 W.

Well 2; depth, 3,350–3,822 feet; Honolulu Oil Corporation

General characteristics

Specific gravity, 0.961; A. P. I. gravity, 15.7°
Sulfur, percent, 3.87; pour point, 10° F.
Saybolt Universal viscosity at 100° F., 2,580 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 578 MM. FIRST DROP, 82° C. (180° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	1.3	1.3	0.762	54.2			167 to 212.
100 to 125	.5	1.8					212 to 257.
125 to 150	.5	2.3	.774	51.3			257 to 302.
150 to 175	1.9	4.2					302 to 347.
175 to 200	2.1	6.3	.799	45.6			347 to 392.
200 to 225	3.3	9.6	.820	41.1			392 to 437.
225 to 250	4.0	13.6	.843	36.4			437 to 482.
250 to 275	8.4	22.0	.859	33.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.2	0.2	0.890	27.5	48	10	Up to 392.
200 to 225	2.5	2.7					392 to 437.
225 to 250	6.1	8.8	.907	24.5	67	30	437 to 482.
250 to 275	5.9	14.7	.923	21.8	110	50	482 to 527.
275 to 300	9.5	24.2	.935	19.8	210	65	527 to 572.

Carbon residue of residuum, 17.3 percent; carbon residue of crude, 9.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.3	0.762	54.2	
Total gasoline and naphtha	6.3	0.780	49.9	
Kerosene distillate	3.3	.820	41.1	
Gas oil	14.4	.859	33.2	
Nonviscous lubricating distillate	8.4	.892–.919	27.1–22.5	50 to 100.
Medium lubricating distillate	8.3	.919–.934	22.5–20.0	100 to 200.
Viscous lubricating distillate	5.5	.934–.942	20.0–18.7	Above 200.
Residuum	53.6	1.021		
Distillation loss	.2			

Sample 30–28

NATRONA COUNTY: POISON SPIDER FIELD, SUNDANCE FORMATION, NW¼ SEC. 18, T. 33 N., R. 82 W.

Composite of 6 wells; depth, 1,400–1,600 feet; Bessemer Oil Co.

General characteristics

Specific gravity, 0.937; A. P. I. gravity, 19.5°
Sulfur, percent, 3.13; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 490 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 51° C. (124° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.7	0.7	0.695	72.1			122 to 167.
75 to 100	1.3	2.0	.727	63.1			167 to 212.
100 to 125	1.7	3.7	.743	58.9			212 to 257.
125 to 150	2.1	5.8	.765	53.5			257 to 302.
150 to 175	2.8	8.6	.783	49.2			302 to 347.
175 to 200	2.9	11.5	.800	45.4			347 to 392.
200 to 225	3.7	15.2	.819	41.3			392 to 437.
225 to 250	4.1	19.3	.836	37.8			437 to 482.
250 to 275	5.9	25.2	.853	34.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.0	3.0	0.879	29.5	43	15	Up to 392.
200 to 225	5.8	8.8	.883	28.8	48	25	392 to 437.
225 to 250	5.8	14.6	.895	26.6	61	45	437 to 482.
250 to 275	6.6	21.2	.908	24.3	93	60	482 to 527.
275 to 300	9.5	30.7	.919	22.5	175	85	527 to 572.

Carbon residue of residuum, 21.0 percent; carbon residue of crude, 10.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	2.0	0.716	66.1	
Total gasoline and naphtha	11.5	0.766	53.2	
Kerosene distillate	3.7	.819	41.3	
Gas oil	16.8	.860	33.0	
Nonviscous lubricating distillate	11.8	.885–.909	28.4–24.2	50 to 100.
Medium lubricating distillate	10.0	.909–.923	24.2–21.8	100 to 200.
Viscous lubricating distillate	2.1	.923–.926	21.8–21.3	Above 200.
Residuum	43.8	1.029		
Distillation loss	.3			

Sample 36L–14

ALBANY COUNTY: QUEALY DOME FIELD, DAKOTA SAND, SW¼ SEC. 18, T. 17 N., R. 67 W.

Wilson No. 1; depth, 3,369–3,401 feet; California Co.

General characteristics

Specific gravity, 0.859; A. P. I. gravity, 33.2°
Sulfur, percent, 0.27; pour point, 15° F.
Saybolt Universal viscosity at 100° F., 54 sec.; color, greenish brown

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 23° C. (73° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.9	1.9	0.669	80.0			Up to 122.
50 to 75	2.1	4.0	.679	76.9			122 to 167.
75 to 100	4.2	8.2	.715	66.4			167 to 212.
100 to 125	4.9	13.1	.740	59.7			212 to 257.
125 to 150	4.2	17.3	.762	54.2			257 to 302.
150 to 175	3.7	21.0	.781	49.7			302 to 347.
175 to 200	3.8	24.8	.798	45.8			347 to 392.
200 to 225	4.4	29.2	.813	42.5			392 to 437.
225 to 250	4.8	34.0	.826	39.8			437 to 482.
250 to 275	6.2	40.2	.833	38.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.3	2.3	0.844	36.2	41	30	Up to 392.
200 to 225	6.0	8.3	.853	34.4	47	45	392 to 437.
225 to 250	8.1	16.4	.866	31.9	58	65	437 to 482.
250 to 275	6.7	23.1	.879	29.5	100	85	482 to 527.
275 to 300	8.4	31.5	.890	26.9	[1] 48	105	527 to 572.

Carbon residue of residuum, 8.3 percent; carbon residue of crude, 2.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	8.3	0.696	71.8	
Total gasoline and naphtha	24.8	0.744	58.7	
Kerosene distillate	4.4	.813	42.5	
Gas oil	18.3	.838	37.4	
Nonviscous lubricating distillate	12.5	.857–.879	33.6–29.5	50 to 100.
Medium lubricating distillate	8.5	.879–.891	29.5–27.3	100 to 200.
Viscous lubricating distillate	3.2	.891–.896	27.3–26.4	Above 200.
Residuum	28.1	.965	15.1	
Distillation loss	.2			

[1] At 212° F.

Sample 36L–15

ALBANY COUNTY: REX LAKE FIELD, DAKOTA SAND,
SW¼ SEC. 23, T. 16 N., R. 77 W.

Well 3; depth, approximately 4,050 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.862; A. P. I. gravity, 32.7°
Sulfur, percent, 0.19; pour point, 50° F.
Saybolt Universal viscosity at 100° F., 57 sec.; color, greenish brown

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 589 MM. FIRST DROP, 26° C.(79° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.8	0.8	0.676	77.8			Up to 122.
50 to 75	1.6	2.4					122 to 167.
75 to 100	2.9	5.3	.714	66.7			167 to 212.
100 to 125	6.0	11.3	.743	58.9			212 to 257.
125 to 150	4.3	15.6	.763	53.9			257 to 302.
150 to 175	3.8	19.4	.782	49.4			302 to 347.
175 to 200	3.6	23.0	.799	45.6			347 to 392.
200 to 225	3.3	26.3	.811	43.0			392 to 437.
225 to 250	5.7	32.0	.824	40.2			437 to 482.
250 to 275	7.3	39.3	.837	37.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.1	2.1	0.849	35.2	44	20	Up to 392.
200 to 225	7.0	9.1	.854	34.2	46	50	392 to 437.
225 to 250	3.8	12.9	.867	31.7	59	60	437 to 482.
250 to 275	6.5	19.4	.875	30.2	76	75	482 to 527.
275 to 300	7.3	26.7	.888	27.8	142	90	527 to 572.

Carbon residue of residuum, 7.6 percent; carbon residue of crude, 2.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	5.3	0.697	71.5	
Total gasoline and naphtha	23.0	0.752	56.7	
Kerosene distillate	9.0	.819	41.3	
Gas oil	14.6	.844	36.2	
Nonviscous lubricating distillate	11.4	.858–.880	33.4–29.3	50 to 100.
Medium lubricating distillate	8.0	.880–.895	29.3–26.6	100 to 200.
Viscous lubricating distillate				
Residuum	33.4	.951	17.3	
Distillation loss	.6			

Sample 37L–13

ALBANY COUNTY: ROCK RIVER FIELD, DAKOTA SAND,
SE¼ SEC. 34, T. 20 N., R. 78 W.

Alva Dixon No. 7; depth, 3,447–3,462 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.838; A. P. I. gravity, 37.4°
Sulfur, percent, 0.13; pour point, 35° F.
Saybolt Universal viscosity at 70° F., 65 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 589 MM. FIRST DROP, 22° C. (71° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.3	2.3	0.653	85.2			Up to 122.
50 to 75	3.1	5.4	.678	77.2			122 to 167.
75 to 100	5.7	11.1	.724	63.9			167 to 212.
100 to 125	5.9	17.0	.750	57.2			212 to 257.
125 to 150	5.0	22.0	.769	52.5			257 to 302.
150 to 175	4.2	26.2	.788	48.1			302 to 347.
175 to 200	3.9	30.1	.802	44.9			347 to 392.
200 to 225	5.2	35.3	.818	41.5			392 to 437.
225 to 250	4.3	39.6	.831	38.8			437 to 482.
250 to 275	6.5	46.1	.840	37.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.2	2.2	0.853	34.4	43	40	Up to 392.
200 to 225	6.3	8.5	.858	33.4	48	45	392 to 437.
225 to 250	5.0	13.5	.870	31.1	61	65	437 to 482.
250 to 275	7.3	20.8	.883	28.7	99	85	482 to 527.
275 to 300	6.2	27.0	.896	26.4	260	100	527 to 572.

Carbon residue of residuum, 8.2 percent; carbon residue of crude, 2.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	11.1	0.696	71.8	
Total gasoline and naphtha	30.1	0.745	58.4	
Kerosene distillate	5.2	.818	41.5	
Gas oil	17.0	.844	36.2	
Nonviscous lubricating distillate	11.0	.860–.883	33.0–28.7	50 to 100.
Medium lubricating distillate	4.3	.883–.891	28.7–27.3	100 to 200.
Viscous lubricating distillate	5.5	.891–.902	27.3–25.4	Above 200.
Residuum	23.2	.961	15.7	
Distillation loss	3.7			

Sample 36L–16

CARBON COUNTY: ROCK RIVER FIELD, SUNDANCE FORMATION, NW¼ SEC. 35, T. 20 N., R. 78 W.

Diamond Cattle No. 5; depth, 3,164–3,188 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.845; A. P. I. gravity, 36.0°
Sulfur, percent, 0.16; pour point, 20° F.
Saybolt Universal viscosity at 100° F., 43 sec.; color, greenish brown

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 591 MM. FIRST DROP, 24° C. (76° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.8	1.8	0.663	81.9			Up to 122.
50 to 75	3.2	5.0	.677	77.5			122 to 167.
75 to 100	6.0	11.0	.715	66.4			167 to 212.
100 to 125	6.4	17.4	.741	59.4			212 to 257.
125 to 150	5.3	22.7	.765	53.5			257 to 302.
150 to 175	4.1	26.8	.784	49.0			302 to 347.
175 to 200	4.6	31.4	.800	45.4			347 to 392.
200 to 225	4.4	35.8	.816	41.9			392 to 437.
225 to 250	5.4	41.2	.828	39.4			437 to 482.
250 to 275	6.4	47.6	.840	37.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.8	1.8	0.853	34.4	43	30	Up to 392.
200 to 225	6.8	8.6	.858	33.4	48	45	392 to 437.
225 to 250	4.8	13.4	.869	31.3	60	60	437 to 482.
250 to 275	5.5	18.9	.879	29.5	83	80	482 to 527.
275 to 300	7.7	26.6	.895	26.6	170	95	527 to 572.

Carbon residue of residuum, 7.8 percent; carbon residue of crude, 2.1 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	11.0	0.696	71.8	
Total gasoline and naphtha	31.4	0.743	58.9	
Kerosene distillate	4.4	.816	41.9	
Gas oil	18.0	.842	36.6	
Nonviscous lubricating distillate	11.2	.860–.882	33.0–28.9	50 to 100.
Medium lubricating distillate	7.4	.882–.900	28.9–25.7	100 to 200.
Viscous lubricating distillate	1.8	.900–.904	25.7–25.0	Above 200.
Residuum	23.8	.960	15.9	
Distillation loss	2.0			

Laboratory No. 34–050 [1]

NATRONA COUNTY: SALT CREEK FIELD, FIRST WALL CREEK SAND, SE¼ SEC. 14, T. 40 N., R. 79 W.

Well 18; depth, 1,370–1,420 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.838; A. P. I. gravity, 37.4°
Sulfur, percent, less than 0.1; pour point, 25° F.
Saybolt Universal viscosity at 100° F., 43 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 643 MM. FIRST DROP, 30° C. (86° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.7	1.7	0.663	81.9			Up to 122.
50 to 75	2.4	4.1	.679	76.9			122 to 167.
75 to 100	5.2	9.3	.701	70.4			167 to 212.
100 to 125	5.7	15.0	.737	60.5			212 to 257.
125 to 150	4.9	19.9	.758	55.2			257 to 302.
150 to 175	4.4	24.3	.776	50.9			302 to 347.
175 to 200	4.2	28.5	.790	47.6			347 to 392.
200 to 225	4.1	32.6	.803	44.7			392 to 437.
225 to 250	4.8	37.4	.815	42.1			437 to 482.
250 to 275	5.6	43.0	.827	39.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	4.0	4.0	0.847	35.6	41	20	Up to 392.
200 to 225	7.0	11.0	.851	34.8	46	40	392 to 437.
225 to 250	4.7	15.7	.858	33.4	57	60	437 to 482.
250 to 275	5.3	21.0	.868	31.5	76	75	482 to 527.
275 to 300	6.4	27.4	.878	30.0	123	90	527 to 572.

Carbon residue of residuum, 5.17 percent; carbon residue of crude, 1.56 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.3	0.688	74.2	
Total gasoline and naphtha	28.5	0.739	60.0	
Kerosene distillate	8.9	.809	43.4	
Gas oil	15.4	.841	36.8	Below 50.
Nonviscous lubricating distillate	11.6	.854–.873	34.2–30.6	50 to 100.
Medium lubricating distillate	6.0	.873–.885	30.6–28.4	100 to 200.
Viscous lubricating distillate				
Residuum	27.8	.941	18.9	
Distillation loss	1.8			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Laboratory No. 34–045 [1]

NATRONA COUNTY: SALT CREEK FIELD, SECOND WALL CREEK SAND, SW¼ SEC. 19, T. 40 N., R. 78 W.

Well 25–A; depth, 2,265–2,326 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.837; A. P. I. gravity, 37.6°
Sulfur, percent, less than 0.1; pour point, 20° F.
Saybolt Universal viscosity at 100° F., 45 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 641 MM. FIRST DROP, 27° C. (80.6° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.3	2.3	0.663	81.9			Up to 122.
50 to 75	2.8	5.1	.680	76.6			122 to 167.
75 to 100	4.4	9.5	.705	69.2			167 to 212.
100 to 125	6.7	16.2	.738	60.2			212 to 257.
125 to 150	6.1	22.3	.760	54.7			257 to 302.
150 to 175	5.8	28.1	.778	50.4			302 to 347.
175 to 200	4.0	32.1	.792	47.2			347 to 392.
200 to 225	4.3	36.4	.804	44.5			392 to 437.
225 to 250	4.7	41.1	.816	41.9			437 to 482.
250 to 275	6.0	47.1	.828	39.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.8	3.8	0.845	36.0	41	20	Up to 392.
200 to 225	5.7	9.5	.848	35.4	45	35	392 to 437.
225 to 250	5.4	14.9	.855	34.0	55	55	437 to 482.
250 to 275	6.0	20.9	.865	32.1	76	75	482 to 527.
275 to 300	5.7	26.6	.875	30.2	113	90	527 to 572.

Carbon residue of residuum, 5.52 percent; carbon residue of crude, 1.65 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.5	0.687	74.5	
Total gasoline and naphtha	32.1	0.741	59.5	
Kerosene distillate	9.0	.810	43.2	
Gas oil	15.6	.839	37.2	Below 50.
Nonviscous lubricating distillate	12.2	.852–.871	34.6–31.0	50 to 100.
Medium lubricating distillate	4.8	.871–.880	31.0–29.3	100 to 200.
Viscous lubricating distillate				
Residuum	27.0	.940	19.0	
Distillation loss	.3			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Laboratory No. 34–053 [1]

NATRONA COUNTY: SALT CREEK FIELD, THIRD WALL CREEK SAND, SE¼ SEC. 26, T. 40 N., R. 79 W.

Well 14–T; depth, 1,735–1,770 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.838; A. P. I. gravity, 37.4°
Sulfur, percent, less than 0.1; pour point, 45° F.
Saybolt Universal viscosity at 100° F., 42 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 646 MM. FIRST DROP, 36° C. (96.8° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.2	1.2	0.672	79.1			Up to 122.
50 to 75	2.3	3.5	.681	76.3			122 to 167.
75 to 100	5.0	8.5	.701	70.4			167 to 212.
100 to 125	6.3	14.8	.734	61.3			212 to 257.
125 to 150	5.0	19.8	.756	55.7			257 to 302.
150 to 175	4.5	24.3	.774	51.3			302 to 347.
175 to 200	4.3	28.6	.787	48.3			347 to 392.
200 to 225	4.3	32.9	.800	45.4			392 to 437.
225 to 250	5.2	38.1	.814	42.3			437 to 482.
250 to 275	5.8	43.9	.826	39.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	4.1	4.1	0.850	35.0	41	20	Up to 392.
200 to 225	7.1	11.2	.854	34.2	46	40	392 to 437.
225 to 250	5.1	16.3	.861	32.8	56	60	437 to 482.
250 to 275	5.1	21.4	.872	30.8	76	75	482 to 527.
275 to 300	6.3	27.7	.882	28.9	117	90	527 to 572.

Carbon residue of residuum, 5.45 percent; carbon residue of crude, 1.62 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	8.5	0.691	73.3	
Total gasoline and naphtha	28.6	0.739	60.0	
Kerosene distillate	9.5	.808	43.6	
Gas oil	16.0	.843	36.4	Below 50.
Nonviscous lubricating distillate	12.1	.857–.878	33.6–29.7	50 to 100.
Medium lubricating distillate	5.4	.878–.888	29.7–27.9	100 to 200.
Viscous lubricating distillate				
Residuum	26.5	.939	19.2	
Distillation loss	1.9			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Laboratory No. 34–049 [1]

NATRONA COUNTY: SALT CREEK FIELD, LAKOTA SAND, NW¼ SEC. 35, T. 40 N., R. 79 W.

Well 1-L; depth, 2,340–2,390 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.840; A. P. I. gravity, 36.9°
Sulfur, percent, 0.12; pour point, 55° F.
Saybolt Universal viscosity at 100° F., 41 sec.; color, greenish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 647 MM. FIRST DROP, 25° C. (77° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	2.1	2.1	0.652	85.5			Up to 122.
50 to 75	2.5	4.6	.683	75.7			122 to 167.
75 to 100	5.2	9.8	.709	68.1			167 to 212.
100 to 125	5.9	15.7	.742	59.2			212 to 257.
125 to 150	4.8	20.5	.764	53.7			257 to 302.
150 to 175	4.1	24.6	.783	49.2			302 to 347.
175 to 200	3.5	28.1	.798	45.8			347 to 392.
200 to 225	3.9	32.0	.813	42.6			392 to 437.
225 to 250	4.4	36.4	.825	40.0			437 to 482.
250 to 275	5.7	42.1	.836	37.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.5	1.5	0.854	34.2	42	20	Up to 392.
200 to 225	7.0	8.5	.859	33.2	46	35	392 to 437.
225 to 250	5.1	13.6	.865	32.1	56	55	437 to 482.
250 to 275	5.5	19.1	.874	30.4	75	70	482 to 527.
275 to 300	6.8	25.9	.885	28.4	121	90	527 to 572.

Carbon residue of residuum, 8.76 percent; carbon residue of crude, 2.78 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.8	0.690	73.6	
Total gasoline and naphtha	28.1	0.741	59.5	
Kerosene distillate	8.3	.819	41.3	
Gas oil	13.2	.848	35.4	Below 50.
Nonviscous lubricating distillate	12.2	.861–.880	32.8–29.3	50 to 100.
Medium lubricating distillate	6.2	.880–.891	29.3–27.3	100 to 200.
Viscous lubricating distillate				
Residuum	31.0	.949	17.6	
Distillation loss	1.0			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Laboratory No. 34–051 [1]

NATRONA COUNTY: SALT CREEK FIELD, THIRD SUNDANCE SAND, SW¼ SEC. 26, R. 40 N., R. 79 W.

Well 6 Sd-3; depth, 2,915–2,921 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.845; A. P. I. gravity, 36.0°
Sulfur, percent, 0.27; pour point, 65° F.
Saybolt Universal viscosity at 100° F., 45 sec.; color, greenish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 647 MM. FIRST DROP, 35° C. (95° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.4	1.4	0.673	78.8			Up to 122.
50 to 75	5.1	6.5	.686	74.8			122 to 167.
75 to 100	2.9	9.4	.715	66.4			167 to 212.
100 to 125	5.0	14.4	.739	60.0			212 to 257.
125 to 150	5.1	19.5	.758	55.2			257 to 302.
150 to 175	4.0	23.5	.778	50.4			302 to 347.
175 to 200	3.4	26.9	.793	46.9			347 to 392.
200 to 225	3.6	30.5	.809	43.4			392 to 437.
225 to 250	5.2	35.7	.823	40.4			437 to 482.
250 to 275	5.7	41.4	.833	38.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	3.3	3.3	0.853	34.4	42	20	Up to 392.
200 to 225	6.4	9.7	.855	34.0	47	40	392 to 437.
225 to 250	6.3	16.0	.862	32.7	56	60	437 to 482.
250 to 275	5.4	21.4	.872	30.8	76	80	482 to 527.
275 to 300	6.0	27.4	.881	29.1	115	90	527 to 572.

Carbon residue of residuum, 8.04 percent; carbon residue of crude, 2.53 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	9.4	0.693	72.7	
Total gasoline and naphtha	26.9	0.739	60.0	
Kerosene distillate	8.8	.817	41.7	
Gas oil	14.5	.846	35.8	Below 50.
Nonviscous lubricating distillate	13.5	.857–.877	33.6–29.9	50 to 100.
Medium lubricating distillate	5.1	.877–.886	29.9–28.2	100 to 200.
Viscous lubricating distillate				
Residuum	29.0	.950	17.5	
Distillation loss	2.2			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 38L–8

NATRONA COUNTY: SALT CREEK FIELD, TENSLEEP SANDSTONE, NW¼ SEC. 35, T. 40 N., R. 79 W.

Well 29 TP; depth, 3,775–3,802 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.893; A. P. I. gravity, 27.0°
Sulfur, percent, 2.25; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 93 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 592 MM. FIRST DROP, 87° C. (188° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	0.4	0.4	0.695	72.1			167 to 212.
100 to 125	2.6	3.0	.707	68.6			212 to 257.
125 to 150	3.7	6.7	.730	62.3			257 to 302.
150 to 175	4.0	10.7	.757	55.4			302 to 347.
175 to 200	4.2	14.9	.775	51.1			347 to 392.
200 to 225	5.2	20.1	.795	46.5			392 to 437.
225 to 250	5.6	25.7	.811	43.0			437 to 482.
250 to 275	7.0	32.7	.828	39.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.4	1.4	0.846	35.8	45	15	Up to 392.
200 to 225	6.5	7.9	.856	33.8	47	35	392 to 437.
225 to 250	6.8	14.7	.871	31.0	60	50	437 to 482.
250 to 275	6.5	21.2	.896	26.4	83	70	482 to 527.
275 to 300	8.0	29.2	.911	23.8	146	85	527 to 572.

Carbon residue of residuum, 14.9 percent; carbon residue of crude, 6.2 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.4	0.695	72.1	
Total gasoline and naphtha	14.9	0.745	58.4	
Kerosene distillate	10.8	.803	44.7	
Gas oil	13.2	.839	37.2	
Nonviscous lubricating distillate	13.8	.860–.900	33.0–25.7	50 to 100.
Medium lubricating distillate	9.2	.900–.919	25.7–22.5	100 to 200.
Viscous lubricating distillate				
Residuum	37.1	.995	10.7	
Distillation loss	1.0			

Sample 30–27

NATRONA COUNTY: SALT CREEK FIELD, MADISON LIMESTONE, NW¼ SEC. 35, T. 40 N., R. 79 W.

Well 29 TP; depth, 4,375 feet; Stanolind Oil & Gas Co.

General characteristics

Specific gravity, 0.924; A. P. I. gravity, 21.6°
Sulfur, percent, 2.66; pour point, 45° F.
Saybolt Universal viscosity at 100° F., 440 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 587 MM. FIRST DROP, 101°C. (213° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	0.8	0.8	0.732	61.8			212 to 257.
125 to 150	1.5	2.3					257 to 302.
150 to 175	2.6	4.9	.757	55.4			302 to 347.
175 to 200	3.3	8.2	.780	49.9			347 to 392.
200 to 225	4.3	12.5	.809	43.4			392 to 437.
225 to 250	5.3	17.8	.814	42.3			437 to 482.
250 to 275	6.5	24.3	.831	38.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.8	2.8	0.851	34.8	40	10	Up to 392.
200 to 225	7.1	9.9	.861	32.8	45	20	392 to 437.
225 to 250	7.7	17.6	.876	30.0	56	50	437 to 482.
250 to 275	6.2	23.8	.894	26.8	80	65	482 to 527.
275 to 300	8.2	32.0	.907	24.5	145	85	527 to 572.

Carbon residue of residuum, 22.4 percent; carbon residue of crude, 10.9 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	8.2	0.759	54.9	
Kerosene distillate	9.6	.812	42.8	
Gas oil	16.4	.847	35.6	
Nonviscous lubricating distillate	13.0	.868–.898	31.5–26.1	50 to 100.
Medium lubricating distillate	9.1	.898–.914	26.1–23.3	100 to 200.
Viscous lubricating distillate				
Residuum	43.6	1.025		
Distillation loss	.1			

Sample 37L–36

CONVERSE COUNTY: SHAWNEE AREA, WHITE RIVER FORMATION, SW¼ SEC. 26, T. 32 N., R. 69 W.

Jennie Evert No. 1; depth, 558–561 feet; Wyoming Southern Oil Co.

General characteristics

Specific gravity, 0.905; A. P. I. gravity, 24.8°
Sulfur, percent, 0.14; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 109 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 590 MM. FIRST DROP, 103° C. (218° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	1.0	1.0	0.770	52.3			212 to 257.
125 to 150	.9	1.9	.777	50.6			257 to 302.
150 to 175	3.0	4.9	.798	45.8			302 to 347.
175 to 200	2.1	7.0	.824	40.2			347 to 392.
200 to 225	5.5	12.5	.846	35.8			392 to 437.
225 to 250	6.4	18.9	.862	32.7			437 to 482.
250 to 275	8.6	27.5	.871	31.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.5	2.5	0.889	27.7	49	45	Up to 392.
200 to 225	10.8	13.3	.896	26.4	56	50	392 to 437.
225 to 250	10.2	23.5	.909	24.2	91	55	437 to 482.
250 to 275	8.2	31.7	.919	22.5	175	55	482 to 527.
275 to 300	9.9	41.6	.926	21.3	385	60	527 to 572.

Carbon residue of residuum, 2.4 percent; carbon residue of crude, 0.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	7.0	0.799	45.6	
Kerosene distillate				
Gas oil	23.4	.865	32.1	
Nonviscous lubricating distillate	16.6	.891–.910	27.3–24.0	50 to 100.
Medium lubricating distillate	9.2	.910–.920	24.0–22.3	100 to 200.
Viscous lubricating distillate	12.9	.920–.930	22.3–20.7	Above 200.
Residuum	30.9	.945	18.2	
Distillation loss				

Sample 35023 [1]

FREMONT COUNTY: SHEEP CREEK FIELD, EMBAR LIME, SW¼ SEC. 14, T. 28 N., R. 92 W.

Well 2; depth, 2,002–2,011 feet; Mid-American Oil Co.

General characteristics

Specific gravity, 0.917; A. P. I. gravity, 22.8°
Sulfur, percent, 2.78; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 152 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 642 MM. FIRST DROP, 68° C. (154° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75	0.1	0.1					122 to 167.
75 to 100	1.5	1.6	0.697	71.5			167 to 212.
100 to 125	1.7	3.3	.711	67.5			212 to 257.
125 to 150	2.3	5.6	.733	61.5			257 to 302.
150 to 175	2.5	8.1	.749	57.4			302 to 347.
175 to 200	2.5	10.6	.770	52.3			347 to 392.
200 to 225	4.0	14.6	.802	44.9			392 to 437.
225 to 250	3.7	18.3	.824	40.2			437 to 482.
250 to 275	6.4	24.7	.842	36.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.5	2.5	0.873	30.6	43	Below 5	Up to 392.
200 to 225	7.0	9.5	.882	28.9	48	20	392 to 437.
225 to 250	6.7	16.2	.895	26.6	61	40	437 to 482.
250 to 275	5.9	22.1	.909	24.2	93	55	482 to 527.
275 to 300	6.4	28.5	.920	22.3	150	70	527 to 572.

Carbon residue of residuum, 18.50 percent; carbon residue of crude, 8.83 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.6	0.697	71.5	
Total gasoline and naphtha	10.6	0.737	60.5	
Kerosene distillate	7.7	.813	42.6	
Gas oil	13.5	.860	33.0	Below 50.
Nonviscous lubricating distillate	12.9	.883–.910	28.8–24.0	50 to 100.
Medium lubricating distillate	8.5	.910–.926	24.0–21.3	100 to 200.
Viscous lubricating distillate				
Residuum	46.0	1.007		
Distillation loss	.8			

[1] Analysis by Geological Survey, U. S. Department of the Interior, Midwest, Wyo.

Sample 37L–19

PARK COUNTY: SHOSHONE FIELD, MUDDY SAND, SW¼ SEC. 21, T. 53 N., R. 101 W.

Getterman No. 2; depth, 1,083–1,098 feet; Cody Petroleum Co.

General characteristics

Specific gravity, 0.816; A. P. I. gravity, 41.9°
Sulfur, percent, less than 0.1; pour point, 10° F.
Saybolt Universal viscosity at 100° F., 36 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 27° C. (80° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.9	0.9	0.680	76.6			Up to 122.
50 to 75	2.8	3.7	.690	73.9			122 to 167.
75 to 100	8.0	11.7	.726	63.4			167 to 212.
100 to 125	8.9	20.6	.747	57.9			212 to 257.
125 to 150	7.2	27.8	.765	53.5			257 to 302.
150 to 175	7.0	34.8	.783	49.2			302 to 347.
175 to 200	5.8	40.6	.801	45.1			347 to 392.
200 to 225	7.2	47.8	.814	42.3			392 to 437.
225 to 250	6.5	54.3	.827	39.6			437 to 482.
250 to 275	7.2	61.5	.837	37.6			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.5	2.5	0.844	36.2	43	30	Up to 392.
200 to 225	2.5	5.0	.845	36.0	46	35	392 to 437.
225 to 250	6.9	11.9	.848	35.4	51	55	437 to 482.
250 to 275	6.4	18.3	.861	32.8	63	75	482 to 527.
275 to 300	2.8	21.1	.871	31.0	85	85	527 to 572.

Carbon residue of residuum, 1.4 percent; carbon residue of crude, 0.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	11.7	0.714	66.7	
Total gasoline and naphtha	40.6	0.755	55.9	
Kerosene distillate	7.2	.814	42.3	
Gas oil	21.5	.837	37.6	
Nonviscous lubricating distillate	13.3	.848–.874	35.4–30.4	50 to 100.
Medium lubricating distillate				
Viscous lubricating distillate				
Residuum	17.2	.919	22.5	
Distillation loss	.2			

Sample 30442

PARK COUNTY: SHOSHONE FIELD, EMBAR LIME, SW¼ SEC. 21., T. 53 N., R. 101 W.

Burlington well 1; depth, 4,309–4,360 and 4,523–4,540 feet; Ohio Oil Co.

General characteristics

Specific gravity, 0.927; A. P. I. gravity, 21.1°
Sulfur, percent, 3.20; pour point, 5° F.
Saybolt Universal viscosity at 100° F., 350 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 744 MM. FIRST DROP, 30° C. (86° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.8	0.8					Up to 122.
50 to 75	1.3	2.1	0.682	76.0			122 to 167.
75 to 100	1.9	4.0					167 to 212.
100 to 125	3.1	7.1	.721	64.8			212 to 257.
125 to 150	2.1	9.2	.748	57.7			257 to 302.
150 to 175	2.7	11.9	.769	52.5			302 to 347.
175 to 200	2.8	14.7	.790	47.6			347 to 392.
200 to 225	3.1	17.8	.811	43.0			392 to 437.
225 to 250	3.8	21.6	.833	38.4			437 to 482.
250 to 275	5.5	27.1	.855	34.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.5	2.5	0.880	29.3	43	5	Up to 392.
200 to 225	5.6	8.1	.894	26.8	52	25	392 to 437.
225 to 250	5.3	13.4	.911	23.8	75	40	437 to 482.
250 to 275	5.1	18.5	.927	21.1	135	55	482 to 527.
275 to 300	8.1	26.6	.939	19.2	260	75	527 to 572.

Carbon residue of residuum, 16.8 percent; carbon residue of crude, 7.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.0	0.682	76.0	
Total gasoline and naphtha	14.7	0.736	60.8	
Kerosene distillate	3.1	.811	43.0	
Gas oil	13.7	.858	33.4	
Nonviscous lubricating distillate	8.6	.891–.918	27.3–22.6	50 to 100.
Medium lubricating distillate	6.5	.918–.933	22.6–20.2	100 to 200.
Viscous lubricating distillate	7.1	.933–.946	20.2–18.1	Above 200.
Residuum	44.0	1.026		
Distillation loss	2.3			

Sample 37L–28

CARBON COUNTY: SIMPSON RIDGE FIELD, QUEALY SAND, W½ SEC. 20, T. 21 N., R. 80 W.

John Jacks wells 3, 7, 8, and 12; average depth, 635 feet; Hatson Oil Co.

General characteristics

Specific gravity, 0.921; A. P. I. gravity, 22.1°
Sulfur, percent, 0.15; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 200 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 82° C. (180° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	0.3	0.3	0.789	47.8			212 to 257.
125 to 150	.5	.8					257 to 302.
150 to 175	1.3	2.1	.805	44.3			302 to 347.
175 to 200	2.7	4.8	.829	39.2			347 to 392.
200 to 225	3.7	8.5	.849	35.2			392 to 437.
225 to 250	6.7	15.2	.864	32.3			437 to 482.
250 to 275	9.1	24.3	.879	29.5			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.0	2.0	0.896	26.4	50	10	Up to 392.
200 to 225	10.5	12.5	.902	25.4	59	25	392 to 437.
225 to 250	10.5	23.0	.913	23.5	90	45	437 to 482.
250 to 275	9.0	32.0	.925	21.5	210	50	482 to 527.
275 to 300	10.0	42.0	.935	19.8	620	60	527 to 572.

Carbon residue of residuum, 7.3 percent; carbon residue of crude, 2.3 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	2.1	0.799	45.6	
Kerosene distillate				
Gas oil	23.2	.865	32.1	
Nonviscous lubricating distillate	17.6	.896–.914	26.4–23.3	50 to 100.
Medium lubricating distillate	8.2	.914–.924	23.3–21.6	100 to 200.
Viscous lubricating distillate	15.2	.924–.940	21.6–19.0	Above 200.
Residuum	33.7	.967	14.8	
Distillation loss				

Sample 30–29 [1]

NATRONA COUNTY: SOUTH CASPER CREEK FIELD, TENSLEEP SANDSTONE, SEC. 3, T. 33 N., R. 83 W.

Composite of 16 wells; depth, 2,400–2,600 feet; Fargo Oil Co.

General characteristics

Specific gravity, 0.964; A. P. I. gravity, 15.3°
Sulfur, percent, 4.49; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 1,220 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 582 MM. FIRST DROP, 45° C. (112° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.3	0.3					Up to 122.
50 to 75	.1	.4	0.739	60.0			122 to 167.
75 to 100	.5	.9					167 to 212.
100 to 125	1.0	1.9	.742	59.2			212 to 257.
125 to 150	1.2	3.1					257 to 302.
150 to 175	2.2	5.3	.798	45.8			302 to 347.
175 to 200	1.7	7.0					347 to 392.
200 to 225	2.7	9.7	.833	38.4			392 to 437.
225 to 250	4.2	13.9	.853	34.4			437 to 482.
250 to 275	7.5	21.4	.875	30.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.1	0.1	0.911	23.8	56	10	Up to 392.
200 to 225	6.3	6.4					392 to 437.
225 to 250	7.7	14.1	.929	20.8	87	20	437 to 482.
250 to 275	7.1	21.2	.944	18.4	165	35	482 to 527.
275 to 300	12.2	33.4	.951	17.3	250	55	527 to 572.

Carbon residue of residuum, 23.1 percent; carbon residue of crude, 10.7 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.9	0.739	60.0	
Total gasoline and naphtha	7.0	0.773	51.6	
Kerosene distillate				
Gas oil	16.2	.866	31.9	
Nonviscous lubricating distillate	9.7	.907–.931	24.5–20.5	50 to 100.
Medium lubricating distillate	10.2	.931–.947	20.5–17.9	100 to 200.
Viscous lubricating distillate	11.7	.947–.955	17.9–16.7	Above 200.
Residuum	44.2	1.046		
Distillation loss	1.0			

[1] Taken after dehydration.

Sample 30–30

NATRONA COUNTY: SPINDLETOP FIELD, SUNDANCE FORMATION, NW¼ SEC. 5, T. 29 N., R. 81 W.

Well 2; depth, 1,057 feet; Spindletop Syndicate

General characteristics

Specific gravity, 0.928; A. P. I. gravity, 21.0°
Sulfur, percent, 3.30; pour point, 15° F.
Saybolt Universal viscosity at 100° F., 360 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 584 MM. FIRST DROP, 76° C. (168° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	0.5	0.5	0.718	65.6			167 to 212.
100 to 125	.9	1.4					212 to 257.
125 to 150	1.9	3.3	.746	58.2			257 to 302.
150 to 175	2.6	5.9	.767	53.0			302 to 347.
175 to 200	2.7	8.6	.790	47.6			347 to 392.
200 to 225	3.8	12.4	.810	43.2			392 to 437.
225 to 250	4.4	16.8	.825	40.0			437 to 482.
250 to 275	6.3	23.1	.839	37.2			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	2.5	2.5	0.861	32.8	43	Below 5	Up to 392.
200 to 225	6.5	9.0	.866	31.9	45	10	392 to 437.
225 to 250	6.7	15.7	.886	28.2	58	30	437 to 482.
250 to 275	6.8	22.5	.898	26.1	79	45	482 to 527.
275 to 300	7.6	30.1	.912	23.7	140	65	527 to 572.

Carbon residue of residuum, 16.6 percent; carbon residue of crude, 8.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	0.5			
Total gasoline and naphtha	8.6	0.762	54.2	
Kerosene distillate	8.2	.818	41.5	
Gas oil	14.6	.854	34.2	
Nonviscous lubricating distillate	13.3	.874–.903	30.4–25.2	50 to 100.
Medium lubricating distillate	8.5	.903–.919	25.2–22.5	100 to 200.
Viscous lubricating distillate				
Residuum	46.7	1.009		
Distillation loss	.1			

Sample 37L–39

PARK COUNTY: SPRING CREEK FIELD, EMBAR, TENSLEEP, AND AMSDEN FORMATIONS, SE¼ SEC. 11, T. 49 N., R. 102 W.

Well 2; depth, 3,657-4,253 feet; Phoenix Oil Co.

General characteristics

Specific gravity, 0.963; A. P. I. gravity, 15.4°
Sulfur, percent, 4.04; pour point, 25° F.
Saybolt Universal viscosity at 100° F., 3,010 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 589 MM. FIRST DROP, 92° C. (198° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	1.1	1.1	0.720	65.0			212 to 257.
125 to 150	1.8	2.9	.728	62.9			257 to 302.
150 to 175	2.1	5.0	.751	56.9			302 to 347.
175 to 200	2.2	7.2	.779	50.1			347 to 392.
200 to 225	2.8	10.0	.806	44.1			392 to 437.
225 to 250	3.9	13.9	.832	38.6			437 to 482.
250 to 275	8.6	22.5	.856	33.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.2	0.2	0.882	28.9	47	35	Up to 392.
200 to 225	1.4	1.6					392 to 437.
225 to 250	6.2	7.8	.909	24.2	71	40	437 to 482.
250 to 275	6.1	13.9	.927	21.1	120	50	482 to 527.
275 to 300	9.6	23.5	.945	18.2	280	75	527 to 572.

Carbon residue of residuum, 20.5 percent; carbon residue of crude, 11.8 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	7.2	0.749	57.4	
Kerosene distillate	2.8	.806	44.1	
Gas oil	14.0	.852	34.6	
Nonviscous lubricating distillate	6.9	.886–.919	28.2–22.5	50 to 100.
Medium lubricating distillate	6.4	.919–.936	22.5–19.7	100 to 200.
Viscous lubricating distillate	8.7	.936–.956	19.7–16.5	Above 200.
Residuum	53.6	1.033	5.5	
Distillation loss	.4			

Sample 36L–4

UINTA COUNTY: SPRING VALLEY FIELD, ASPEN SHALE, E½ SEC. 14, T. 15 N., R. 118 W.

Composite of 4 wells; depth, 700–1,200 feet; A. J. Whiteman

General characteristics

Specific gravity, 0.830; A. P. I. gravity, 39°
Sulfur, percent, 0.10; pour point, 15° F.
Saybolt Universal viscosity at 100° F., 41 sec.; color, green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 32° C. (90° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.1	1.1	0.678	77.2			Up to 122.
50 to 75	2.1	3.2					122 to 167.
75 to 100	5.1	8.3	.724	64.0			167 to 212.
100 to 125	6.6	14.9	.746	58.2			212 to 257.
125 to 150	5.8	20.7	.762	54.2			257 to 302.
150 to 175	4.5	25.2	.780	49.9			302 to 347.
175 to 200	4.7	29.9	.792	47.2			347 to 392.
200 to 225	4.6	34.3	.805	44.3			392 to 437.
225 to 250	9.5	44.0	.820	41.1			437 to 482.
250 to 275	8.8	52.8	.830	39.0			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.1	1.1	0.838	37.4	48	40	Up to 392.
200 to 225	6.5	7.6	.836	37.8	49	50	392 to 437.
225 to 250	10.1	17.7	.848	35.4	51	70	437 to 482.
250 to 275	10.7	28.4	.864	32.3	120	90	482 to 527.
275 to 300	2.5	30.9	.878	29.7	230	100	527 to 572.

Carbon residue of residuum, 3.4 percent; carbon residue of crude, 0.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	8.3	0.706	68.9	
Total gasoline and naphtha	29.9	0.749	57.4	
Kerosene distillate	14.1	.814	42.3	
Gas oil	13.6	.838	37.4	
Nonviscous lubricating distillate	15.0	.837–.859	37.6–33.2	50 to 100.
Medium lubricating distillate	8.3	.859–.874	33.2–30.4	100 to 200.
Viscous lubricating distillate	2.9	.874–.880	30.4–29.3	Above 200.
Residuum	15.5	.927	21.2	
Distillation loss	.7			

Sample 30–18

PARK COUNTY: SUNSHINE FIELD (NORTH), TENSLEEP SANDSTONE, NW¼ SEC. 22, T. 47 N., R. 101 W.

D. Taylor well 2; depth, 3,486–3,632 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.968; A. P. I. gravity, 14.7°
Sulfur, percent, 3.74; pour point, 35° F.
Saybolt Universal viscosity at 100° F., 4,000 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 573 MM. FIRST DROP, 77° C. (171° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	°A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100	1.1	1.1	0.754	56.2			167 to 212.
100 to 125	.5	1.6	.768	52.7			212 to 257.
125 to 150	.1	1.7					257 to 302.
150 to 175	1.7	3.4					302 to 347.
175 to 200	1.9	5.3	.793	46.9			347 to 392.
200 to 225	2.9	8.2	.817	41.7			392 to 437.
225 to 250	3.2	11.4	.839	37.2			437 to 482.
250 to 275	8.1	19.5	.862	32.7			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	0.2	0.2	0.897	26.3	57	25	Up to 392.
200 to 225	2.9	3.1					392 to 437.
225 to 250	7.2	10.3	.910	24.0	80	40	437 to 482.
250 to 275	5.5	15.8	.924	21.6	135	55	482 to 527.
275 to 300	9.0	24.8	.937	19.5	250	75	527 to 572.

Carbon residue of residuum, 19.7 percent; carbon residue of crude, 11.6 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	1.1	0.754	56.2	
Total gasoline and naphtha	5.3	0.774	51.3	
Kerosene distillate	2.9	.817	41.7	
Gas oil	11.5	.856	33.8	
Nonviscous lubricating distillate	8.9	.893–.915	27.0–23.1	50 to 100.
Medium lubricating distillate	8.1	.915–.931	23.1–20.5	100 to 200.
Viscous lubricating distillate	7.6	.931–.945	20.5–18.2	Above 200.
Residuum	55.5	1.028		
Distillation loss	.2			

Sample 30–19

PARK COUNTY: SUNSHINE FIELD (SOUTH), EMBAR LIME, NE¼ SEC. 9, T. 46 N., R. 101 W.

Wolff No. 1; depth, 2,480–2,514 feet; Continental Oil Co.

General characteristics

Specific gravity, 0.947; A. P. I. gravity, 17.9°
Sulfur, percent, 3.15; pour point, 10°F.
Saybolt Universal viscosity at 100°F., 1,110 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 578 MM. FIRST DROP, 109°C. (228°F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50							Up to 122.
50 to 75							122 to 167.
75 to 100							167 to 212.
100 to 125	0.7	0.7					212 to 257.
125 to 150	1.4	2.1	0.766	53.2			257 to 302.
150 to 175	1.8	3.9					302 to 347.
175 to 200	2.3	6.2	.794	46.7			347 to 392.
200 to 225	3.0	9.2	.814	42.3			392 to 437.
225 to 250	4.1	13.3	.834	38.2			437 to 482.
250 to 275	6.8	20.1	.848	35.4			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	1.5	1.5	0.872	30.8	44	Below 5	Up to 392.
200 to 225	6.0	7.5	.880	29.3	49	15	392 to 437.
225 to 250	6.3	13.8	.897	26.3	67	35	437 to 482.
250 to 275	7.3	21.1	.912	23.7	110	60	482 to 527.
275 to 300	11.9	33.0	.925	21.5	200	80	527 to 572.

Carbon residue of residuum, 20.5 percent; carbon residue of crude, 10.5 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline				
Total gasoline and naphtha	6.2	0.776	50.9	
Kerosene distillate	3.0	.814	42.3	
Gas oil	15.8	.853	34.4	
Nonviscous lubricating distillate	11.0	.881–.908	29.1–24.3	50 to 100.
Medium lubricating distillate	11.2	.908–.925	24.3–21.5	100 to 200.
Viscous lubricating distillate	5.9	.925–.933	21.5–20.2	Above 200.
Residuum	46.8	1.022		
Distillation loss	.1			

WESTON COUNTY: THORNTON FIELD, CARLILE SHALE, NW¼ SEC. 4, T. 48 N., R. 66 W.

Well 3; depth, 708–737 feet; Southwest Oil Co.

General characteristics

Specific gravity, 0.822; A. P. I. gravity, 40.6°
Sulfur, percent, 0.08; color, olive green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 735 MM. FIRST DROP, 25°C. (77°F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut
Up to 125	23.1	23.1	0.770	52.3
125 to 150				
150 to 275	31.4	54.5	.846	35.8
275 to 300				

VACUUM DISTILLATION AT 38 MM.

Up to 300	21.5			

Residuum, 24.0 percent.

BIG HORN COUNTY: TORCHLIGHT FIELD, KIMBALL SAND, SEC. 19, T. 51 N., R. 92 W.

Kimball No. 3; depth, 450–700 feet; Greybull Oil Co.

General characteristics

Specify gravity, 0.796; A. P. I. gravity, 46.3°
Color, dark green

Distillation

DRY DISTILLATION. FIRST DROP, 34° C. (93° F.)

Temperature, ° C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I.
Up to 50	2.5	2.5	0.7216	64.6
50 to 75	4.5	7.0		
75 to 100	6.0	13.0		
100 to 125	10.0	23.0		
125 to 150	7.5	30.5		
150 to 175	6.0	36.5	.8102	43.2
175 to 200	5.5	42.0		
200 to 225	5.5	47.5		
225 to 250	6.0	53.5		
250 to 275	5.5	59.0		
275 to 300	9.5	68.5		
Residuum	31.5	100.0	.8425	36.5

Sample 37L–43

HOT SPRINGS COUNTY: WARM SPRINGS FIELD (WEST), EMBAR LIME, SECS. 34 AND 35, T. 43 N., R. 94 W.

Composite of 7 wells; depth, approximately 1,000 feet; D. D. Gibson

General characteristics

Specific gravity, 0.922; A. P. I. gravity, 22.0°
Sulfur, percent, 3.16; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 230 sec.; color, brownish black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 585 MM. FIRST DROP, 27° C. (81° F.)

Temperature, ° C.	Percent cut	Sum, per-cent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Tempera-ture, ° F.
Up to 50	0.4	0.4	0.678	77.2			Up to 122.
50 to 75	.9	1.3	.680	76.6			122 to 167.
75 to 100	1.3	2.6	.692	73.0			167 to 212.
100 to 125	1.4	4.0	.723	64.2			212 to 257.
125 to 150	2.3	6.3	.752	56.7			257 to 302.
150 to 175	2.8	9.1	.774	51.3			302 to 347.
175 to 200	3.1	12.2	.806	44.1			347 to 392.
200 to 225	3.1	15.3	.820	41.1			392 to 437.
225 to 250	5.3	20.6	.836	37.8			437 to 482.
250 to 275	8.8	29.4	.854	34.2			482 to 527.

VACUUM DISTILLATION AT 40 MM.

Up to 200	0.5	0.5	0.879	29.4	52	15	Up to 392.
200 to 225	6.1	6.6				35	392 to 437.
225 to 250	9.5	16.1	.898	26.1	77	45	437 to 482.
250 to 275	7.8	23.9	.922	22.0	180	60	482 to 527.
275 to 300	11.9	35.8	.928	21.0	310	80	527 to 572.

Carbon residue of residuum, 22.2 percent; carbon residue of crude, 8.5 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	2.6	0.686	74.8	
Total gasoline and naphtha	12.2	0.753	56.4	
Kerosene distillate	3.1	.820	41.1	
Gas oil	16.7	.851	34.8	
Nonviscous lubricating distillate	10.7	.876–.903	30.0–25.2	50 to 100.
Medium lubricating distillate	8.3	.903–.923	25.2–21.8	100 to 200.
Viscous lubricating distillate	14.2	.923–.932	21.8–20.3	Above 200.
Residuum	34.8	1.022	7.0	
Distillation loss				

Sample 36L–6

HOT SPRINGS COUNTY: WAUGH FIELD, EMBAR LIME, NE¼ SEC. 12, T. 44 N., R. 97 W.

Well 1; depth, 3,690–3,807 feet; Honolulu Oil Corporation

General characteristics

Specific gravity, 0.888; A. P. I. gravity, 27.8°
Sulfur, percent, 1.77; pour point, below 0° F.
Saybolt Universal viscosity at 100° F., 77 sec.; color, black

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 593 MM. FIRST DROP, 47° C. (116° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	0.3	0.3	0.680	76.6			Up to 122.
50 to 75	1.7	2.0					122 to 167.
75 to 100	2.3	4.3	.703	69.8			167 to 212.
100 to 125	3.5	7.8	.726	63.4			212 to 257.
125 to 150	3.6	11.4	.747	57.9			257 to 302.
150 to 175	3.8	15.2	.771	52.0			302 to 347.
175 to 200	4.7	19.9	.794	46.7			347 to 392.
200 to 225	4.6	24.5	.813	42.5			392 to 437.
225 to 250	5.7	30.2	.827	39.6			437 to 482.
250 to 275	7.9	38.1	.841	36.8			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.4	1.4	0.861	32.8	43	15	Up to 392.
200 to 225	7.9	9.3	.870	31.1	49	25	392 to 437.
225 to 250	6.8	16.1	.887	28.0	61	45	437 to 482.
250 to 275	7.4	23.5	.906	24.7	97	65	482 to 527.
275 to 300	6.9	30.4	.919	22.5	200	85	527 to 572.

Carbon residue of residuum, 17.9 percent; carbon residue of crude, 6.4 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	4.3	0.692	73.0	
Total gasoline and naphtha	19.9	0.747	57.9	
Kerosene distillate	4.6	.813	42.5	
Gas oil	19.8	.844	36.2	
Nonviscous lubricating distillate	13.8	.872–.906	30.8–24.7	50 to 100.
Medium lubricating distillate	6.7	.906–.919	24.7–22.5	100 to 200.
Viscous lubricating distillate	3.7	.919–.925	22.5–21.5	Above 200.
Residuum	31.5	1.000	10.0	
Distillation loss				

Sample 37L–5

CARBON COUNTY: WERTZ FIELD, TENSLEEP SANDSTONE, NW¼ SEC. 7, T. 26 N., R. 89 W.

Well 10A; depth, 5,872–5,886 feet; Sinclair-Wyoming Oil Co.

General characteristics

Specific gravity, 0.849; A. P. I. gravity, 35.2°
Sulfur, percent, 1.30; pour point, below 5° F.
Saybolt Universal viscosity at 100° F., 41 sec.; color, brownish green

Distillation, Bureau of Mines Hempel method

DRY DISTILLATION. BAROMETER, 588 MM. FIRST DROP, 27° C. (80° F.)

Temperature, ° C.	Percent cut	Sum, percent	Specific gravity of cut	° A. P. I. of cut	Viscosity at 100° F.	Cloud test, ° F.	Temperature, ° F.
Up to 50	1.9	1.9	0.665	81 3			Up to 122.
50 to 75	4.4	6.3	.666	81.0			122 to 167.
75 to 100	3.7	10.0	.702	70.1			167 to 212.
100 to 125	5.2	15.2	.731	62.1			212 to 257.
125 to 150	5.5	20.7	.757	55.4			257 to 302.
150 to 175	5.3	26.0	.778	50.4			302 to 347.
175 to 200	4.8	30.8	.794	46.7			347 to 392.
200 to 225	5.1	35.9	.809	43.4			392 to 437.
225 to 250	5.8	41.7	.828	39.4			437 to 482.
250 to 275	7.2	48.9	.848	35.4			482 to 527.
VACUUM DISTILLATION AT 40 MM.							
Up to 200	1.0	1.0	0.869	31.3	46	30	Up to 392.
200 to 225	8.9	9.9	.876	30.0	50	35	392 to 437.
225 to 250	5.5	15.4	.892	27.1	69	55	437 to 482.
250 to 275	5.3	20.7	.905	24.8	105	70	482 to 527.
275 to 300	6.8	27.5	.915	23.1	210	85	527 to 572.

Carbon residue of residuum, 9.3 percent; carbon residue of crude, 2.5 percent.

Approximate summary

	Percent	Specific gravity	° A. P. I.	Viscosity
Light gasoline	10.0	0.679	76.9	
Total gasoline and naphtha	30.8	0.737	60.5	
Kerosene distillate	5.1	.809	43.4	
Gas oil	18.5	.849	35.2	
Nonviscous lubricating distillate	11.9	.876–.903	30.0–25.2	50 to 100.
Medium lubricating distillate	6.0	.903–.914	25.2–23.3	100 to 200.
Viscous lubricating distillate	4.1	.914–.920	23.3–22.3	Above 200.
Residuum	23.5	.972	14.1	
Distillation loss				

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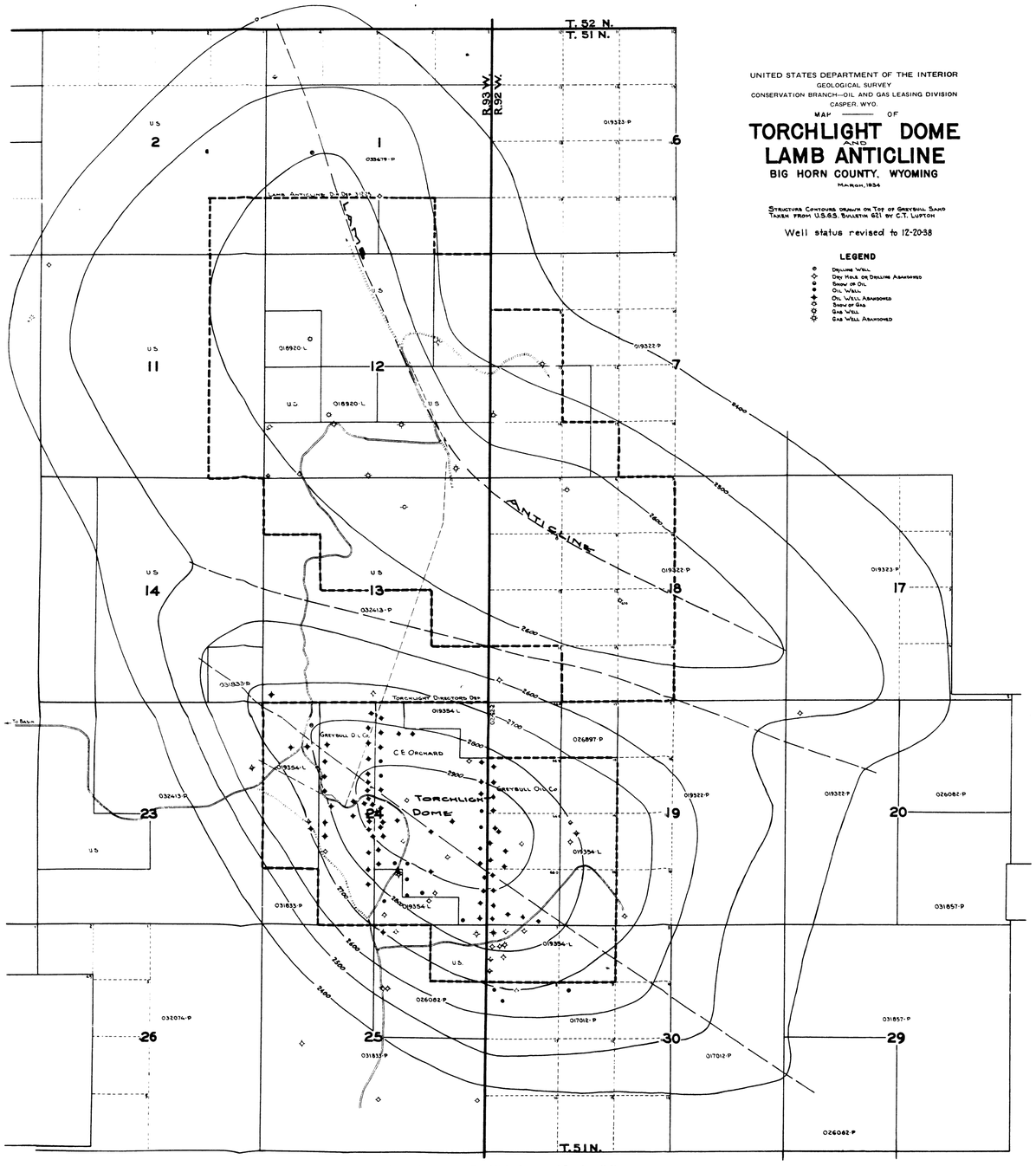


UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION BRANCH—OIL AND GAS LEASING DIVISION
CASPER, WYO.

MAP OF

TORCHLIGHT DOME AND LAMB ANTICLINE

BIG HORN COUNTY, WYOMING

MARCH, 1934

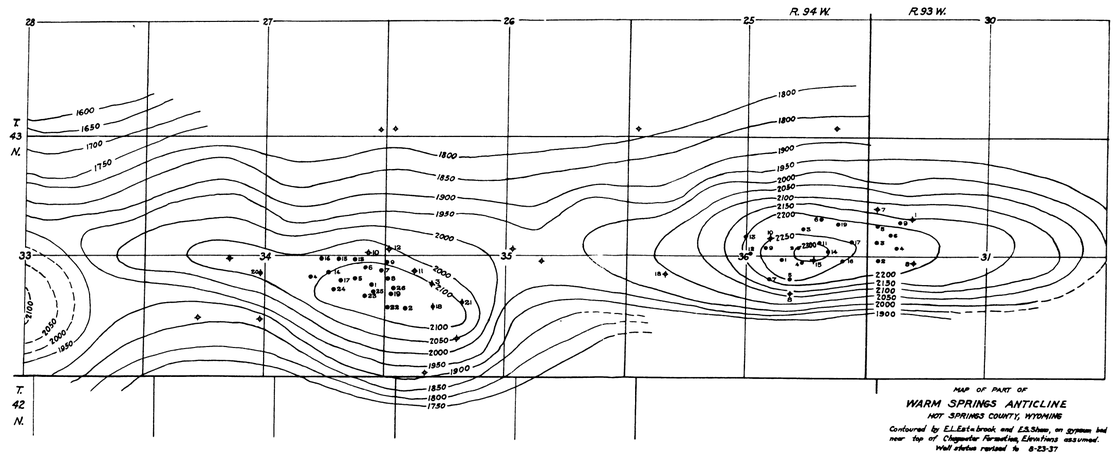
STRUCTURE CONTOURS DRAWN ON TOP OF GREYBULL SAND TAKEN FROM U.S.G.S. BULLETIN 621 BY C.T. LUPTON

Well status revised to 12-20-38

LEGEND

- Drilling Well
- Dry Hole or Drilling Abandoned
- Show of Oil
- Oil Well
- Oil Well Abandoned
- Show of Gas
- Gas Well
- Gas Well Abandoned

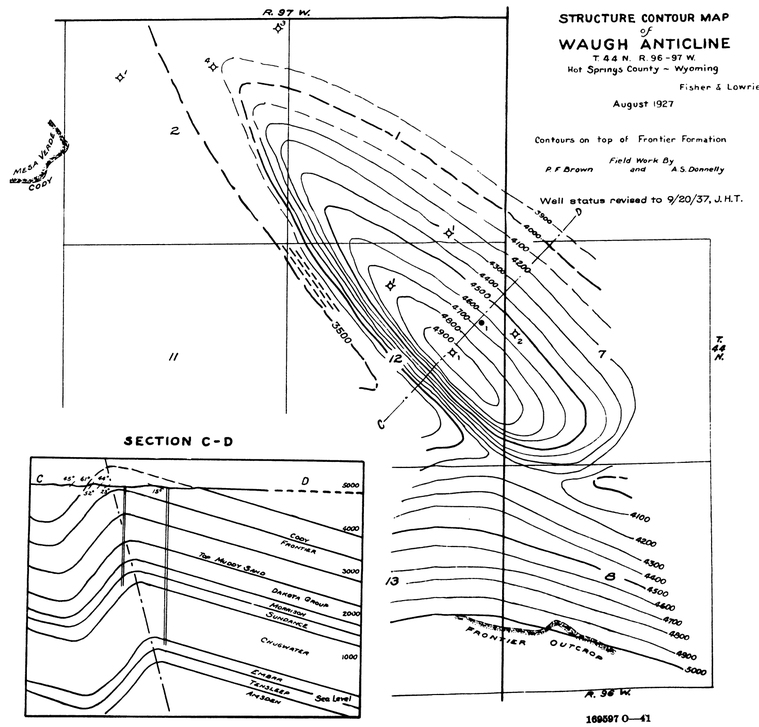
FIGURE 69.—Map of Torchlight Dome and Lamb anticline.



MAP OF PART OF
WARM SPRINGS ANTICLINE
HOT SPRINGS COUNTY, WYOMING

Contoured by E.I. Eastbrook and E.S. Shaw, on pyramen bed near top of Chugwater Formation. Elevations assumed.
Well status revised to 8-23-37

FIGURE 70.—Map of Warm Springs fold.



STRUCTURE CONTOUR MAP
OF
WAUGH ANTICLINE
T. 44 N. R. 96-97 W.
Hot Springs County ~ Wyoming

Fisher & Lowrie

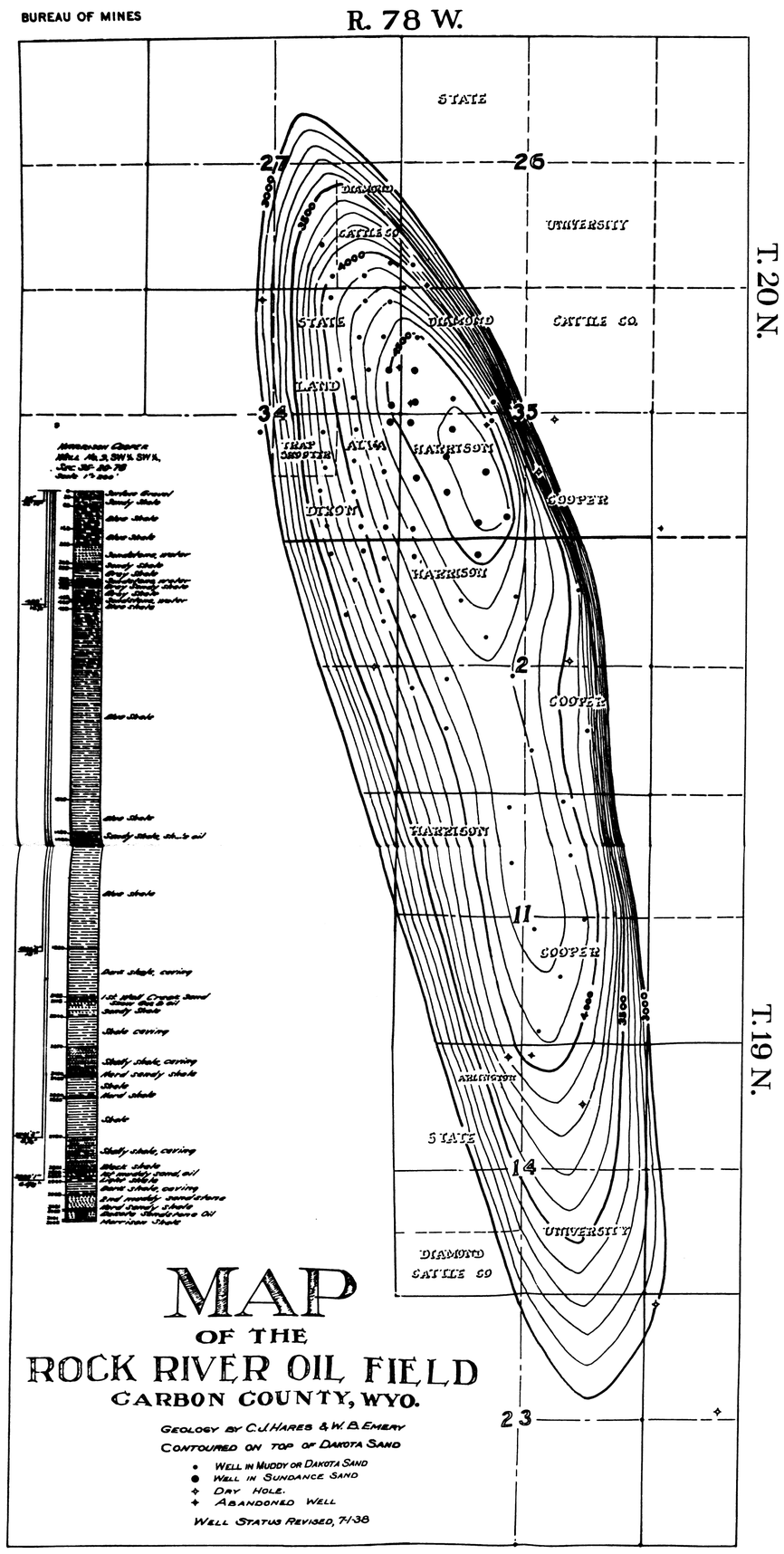
August 1927

Contours on top of Frontier Formation

P.F. Brown Field Work By and A.S. Donnelly

Well status revised to 9/20/37, J.H.T.

FIGURE 72.—Structural contour map of Waugh anticline.



MAP
OF THE
ROCK RIVER OIL FIELD
CARBON COUNTY, WYO.

GEOLOGY BY C. J. HARES & W. B. EMERY
CONTOURED ON TOP OF DAKOTA SAND

- WELL IN MUDDY OR DAKOTA SAND
- WELL IN SUNDANCE SAND
- DRY HOLE.
- ABANDONED WELL

WELL STATUS REVISED, 7-1-38

FIGURE 60.—Map of Rock River field.

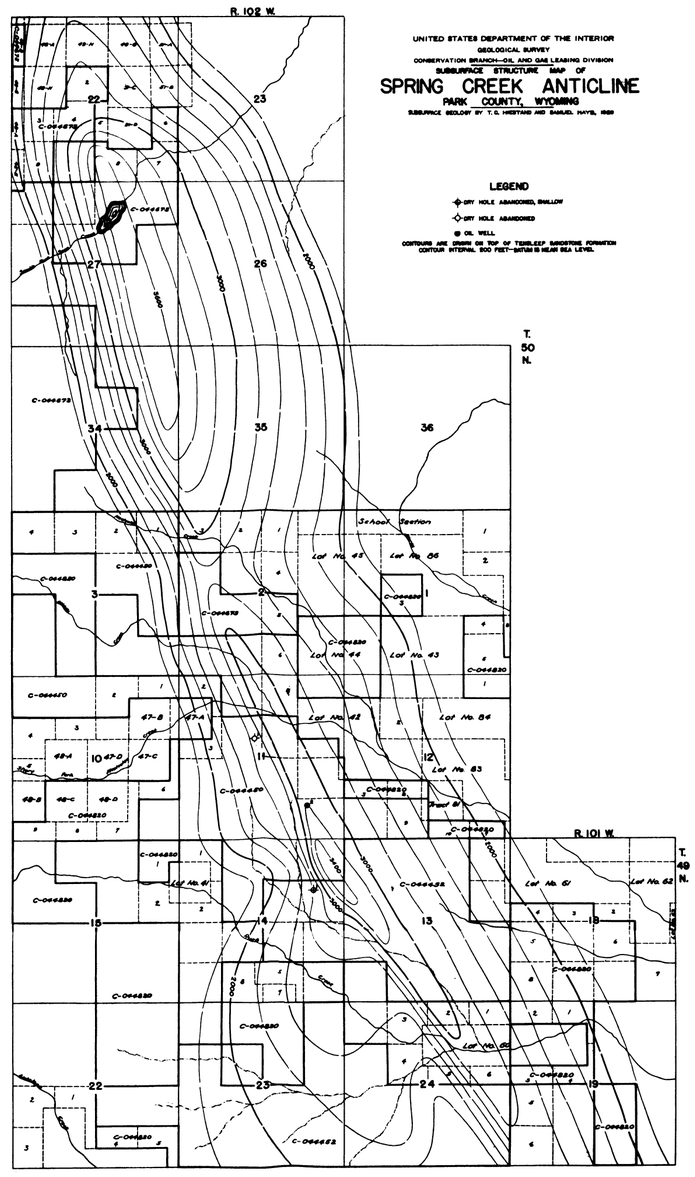


FIGURE 66.—Subsurface structure map of Spring Creek anticline.

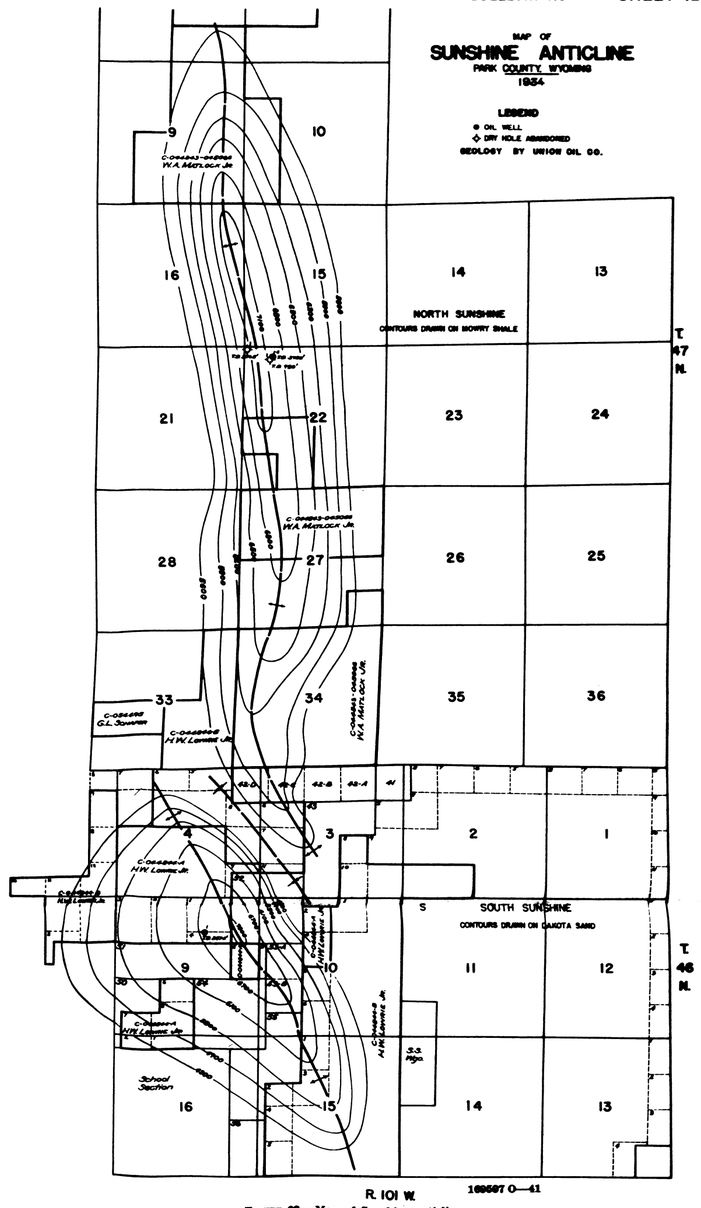


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FIGURE 68.—Map of Sunshine anticline.

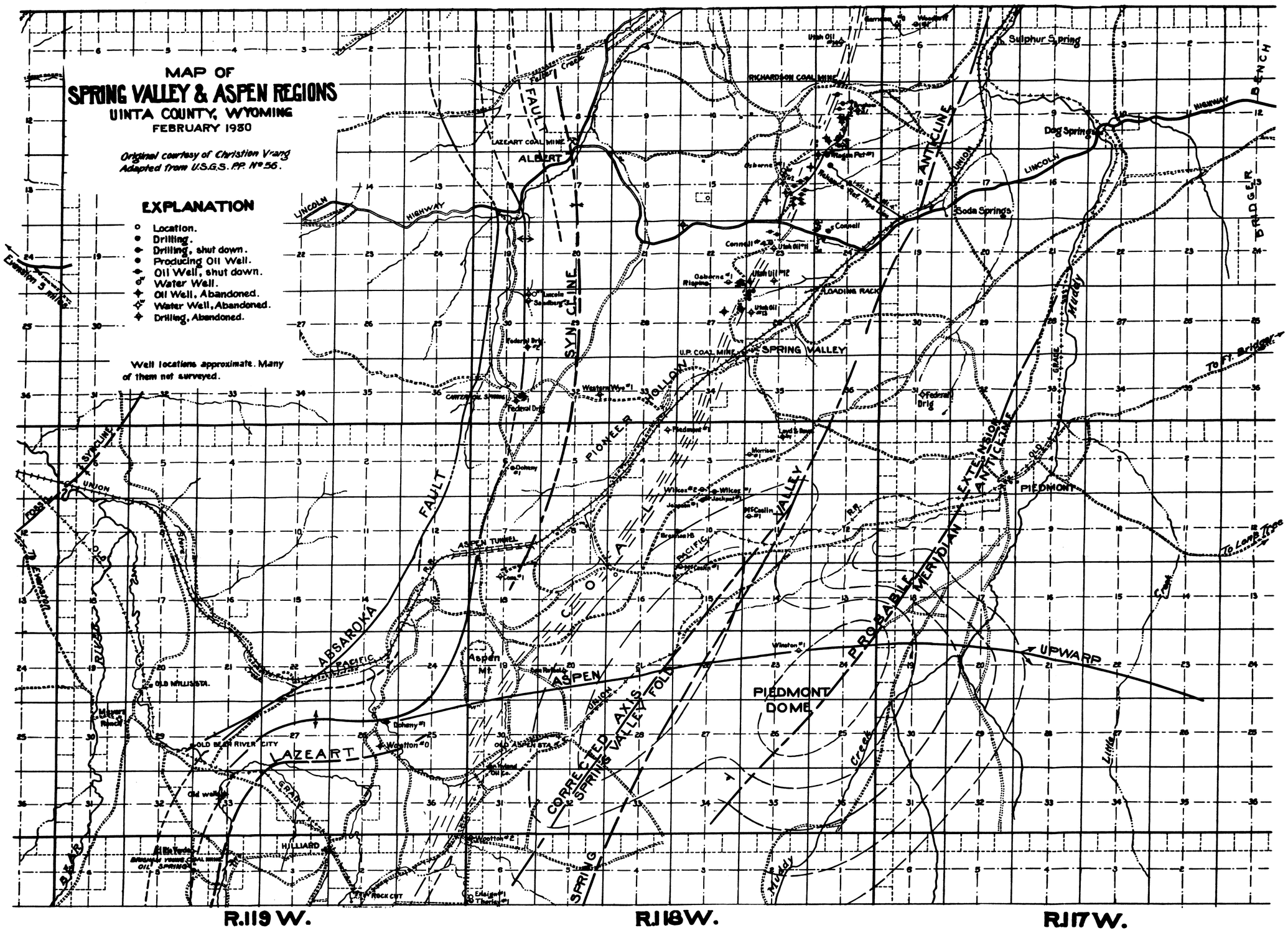

FIGURE 67.—Structural map of Spring Valley and Aspen Creek.

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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION BRANCH—OIL AND GAS LEASING DIVISION
MIDWEST, WYO.
MAP OF
SALT CREEK FIELD
NATRONA COUNTY, WYOMING
DRAWN BY R.R.PATTERSON
DATE MARCH 25, 1930.
APPROVED BY J.E.WALL
No MIDWEST 8699
REVISIONS
EXPLANATION
Location
Drilling
Drilling, shut down.
Producer - oil.
Producer - mostly gas.
Abandoned, dry or while drilling.
Abandoned, oil.
Abandoned, water.
Water supply.
Shannon.
Shale above 1st Wall Creek.
First Wall Creek.
Second Wall Creek.
Third Wall Creek.
Deepened from 2nd W.C. to 3rd W.C. etc.
Shale between 3rd W.C. and Lakota.
Third W.C. plugged back to 2nd W.C. etc.
Lakota.
Morrison.
First Sundance.
Second Sundance.
Third Sundance.
Tensleep
Skidded Rig
Well off Location
Deepened & Cored thru 2nd W.C.
BOUNDARIES
Withdrawal of 1909 & 1910.
Township line.
Section line
Section center line.
Lease subdivision line.
Definition of January 12, 1933.
WORKS and STRUCTURES
Oiled highway.
Main Graded field roads.
Unimproved roads.
Bridges.
Single track railroad.
Buildings.
Camps.
Boosters.
Central pumping power.
Pump stations.
Gas plant.
Storage Tanks.
WATER FEATURES
Streams.
Streams, intermittent.
Water reservoirs.
SHANNON POOL
SCALE
QUARTER SECTION SHOWING WELL LOCATIONS. UNNUMBERED WELLS TAKE LOCATION NUMBER.
T.40N. R.79W.
T.40N. R.78W.
T.39N. R.79W.
T.39N. R.78W.
WEST SALT CREEK
MIDWEST HOME CAMP
CONTINENTAL HOME CAMP
TEAPOT WITHDRAWAL MIDWEST MAP No 6030
COMPOSITE LOG
125 SHANNON
1090 STEELE
730 NIOBRARA
200 CARLILE
120 1st WALL CREEK
260
1035 FRONTIER
70 2nd WALL CREEK
165
15 3rd WALL CREEK
UPPER CRETACEOUS
230 MOWRY
7 MUDDY
230 THERMOPOLIS
DAKOTA
FUSON
LOWER CRETACEOUS
50 LAKOTA
115 MORRISON
100 UPPER BENCH
445 SUNDANCE
100 MIDDLE BENCH
60 LOWER BENCH
JURASSIC
705 RED BEDS
TRIASSIC
220 EMBAR
300 TENSLEEP
CARBONIFEROUS
PENNSYLVANIAN
690 UNDIFFERENTIATED AMSDEN AND TENSLEEP
395 AMSDEN
230 MADISON LIME
MISSISSIPPIAN
705 DEADWOOD FORMATION
CAMBRIAN
UPPER CAMBRIAN
PRE-CAMBRIAN
GRANITE

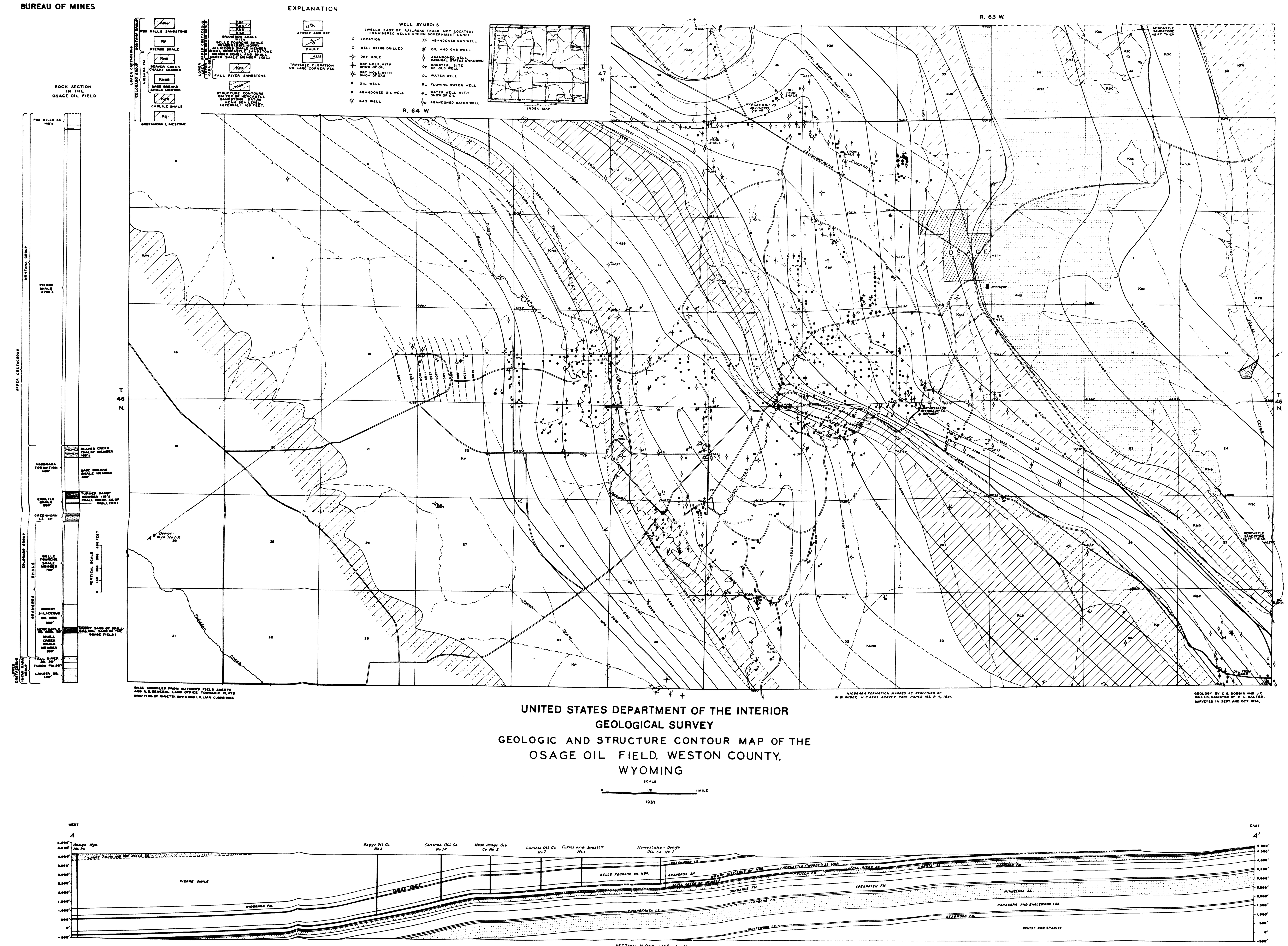

FIGURE 52.—Geologic and structural contour map of Osage field.

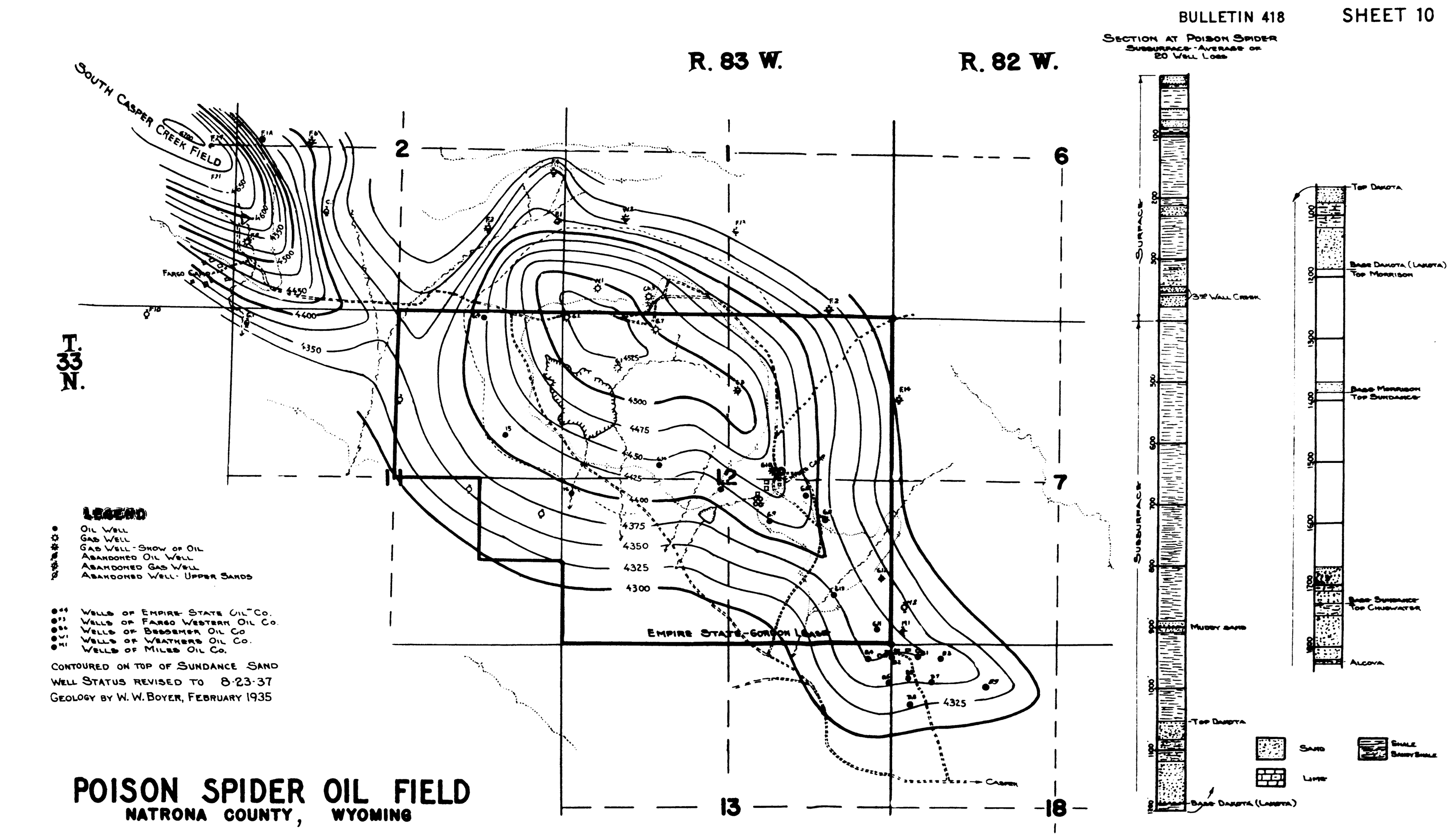

FIGURE 55.—Map of Poison Spider oil field.

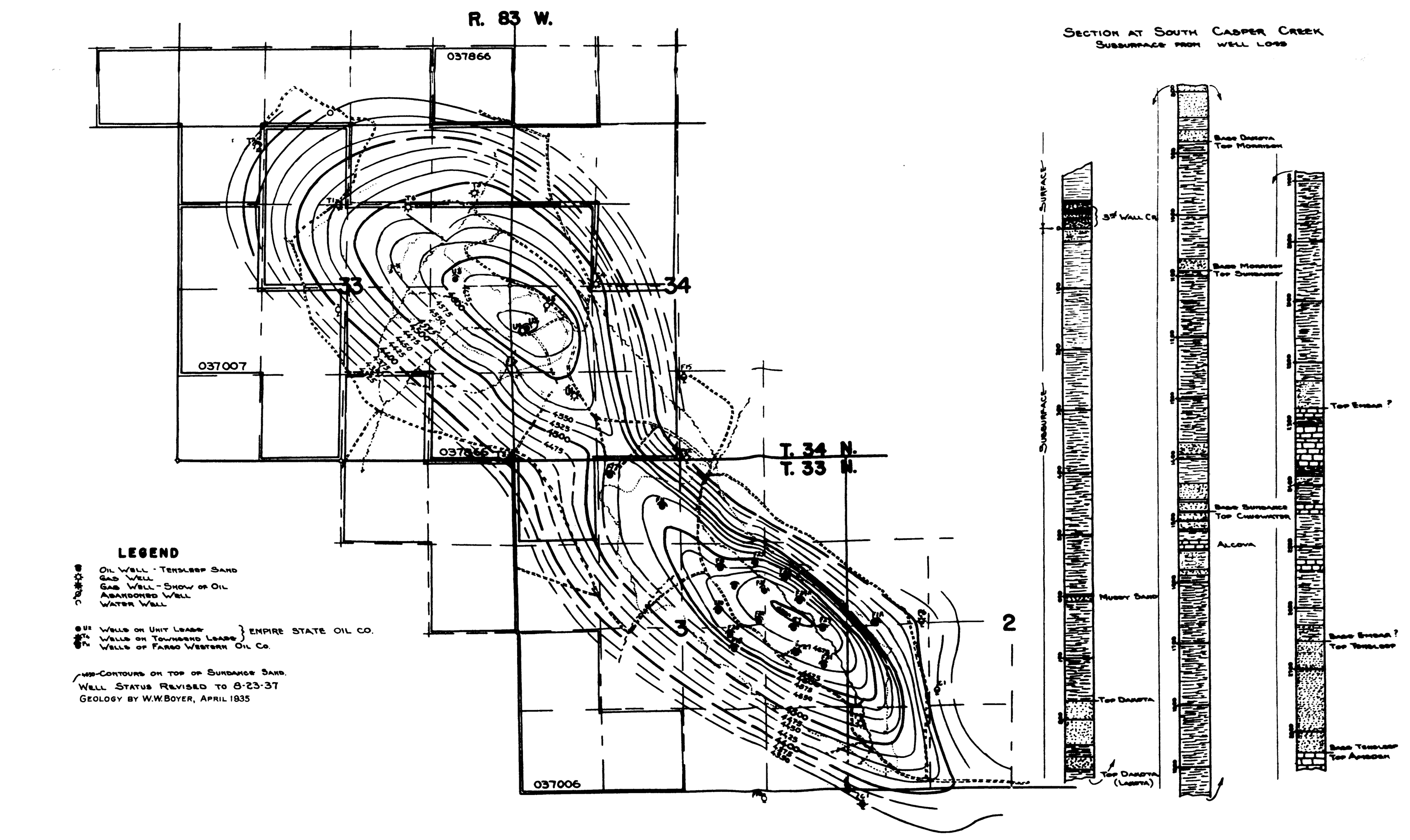

FIGURE 56.—Map of South Casper Creek oil field, Natrona County, Wyo.

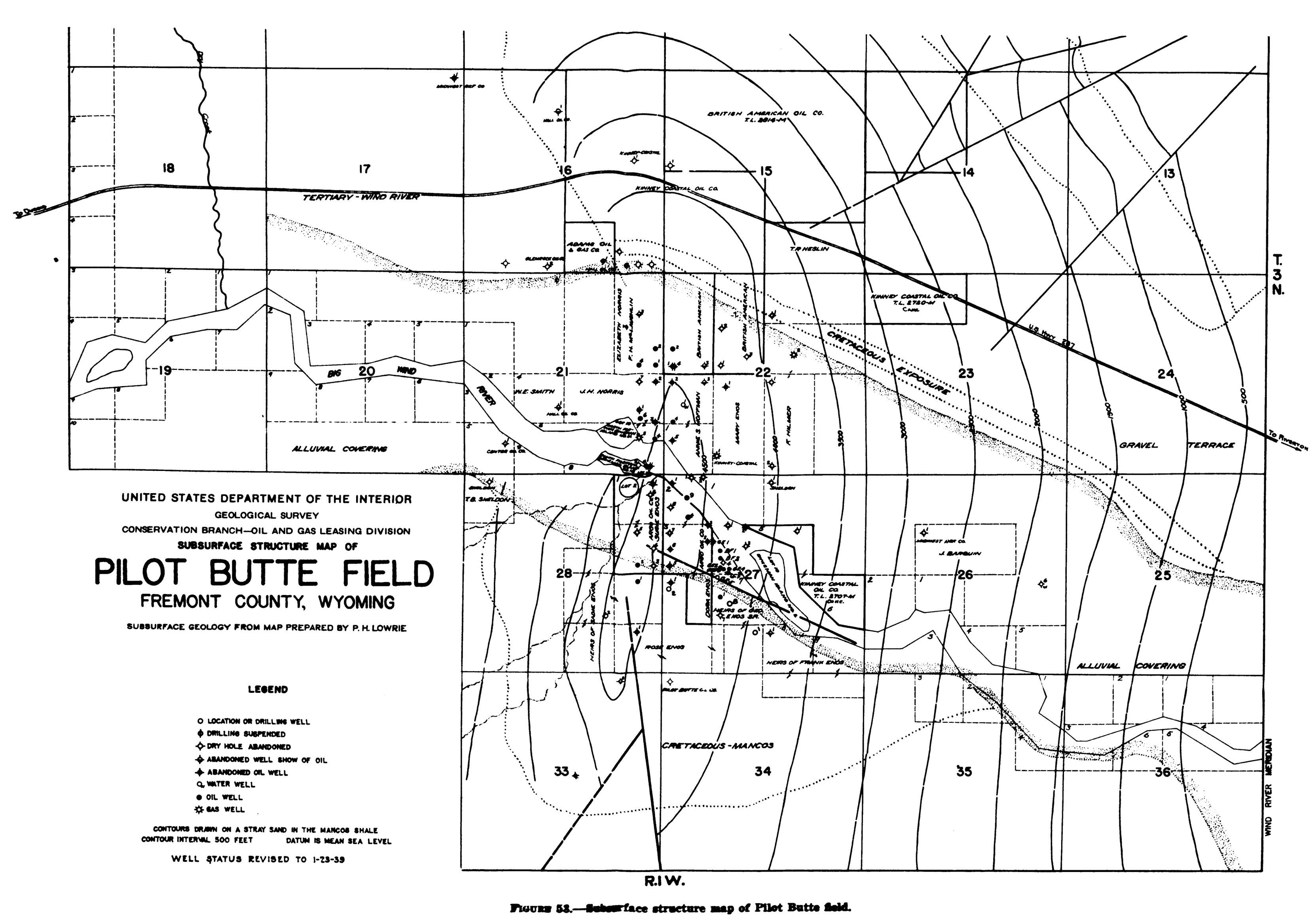

FIGURE 53.—Subsurface structure map of Pilot Butte field.

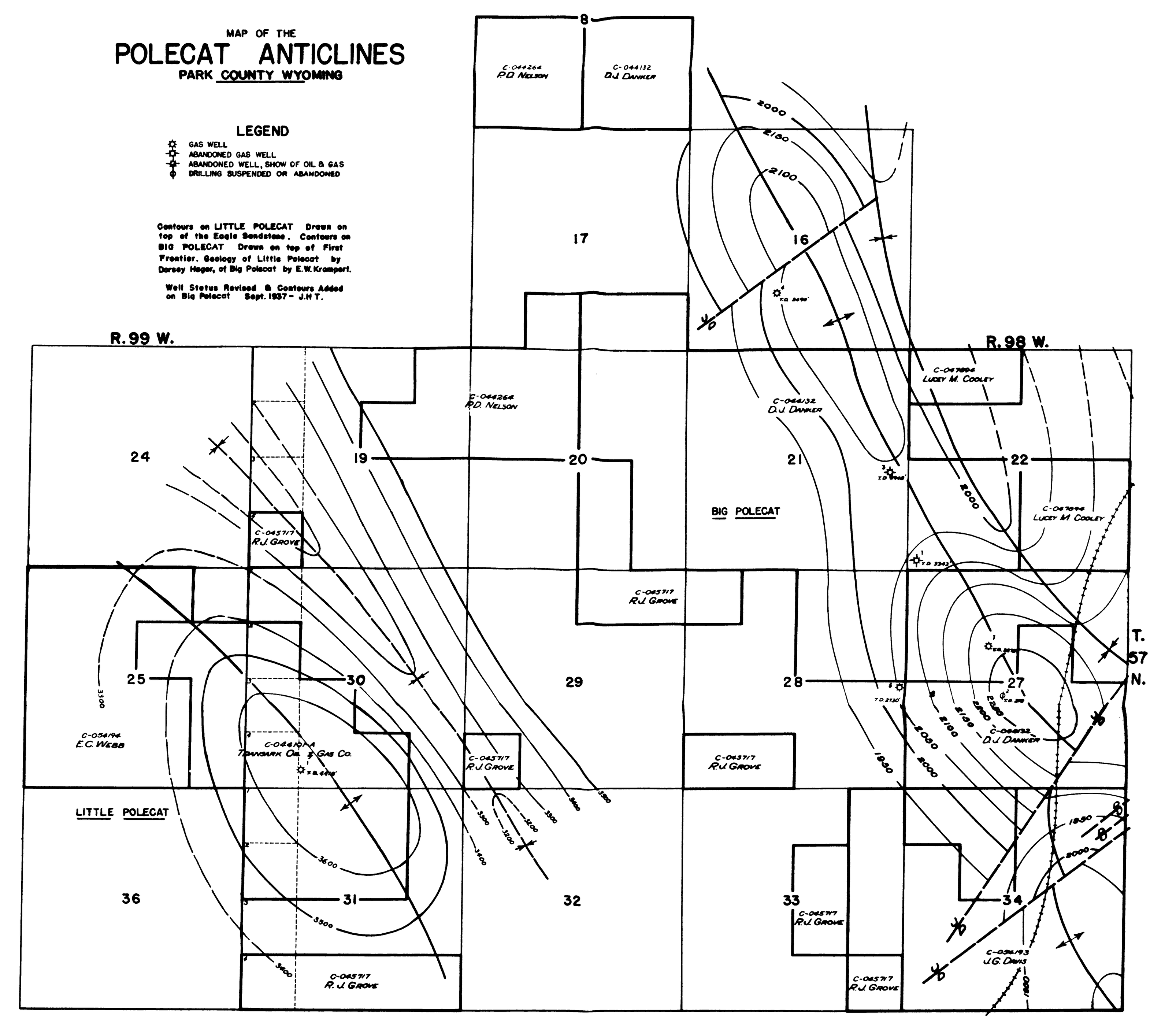

FIGURE 57.—Map of Polecat anticlines.

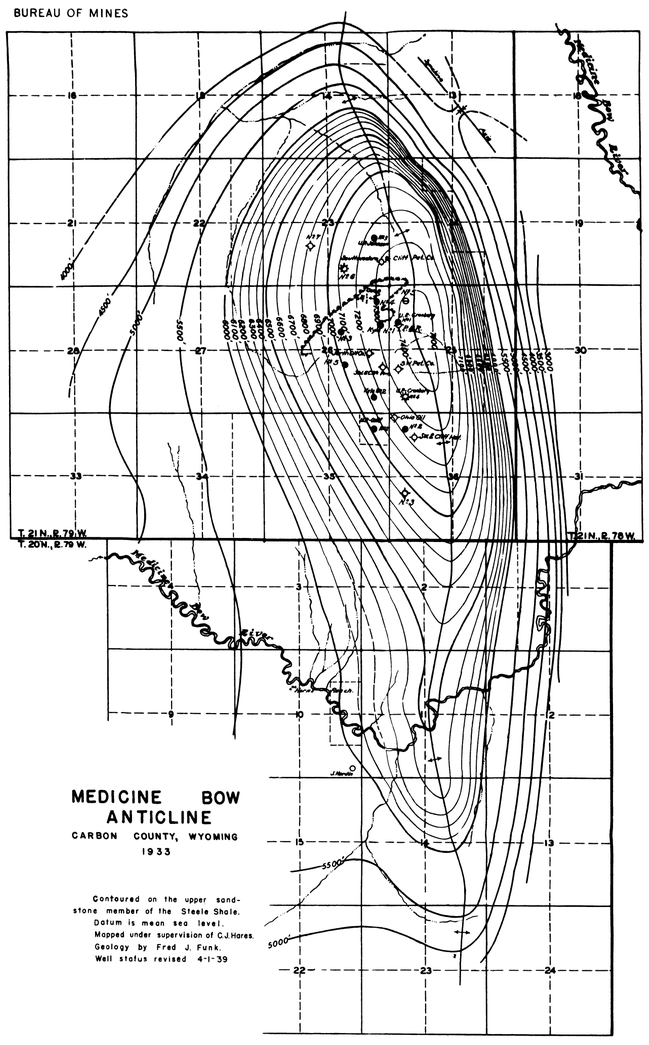

FIGURE 45.—Map of Medicine Bow anticline.

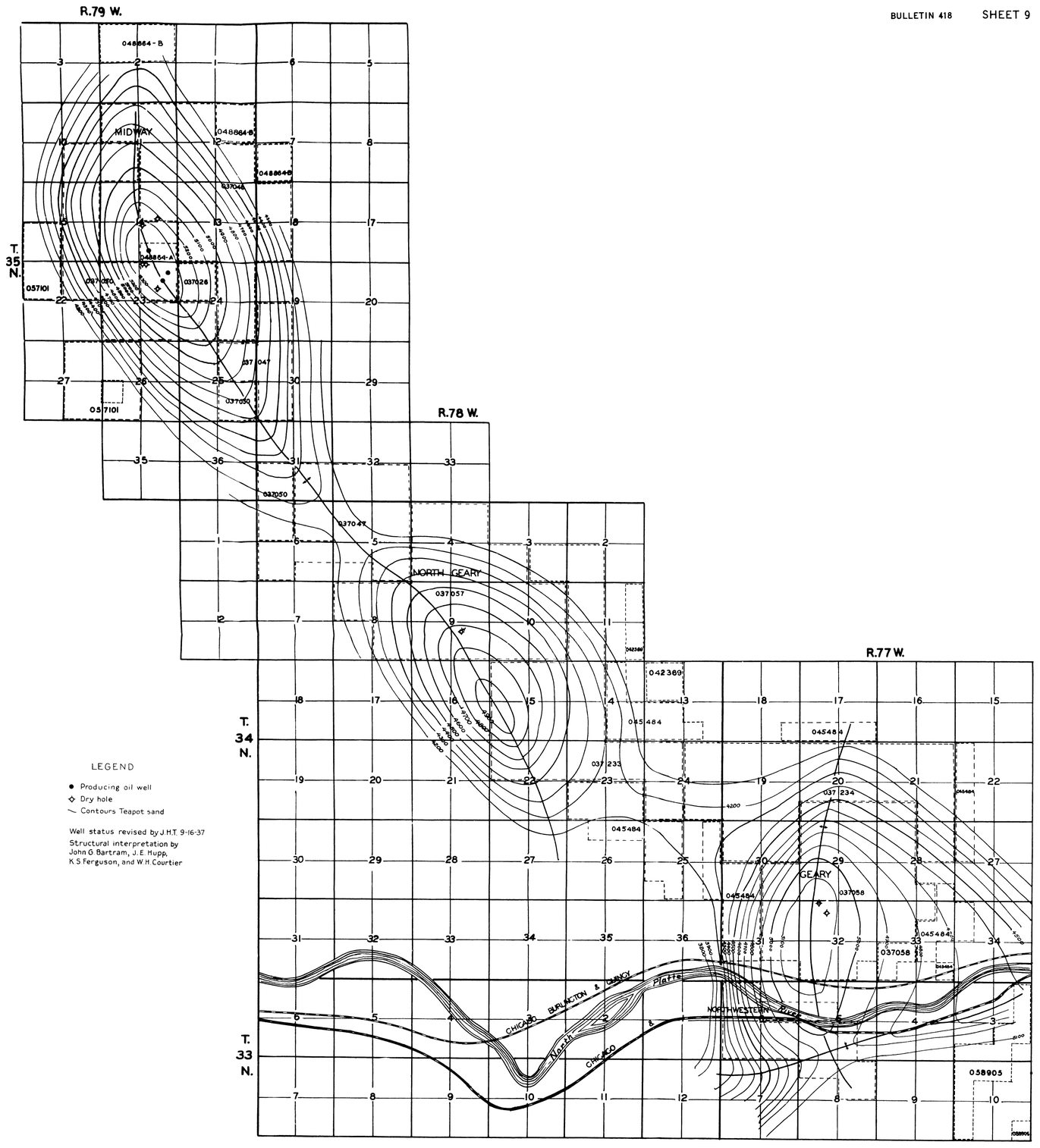

FIGURE 46.—Map of Midway, Geary, and North Geary structures.

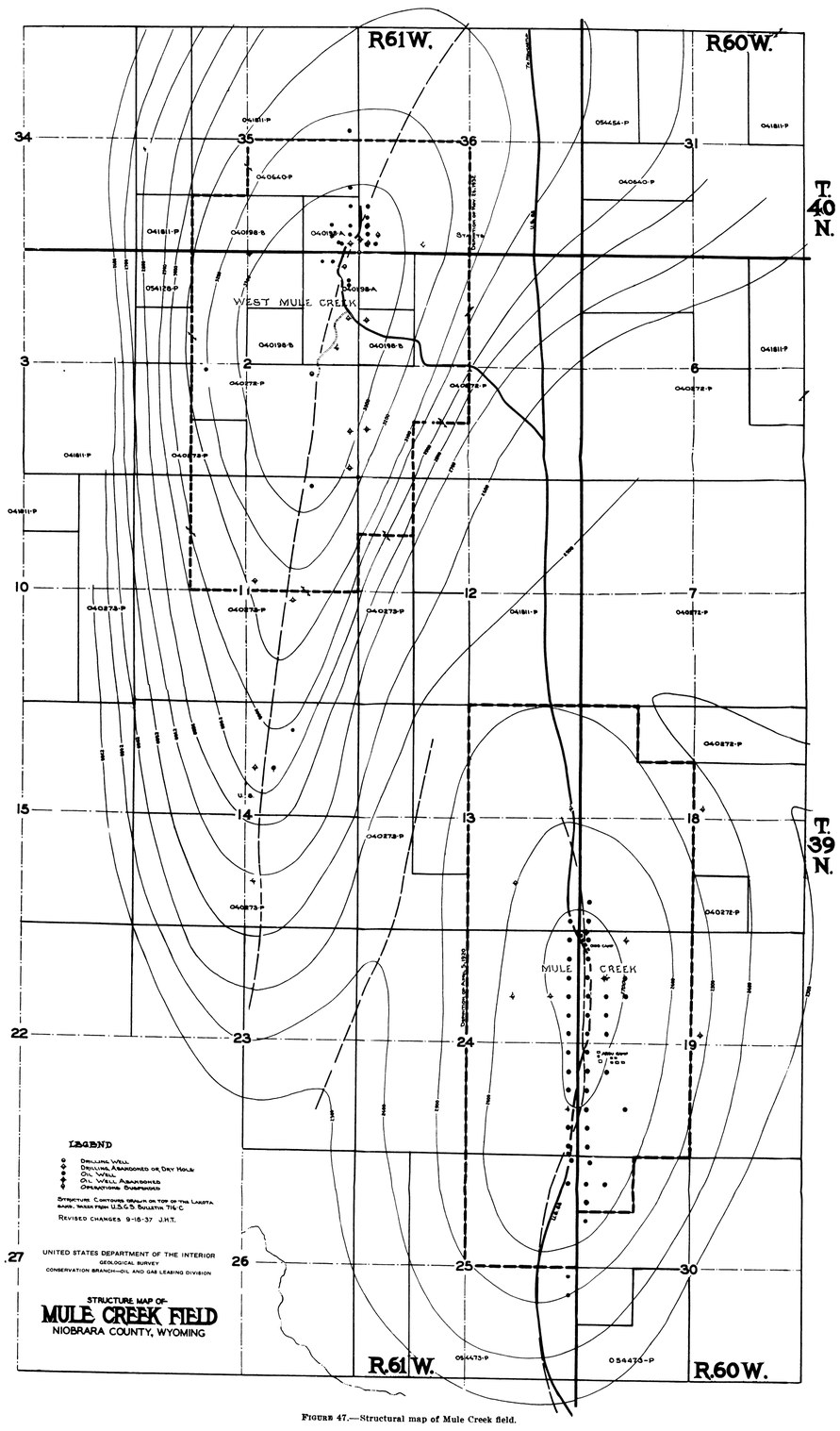

FIGURE 47.—Structural map of Mule Creek field.

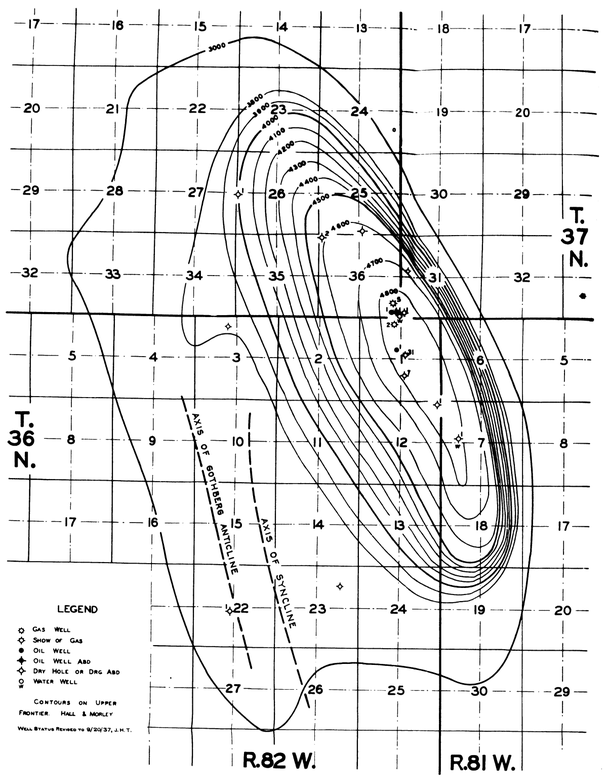

FIGURE 49.—Map of North Casper Creek anticline.

FIGURE 48.—Structural contour map of Muskrat anticline.

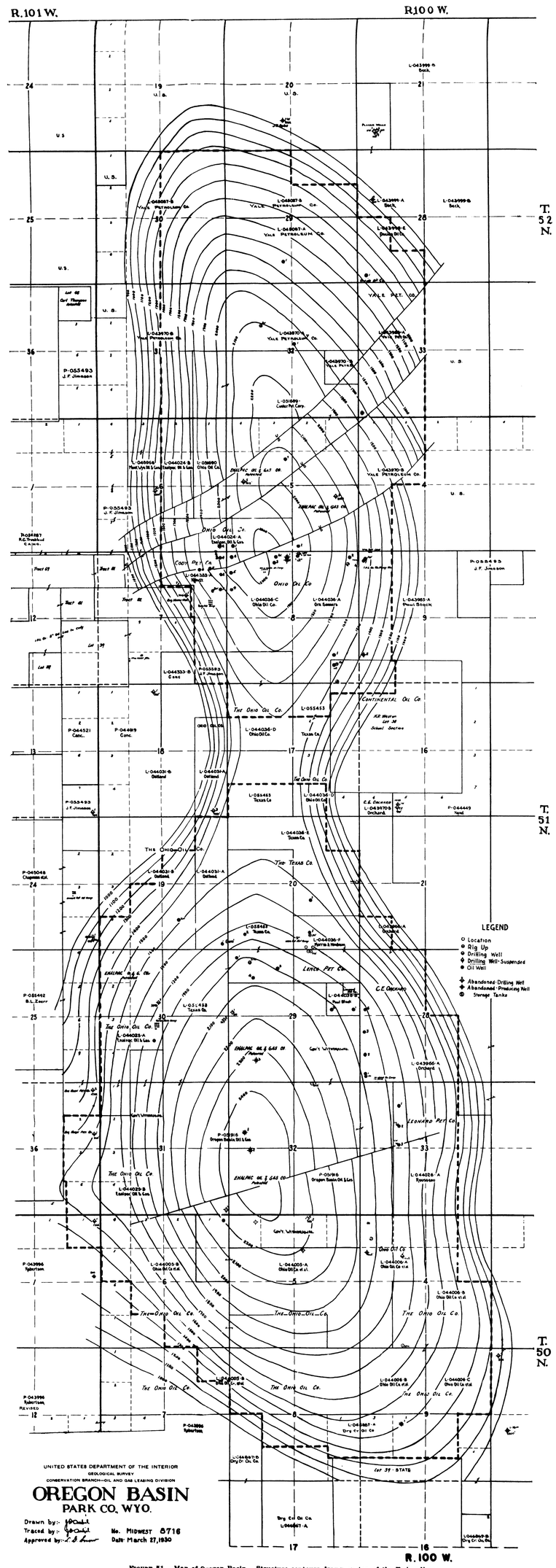

FIGURE 51.—Map of Oregon Basin. Structure contours drawn on top of the Ember lime; interval, 100 feet. Geology by J. D. Cerkel and L. G. Snow. Map revised to May 6, 1938, by J. H. Thompson.

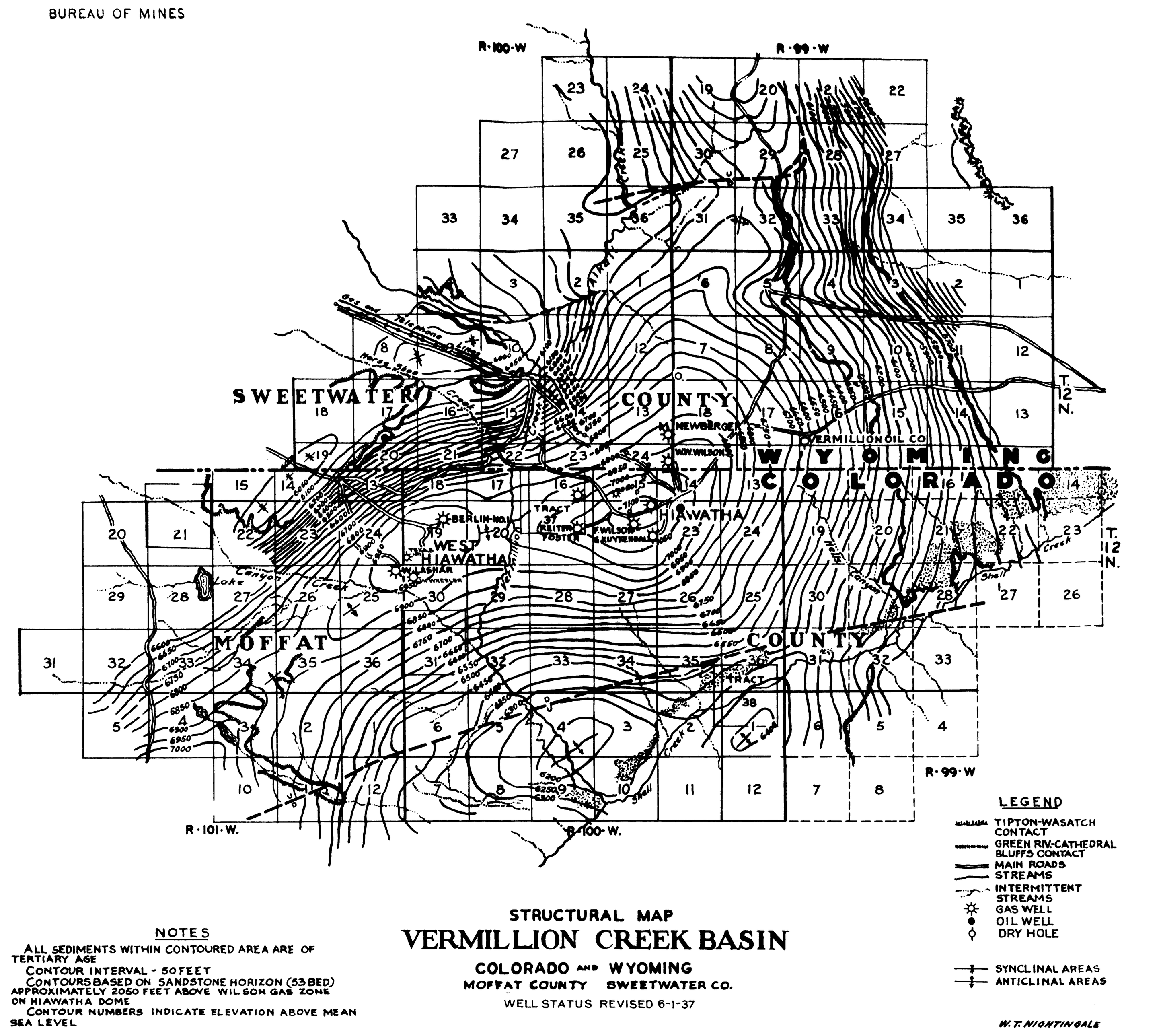

FIGURE 35.—Structural map of Vermillion Creek Basin.

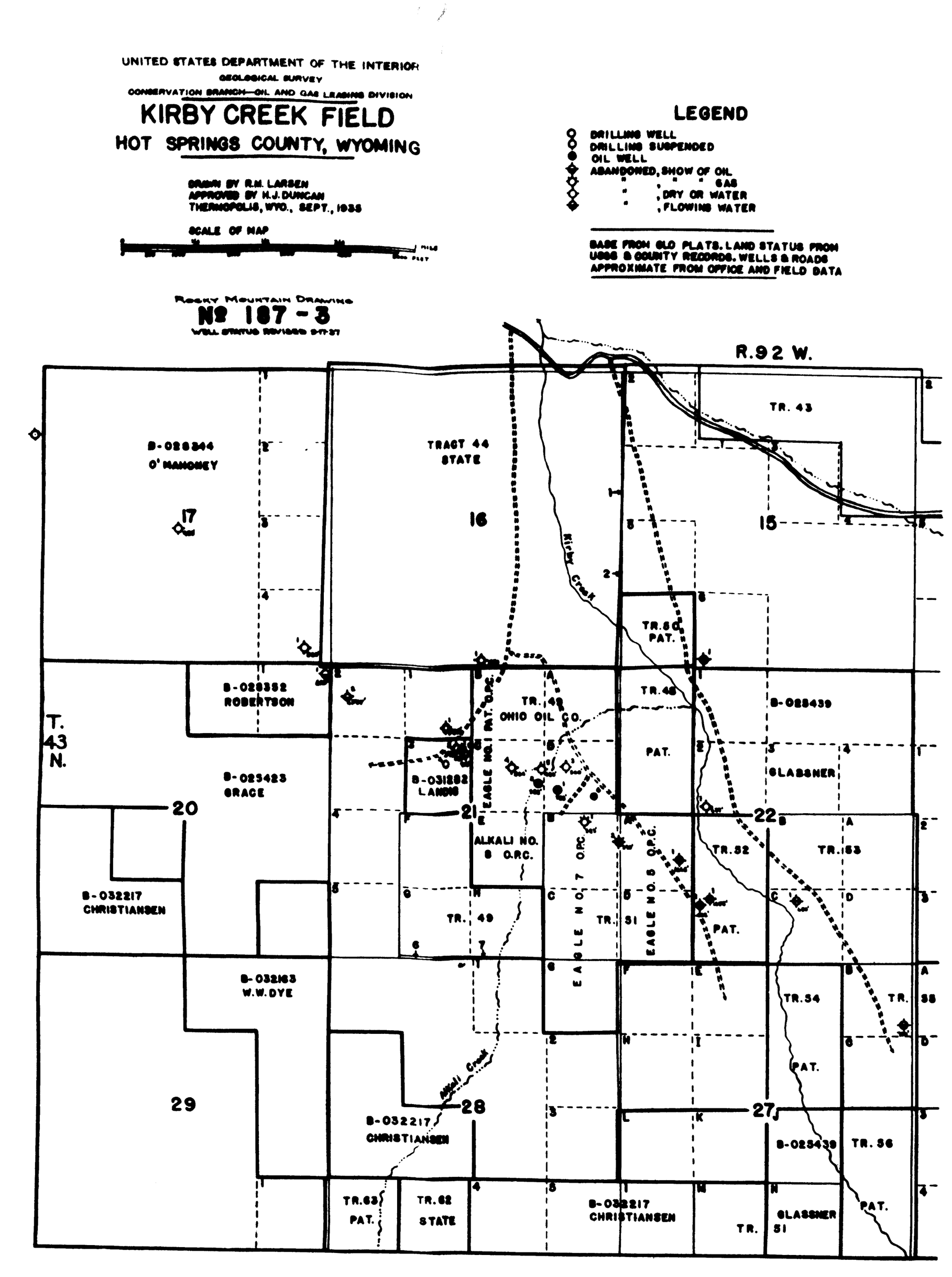

FIGURE 38.—Map of Kirby Creek field.

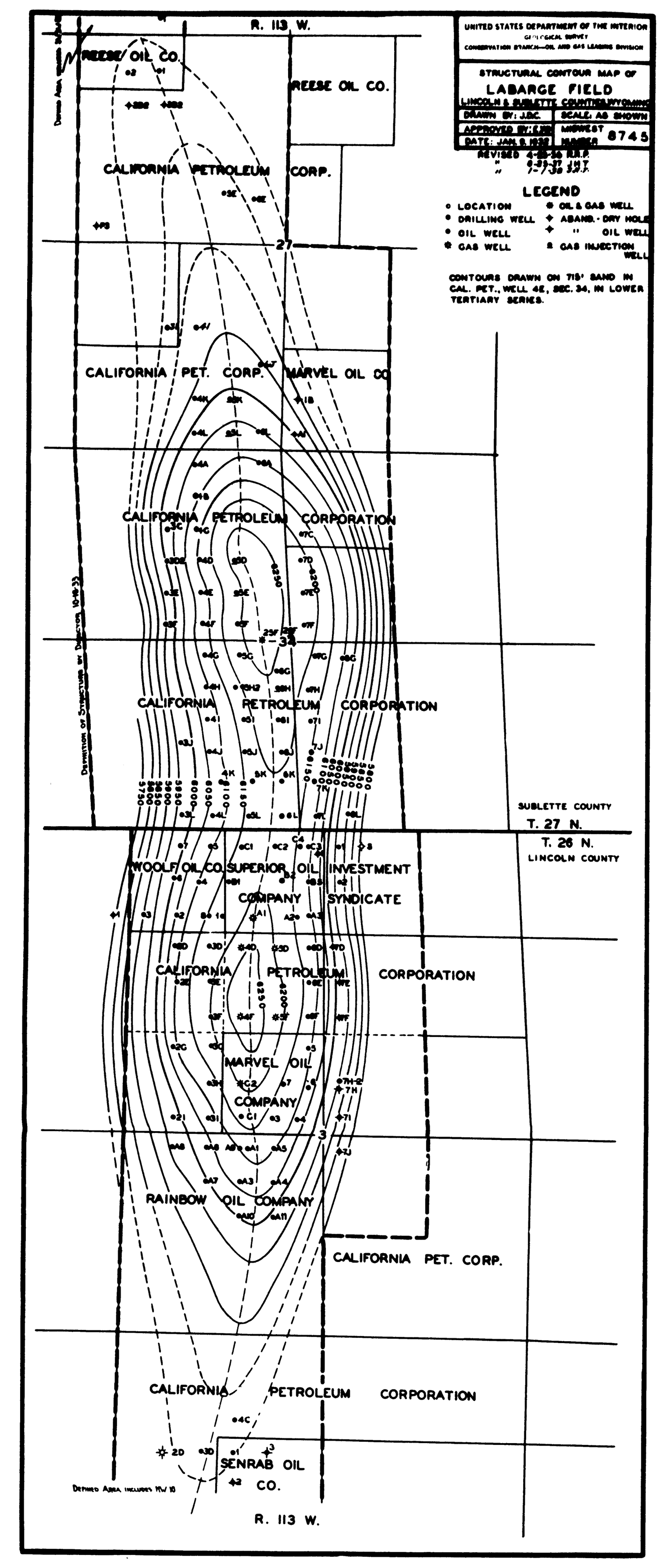

FIGURE 39.—Structural contour map of LaBarge field.

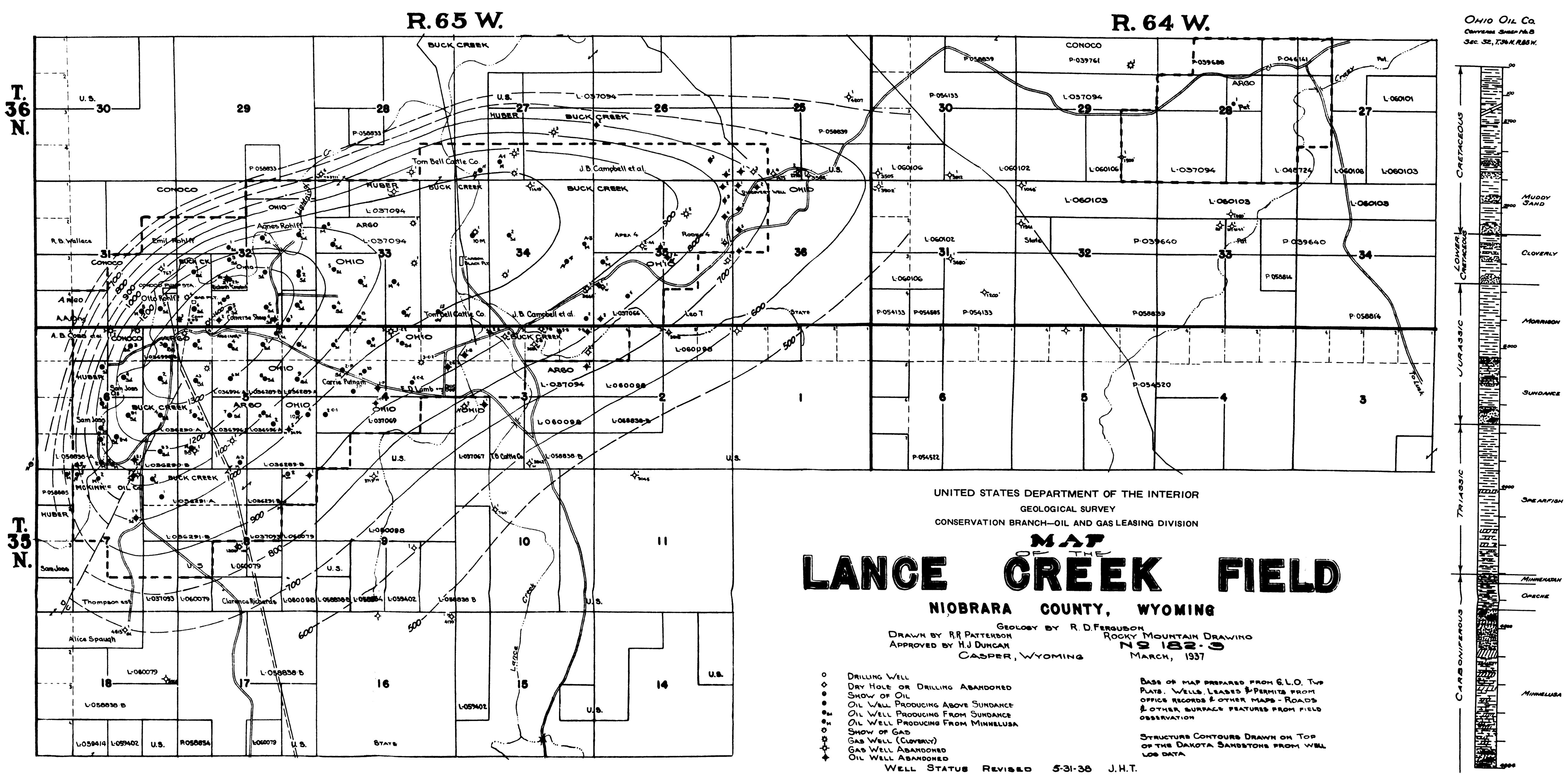

FIGURE 40.—Map of Lance Creek field.

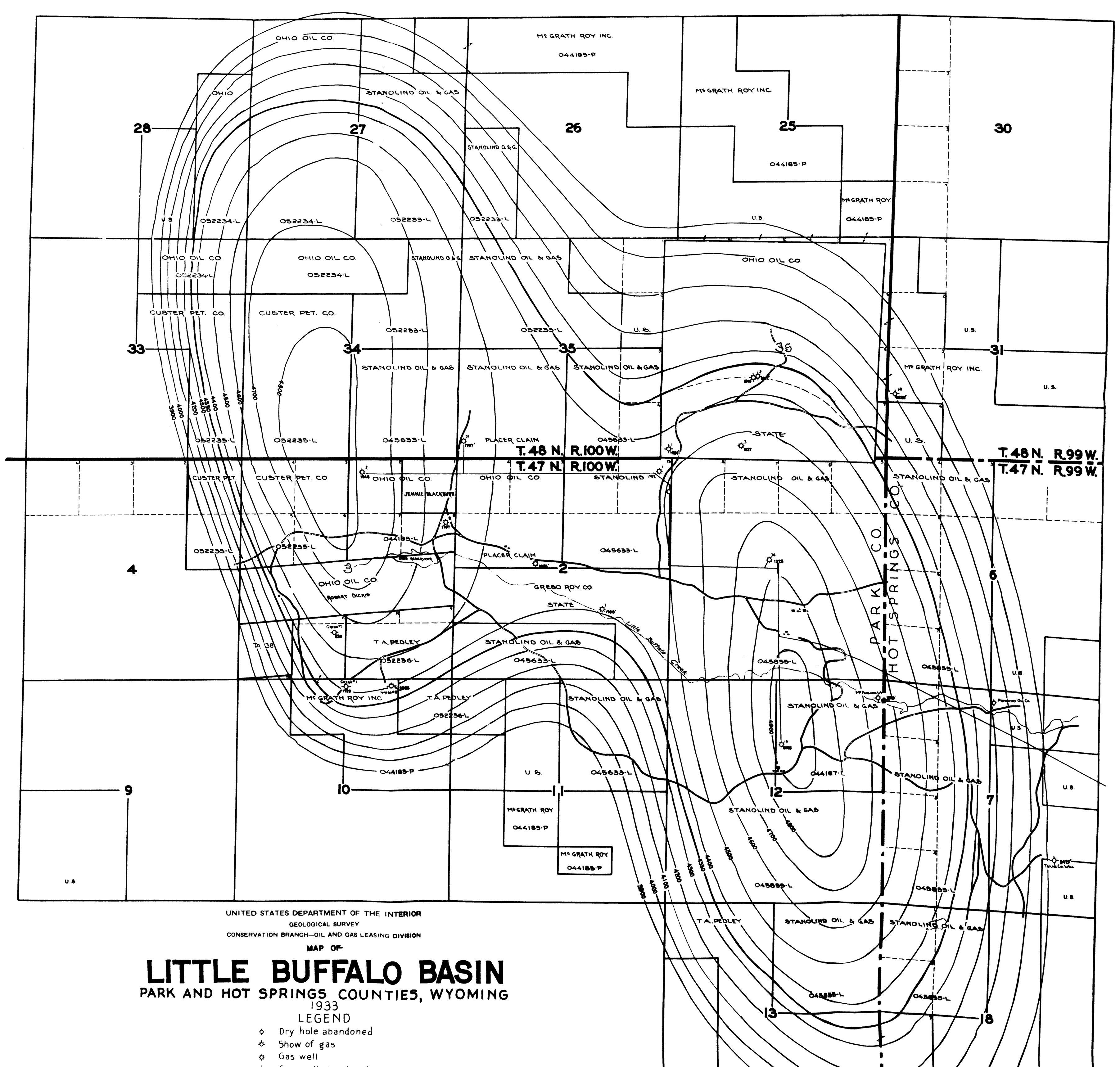

FIGURE 42.—Map of Little Buffalo Basin field.

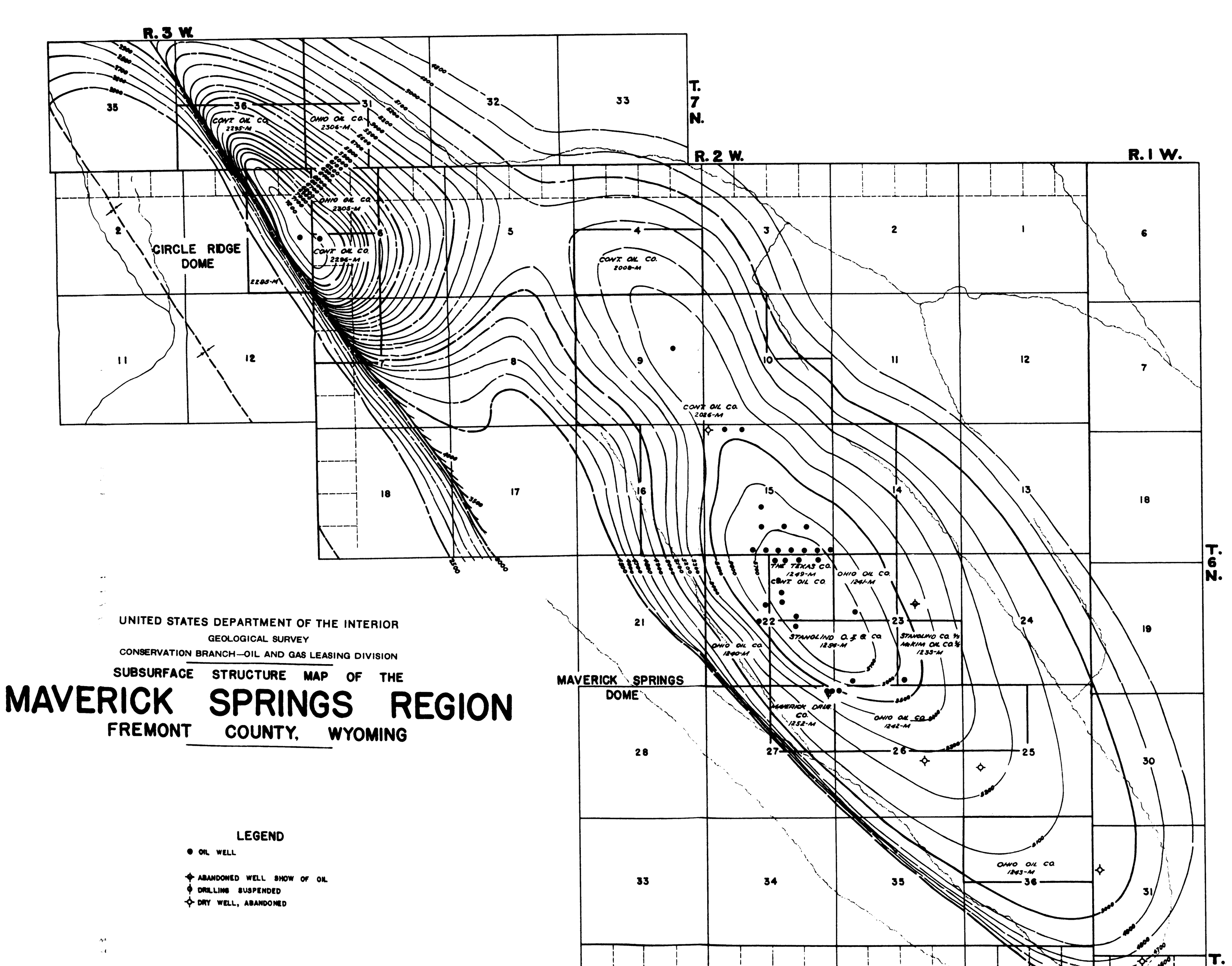

FIGURE 44.—Subsurface structure map of Maverick Springs region. The solid contours show the altitude of the top of the Embar lime as determined from well logs by A. W. Milek and L. G. Snow in 1934 and revised by L. G. Snow in 1937. The broken contours were plotted from plate 21 of Geological Survey Bulletin 711–H, Anticlines near Maverick Springs, Fremont County, Wyo., by A. J. Collier, 1920. Datum, mean sea level; contour interval, 100 feet.

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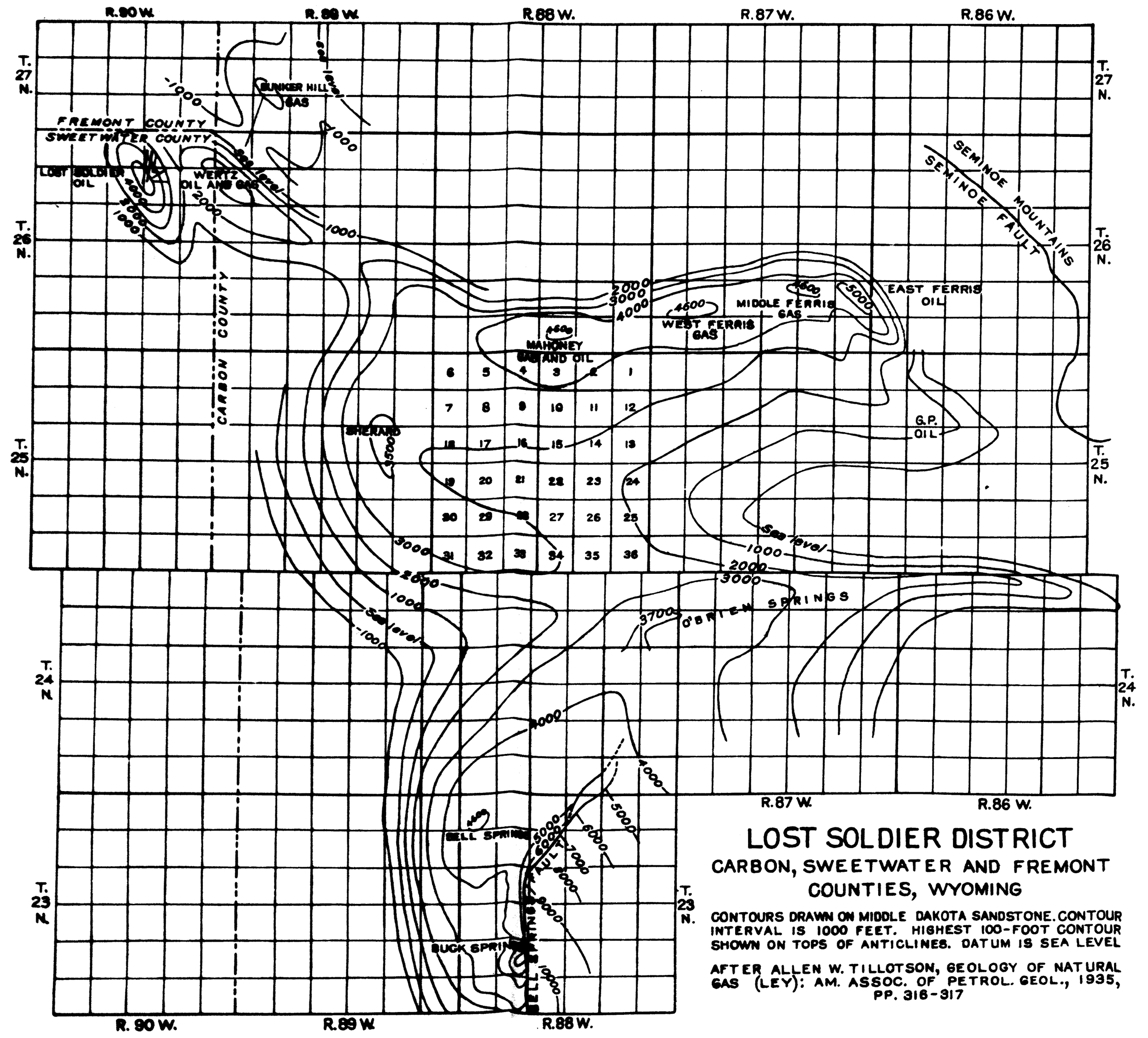
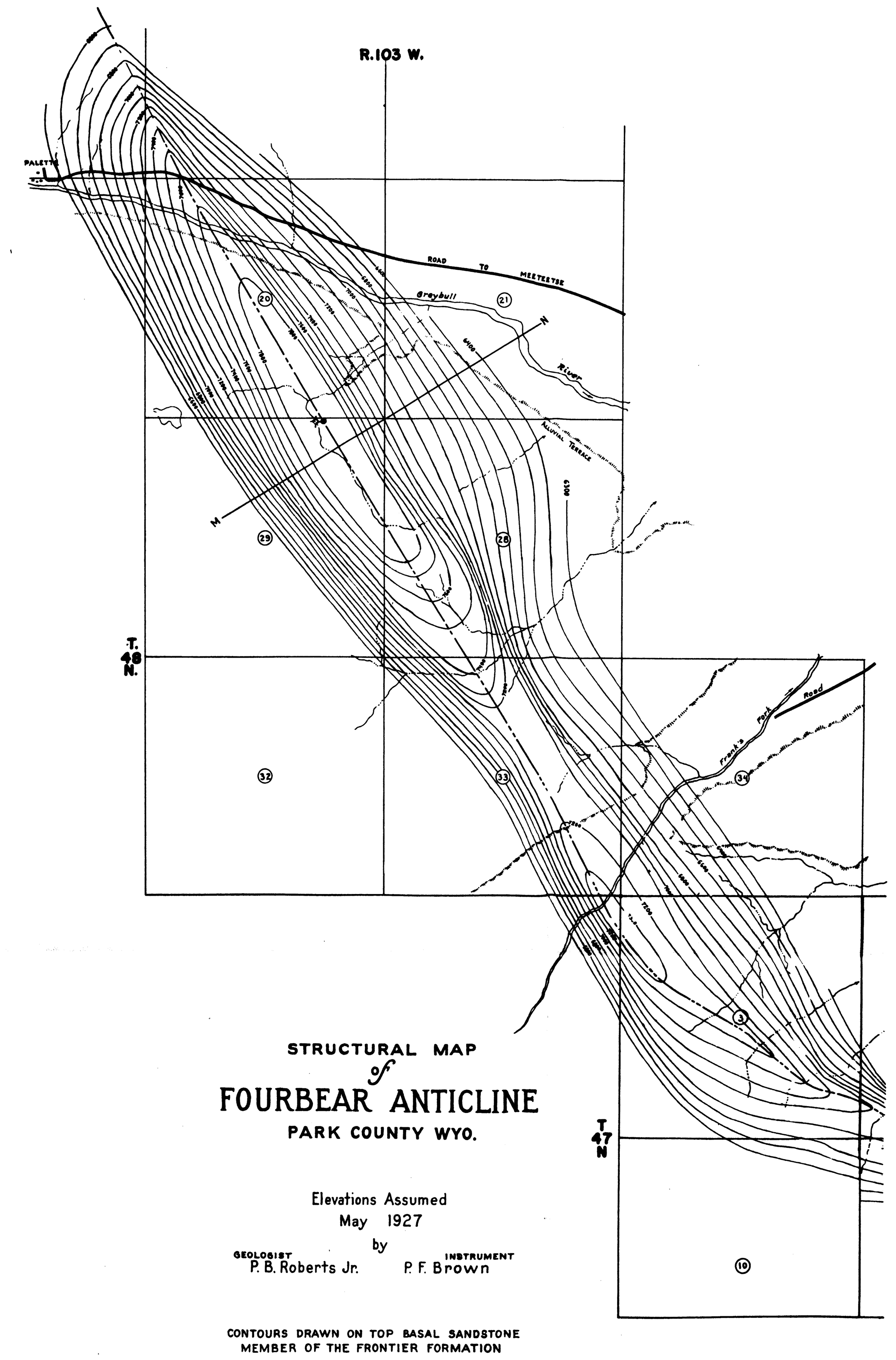


FIGURE 25.—Map of Lost Soldier district.



Well status revised July 1, 1937.

FIGURE 28.—Structural map of Fourbear anticline.

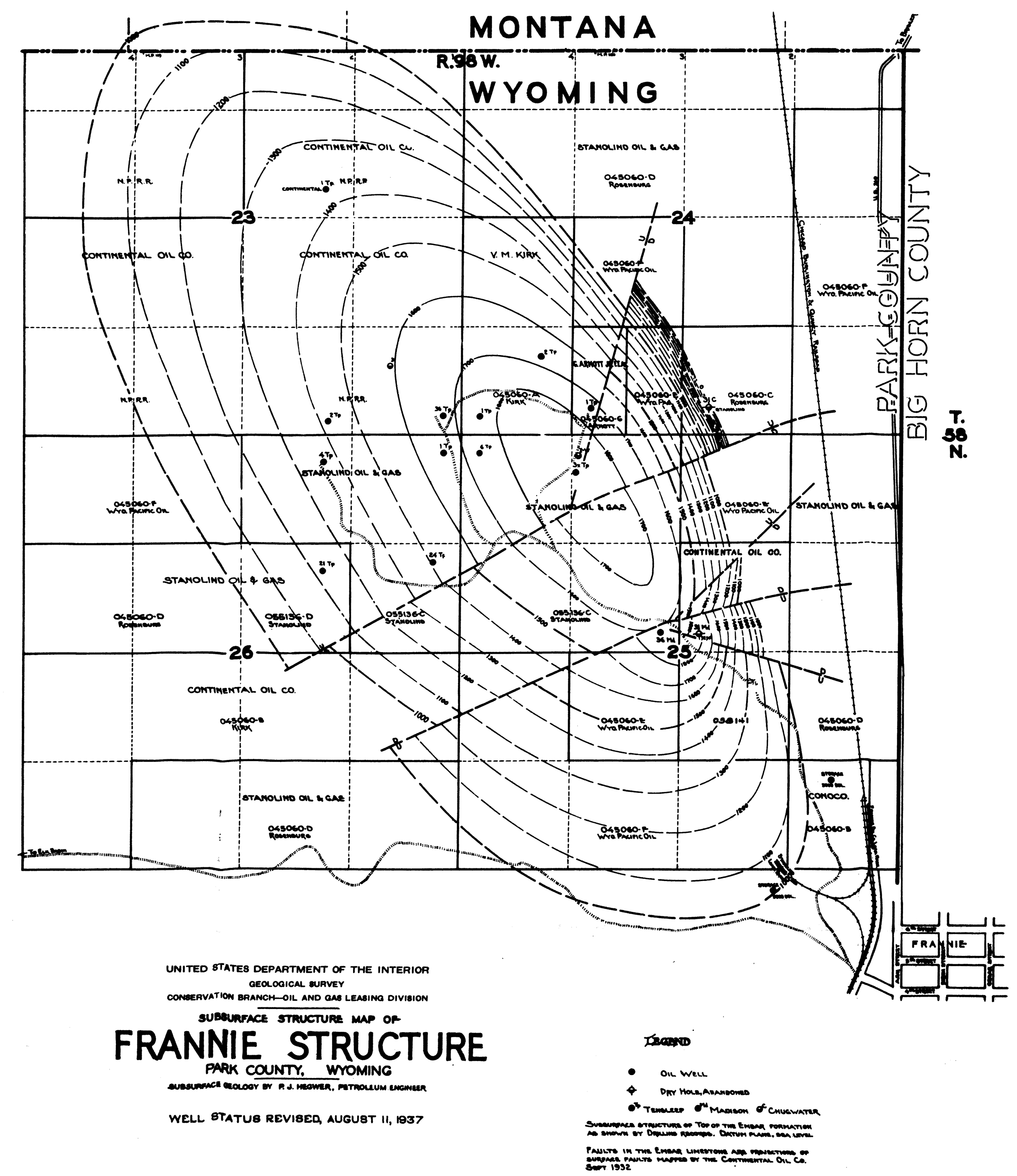


FIGURE 29.—Subsurface structure map of Frannie structure.

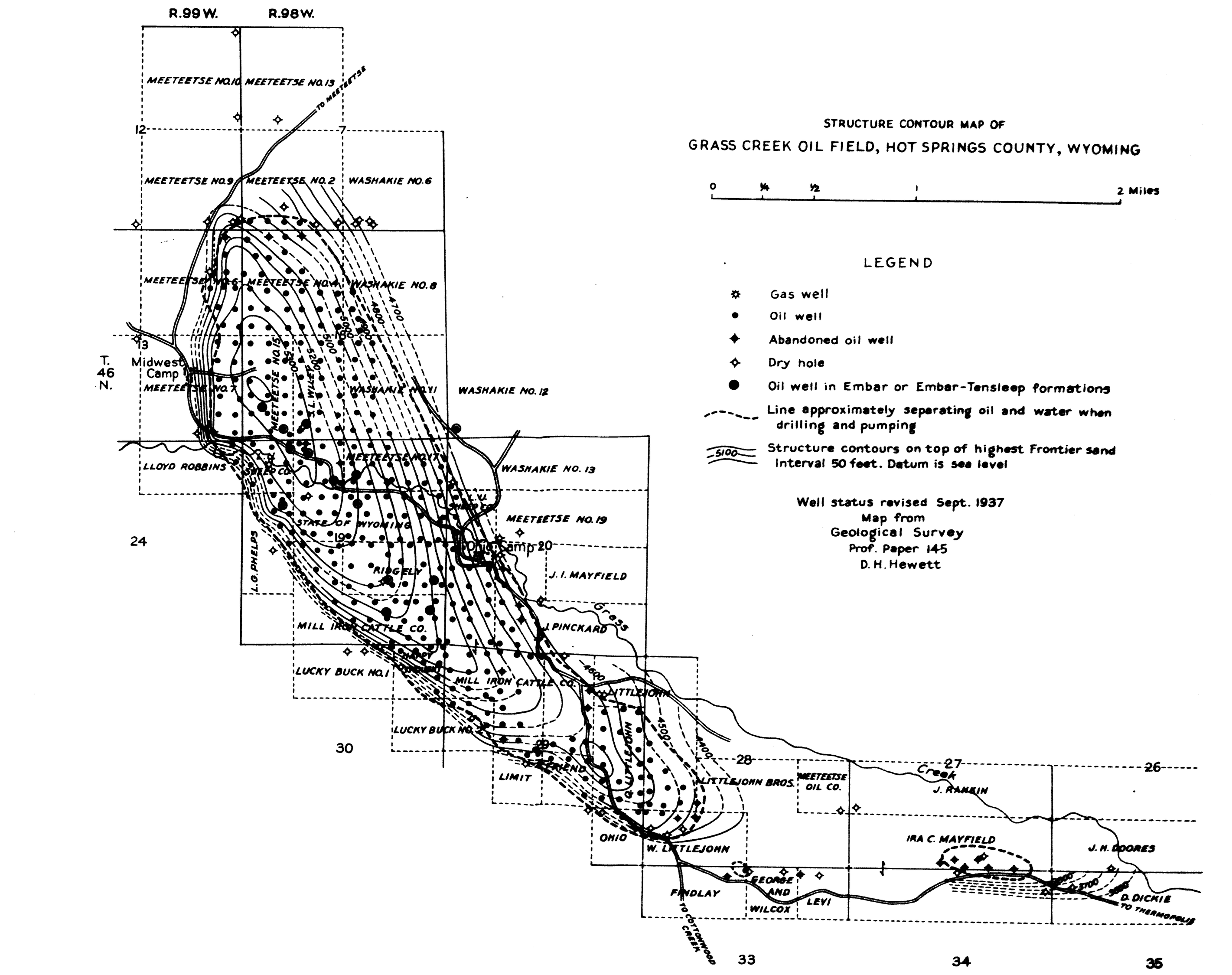


FIGURE 31.—Structural contour map of Grass Creek oil fields.

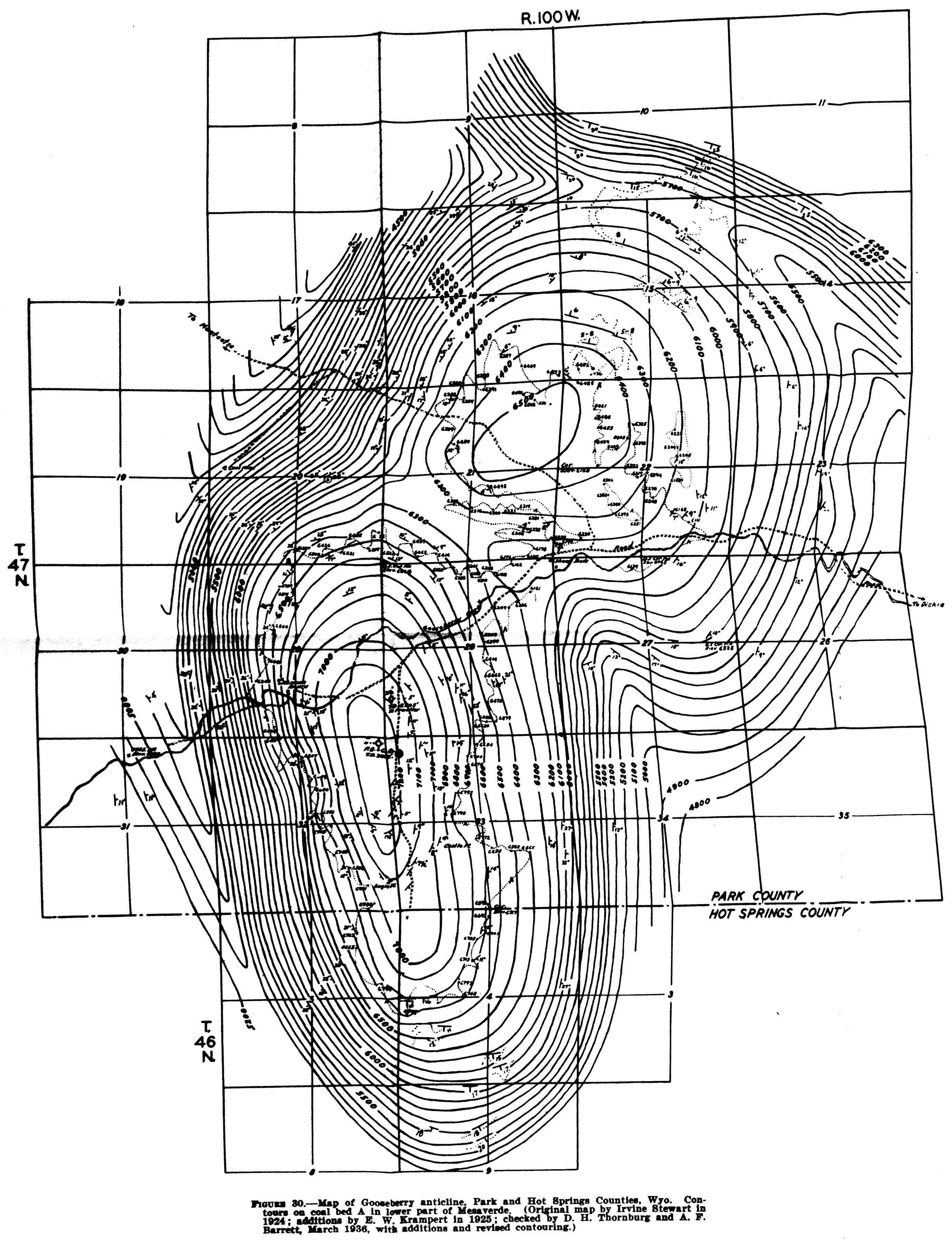


FIGURE 30.—Map of Gooseberry anticline, Park and Hot Springs Counties, Wyo. Contours on coal bed A in lower part of Mesaverde. (Original map by Irvine Stewart in 1924; additions by E. W. Krampert in 1925; checked by D. H. Thornburg and A. F. Barrett, March 1936, with additions and revised contouring.)

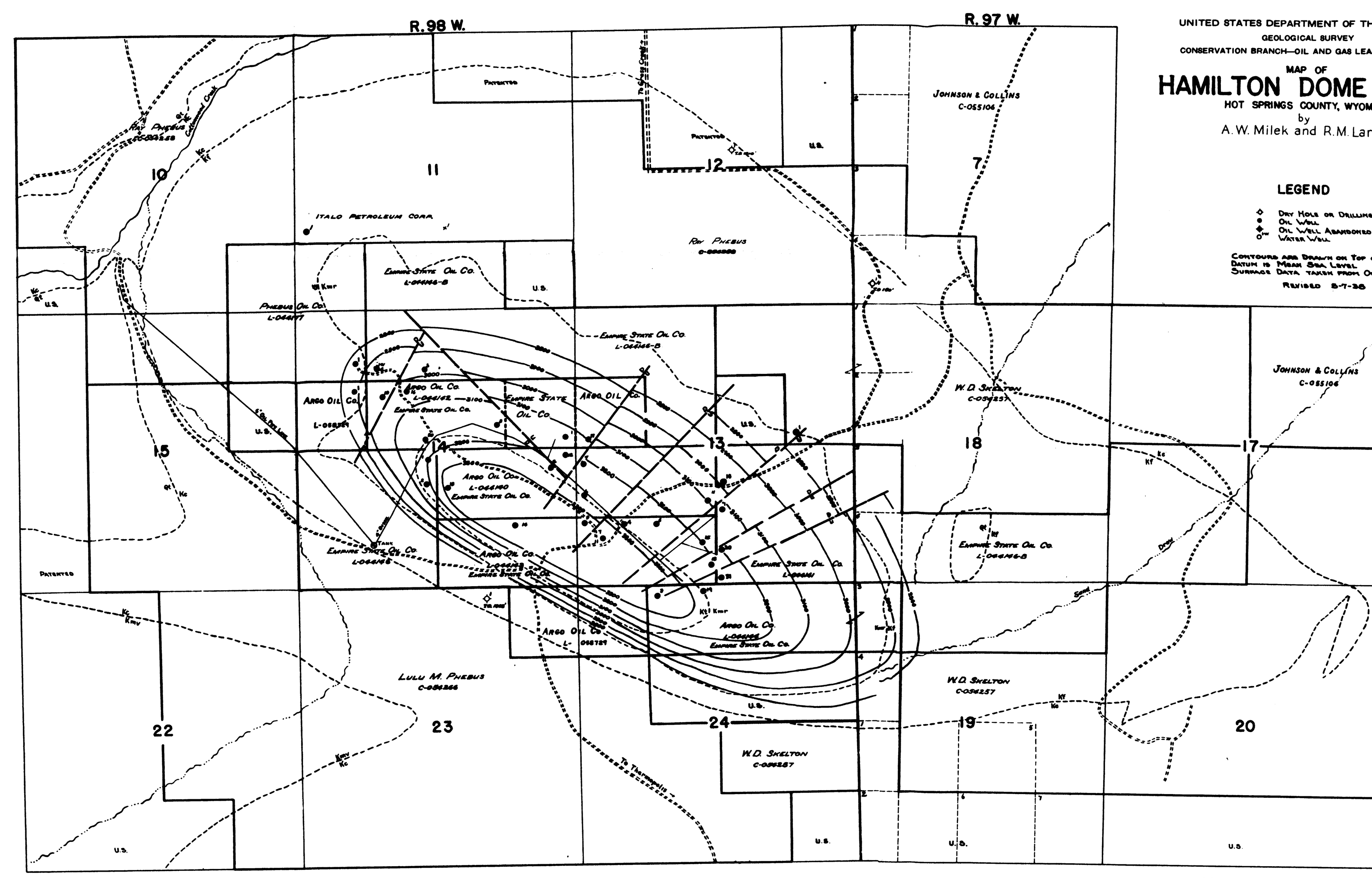


FIGURE 32.—Map of Hamilton Dome field.

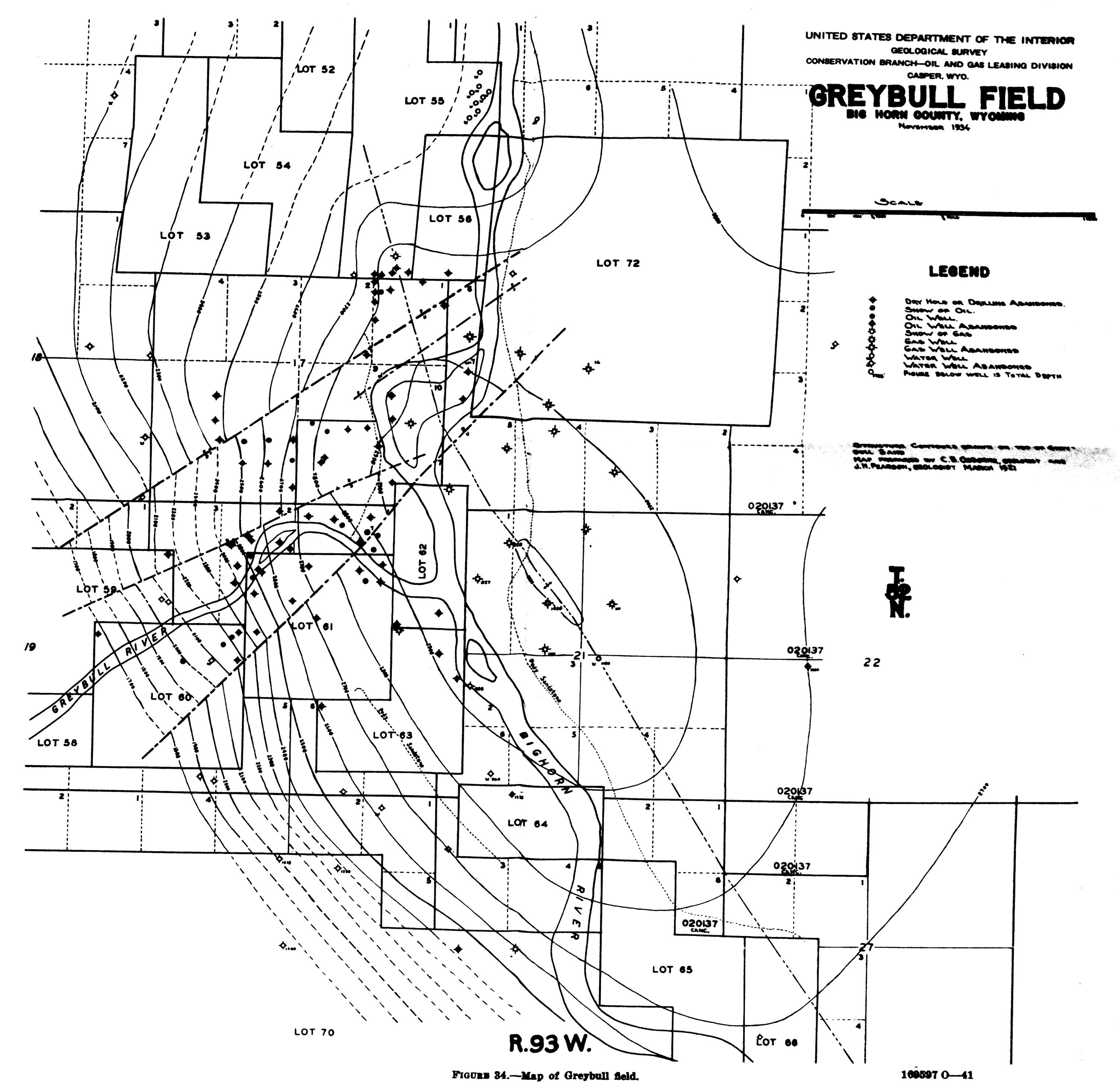
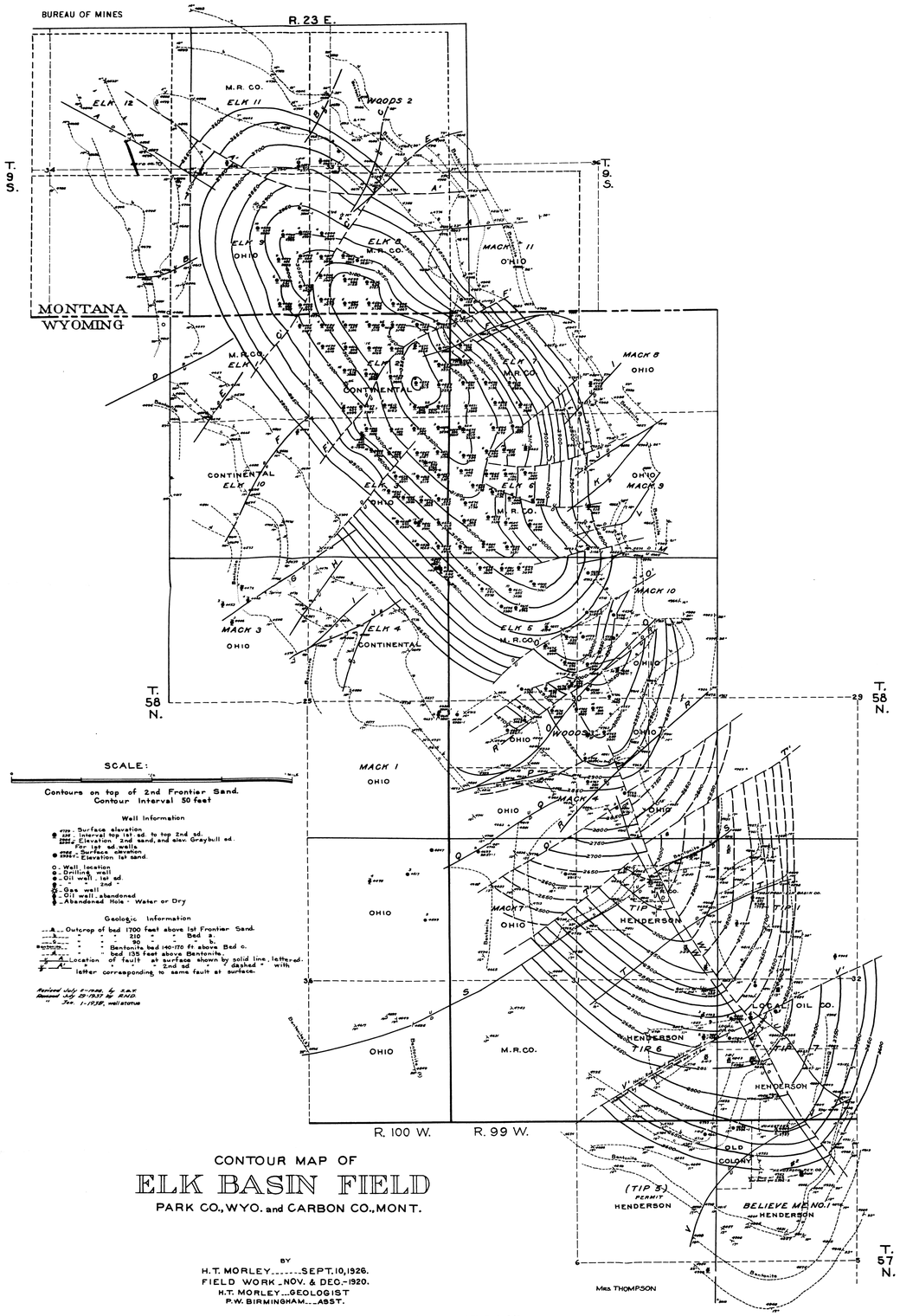


FIGURE 34.—Map of Greybull field.

BUREAU OF MINES



SCALE:

Contours on top of 2nd Frontier Sand.
Contour Interval 50 feet

Well Information

- 4700 - Surface elevation
- 400 - Interval top 1st sd. to top 2nd sd.
- 4300 - Elevation 2nd sand, and elev. Graybull sd. For 1st sd. wells
- 4700 - Surface elevation
- 4300 - Elevation 1st sand.
- O. Wall location
- ⊕ - Drilling well
- ⊕ - Oil well 1st sd.
- ⊕ - " 2nd "
- ⊕ - Gas well
- ⊕ - Oil well, abandoned
- ⊕ - Abandoned Hole - Water or Dry

Geologic Information

- A Outcrop of bed 1700 feet above 1st Frontier Sand.
- B " " 210 " " Bed a.
- C " " 90 " " b.
- Bentonite bed 140-170 ft above Bed c.
- A Bed 135 feet above Bentonite.
- A-A' Location of fault at surface shown by solid line, lettered. 2nd sd. " dashed " with letter corresponding to same fault at surface.

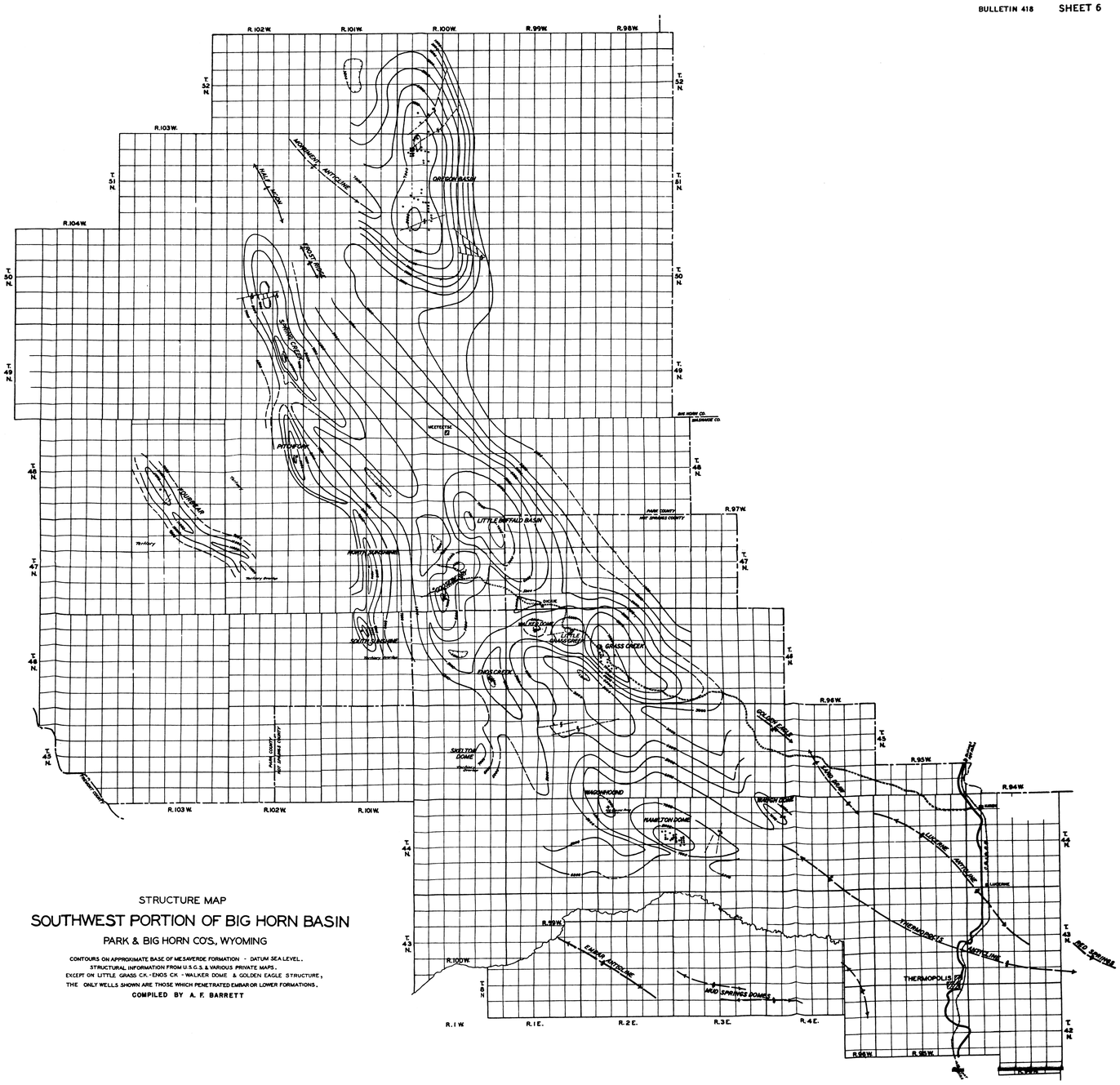
Revised July 1932 by R.H.D.
" Jan. 1-1938, well status

CONTOUR MAP OF ELK BASIN FIELD

PARK CO., WYO. and CARBON CO., MONT.

BY
H.T. MORLEY.....SEPT. 10, 1926.
FIELD WORK - NOV. & DEC. - 1920.
H.T. MORLEY...GEOLOGIST
P.W. BIRMINGHAM...ASST.

FIGURE 23.—Contour map of Elk Basin field.



STRUCTURE MAP

SOUTHWEST PORTION OF BIG HORN BASIN

PARK & BIG HORN CO'S, WYOMING

CONTOURS ON APPROXIMATE BASE OF MESAVERDE FORMATION - DATUM SEA LEVEL.
STRUCTURAL INFORMATION FROM U.S.G.S. & VARIOUS PRIVATE MAPS.
EXCEPT ON LITTLE GRASS CK.-ENOS CK.-WALKER DOME & GOLDEN EAGLE STRUCTURE,
THE ONLY WELLS SHOWN ARE THOSE WHICH PENETRATED EMBAR OR LOWER FORMATIONS.

COMPILED BY A. F. BARRETT

FIGURE 24.—Structural map of southwest part of Big Horn Basin.

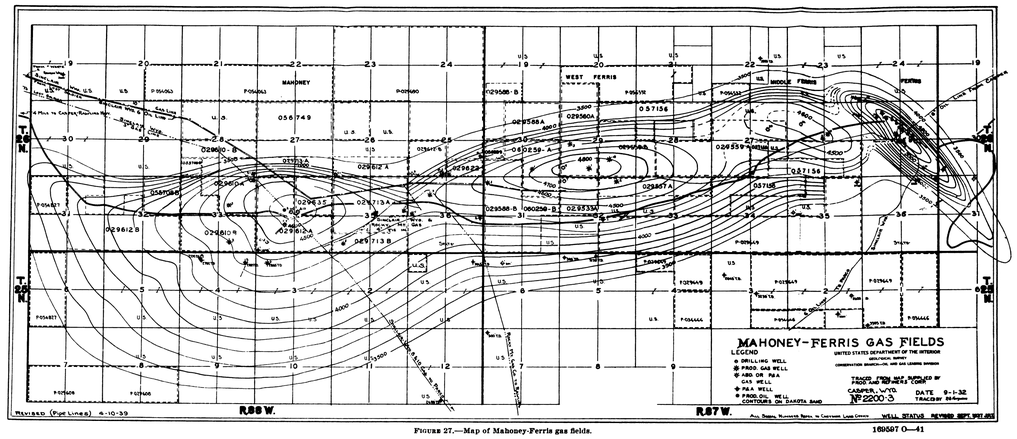


FIGURE 27.—Map of Mahoney-Ferris gas fields.

BUREAU OF MINES

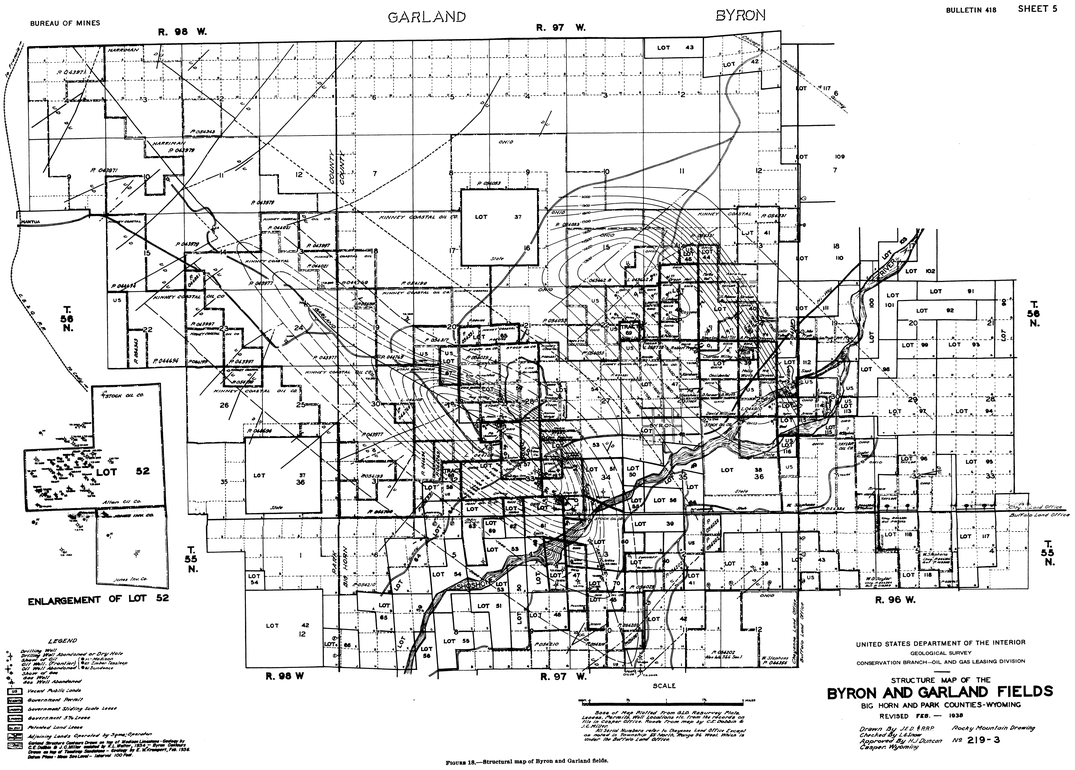


FIGURE 18.—Structural map of Byron and Garland fields.

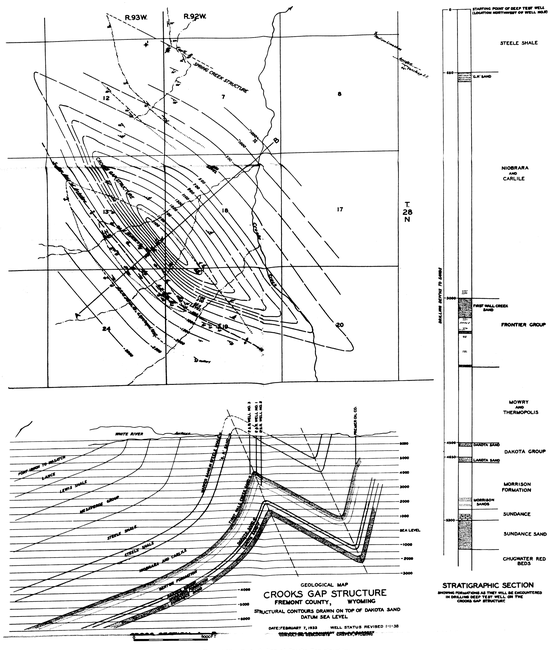


FIGURE 19.—Geologic Map of Crooks Gap structure.

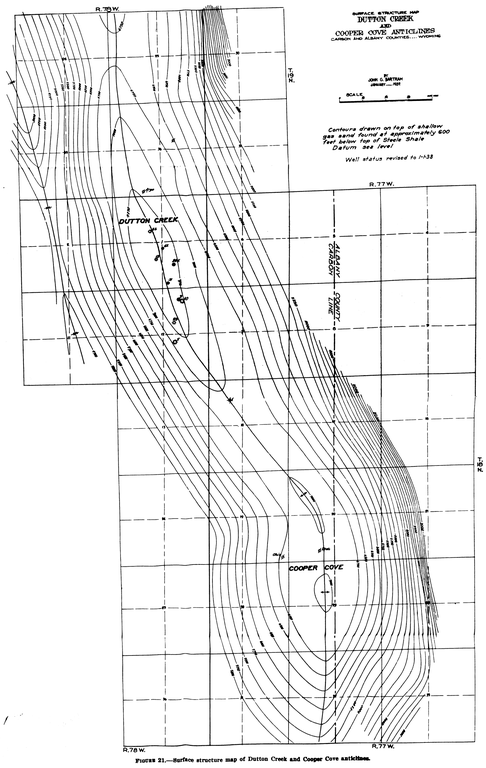
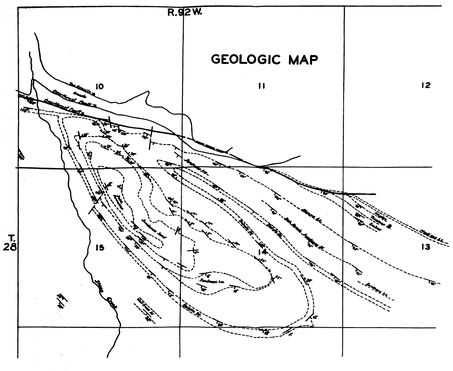


FIGURE 21.—Surface structure map of Dutton Creek and Cooper Cove anticlines.



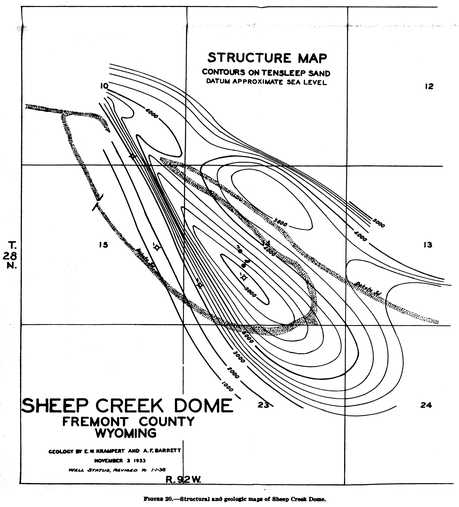


FIGURE 20.—Structural and geologic maps of Sheep Creek Dome.

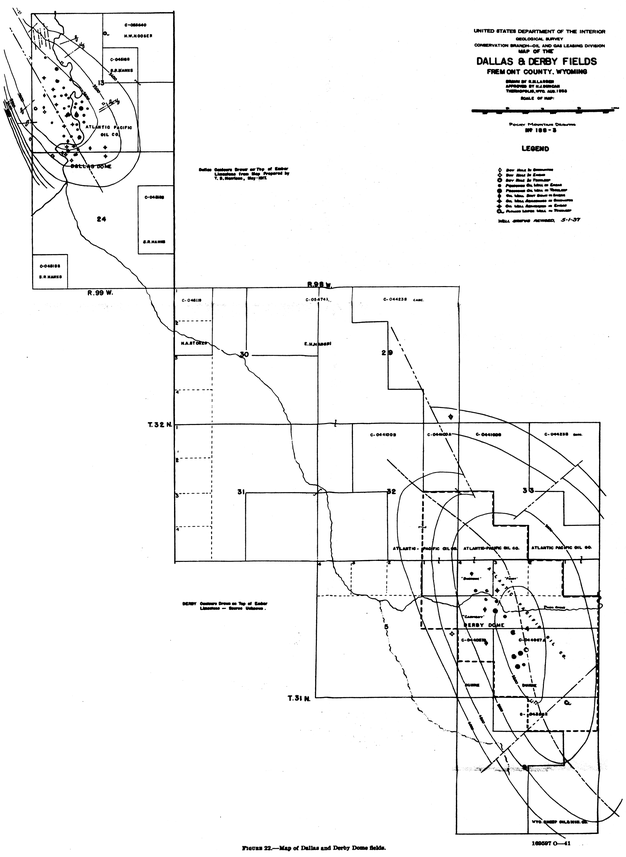


FIGURE 22.—Map of Dallas and Derby Dome fields.

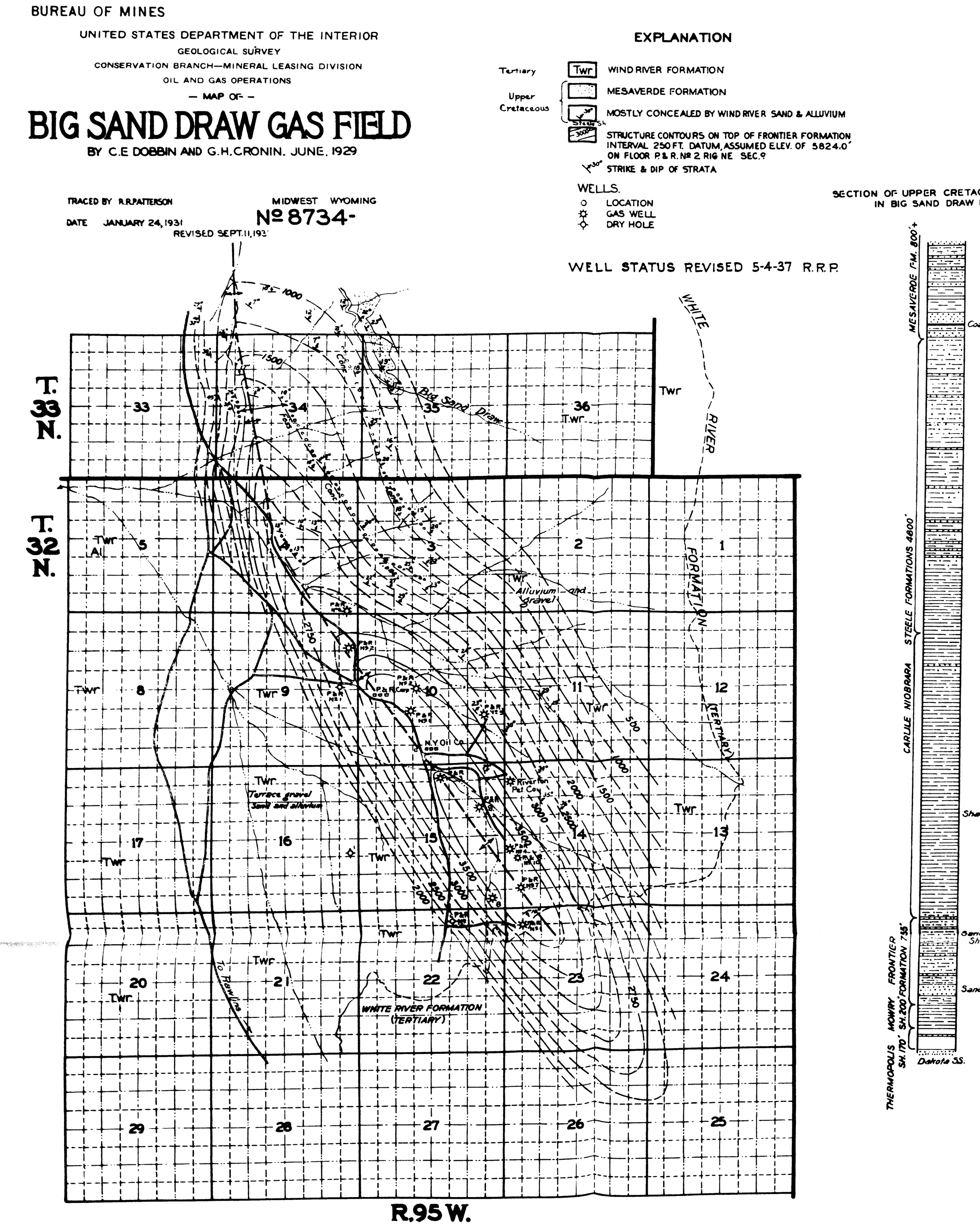


Figure 11.—Map of Big Sand Draw gas field.

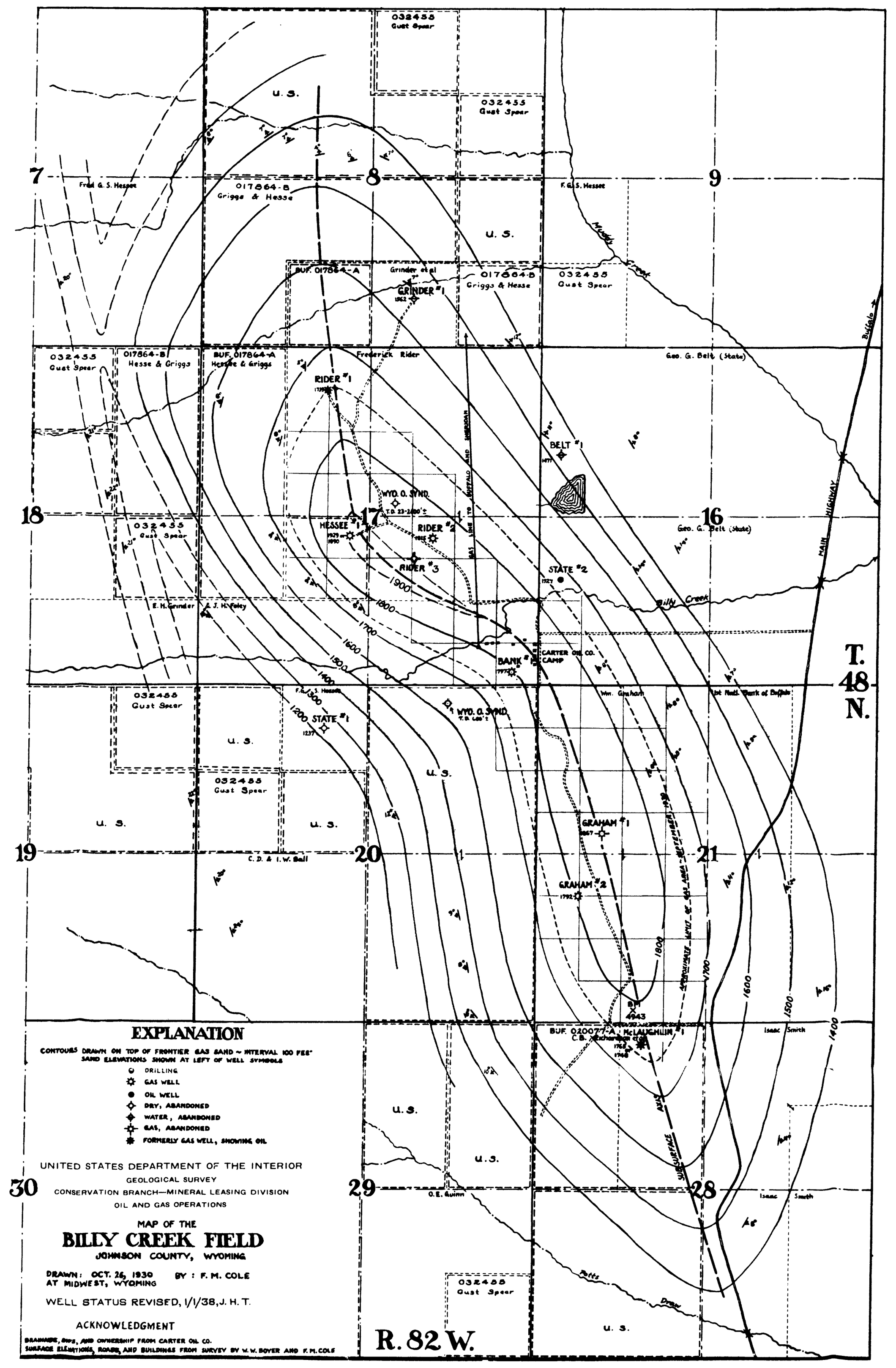


Figure 12.—Map of Billy Creek field.

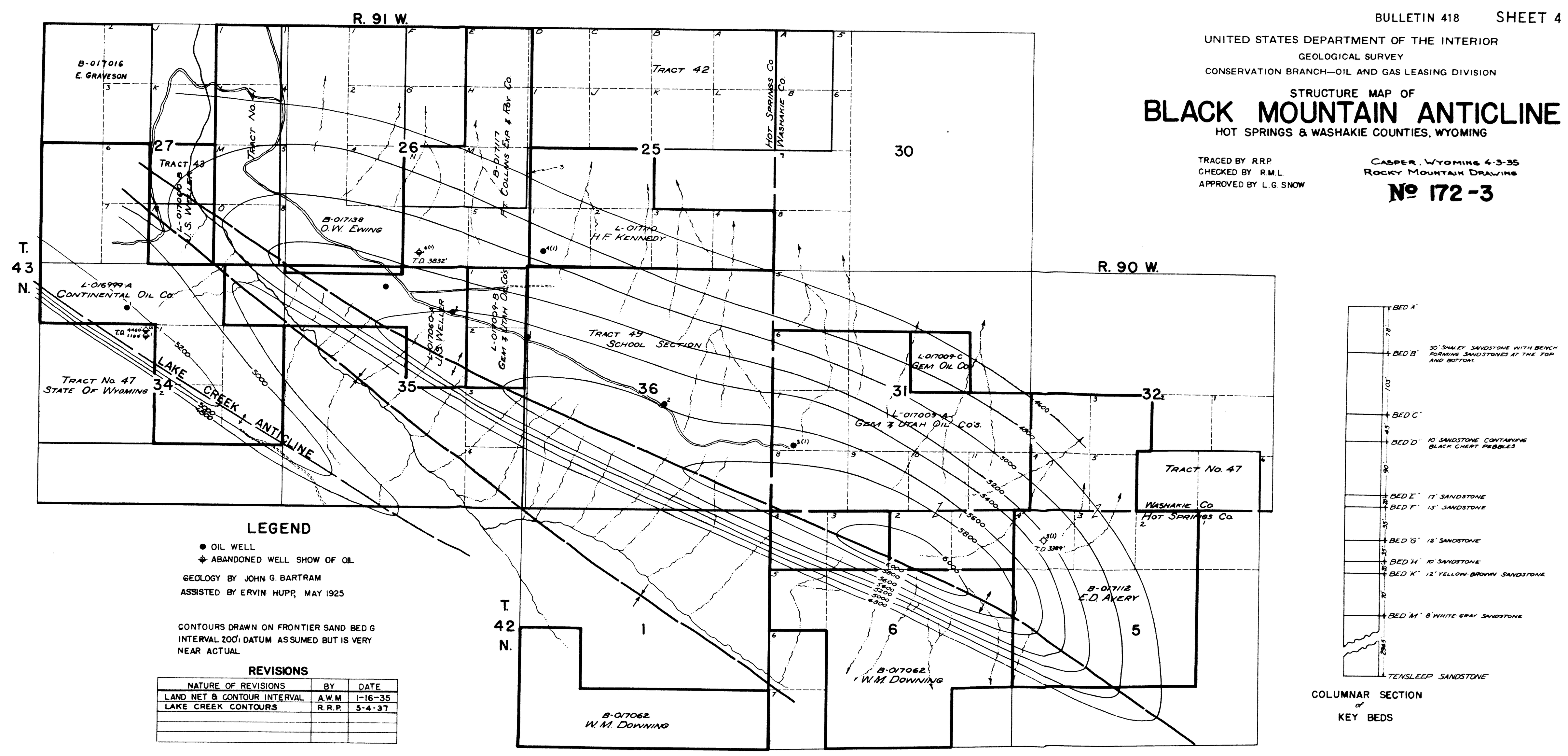


Figure 14.—Structural map of Black Mountain anticline.

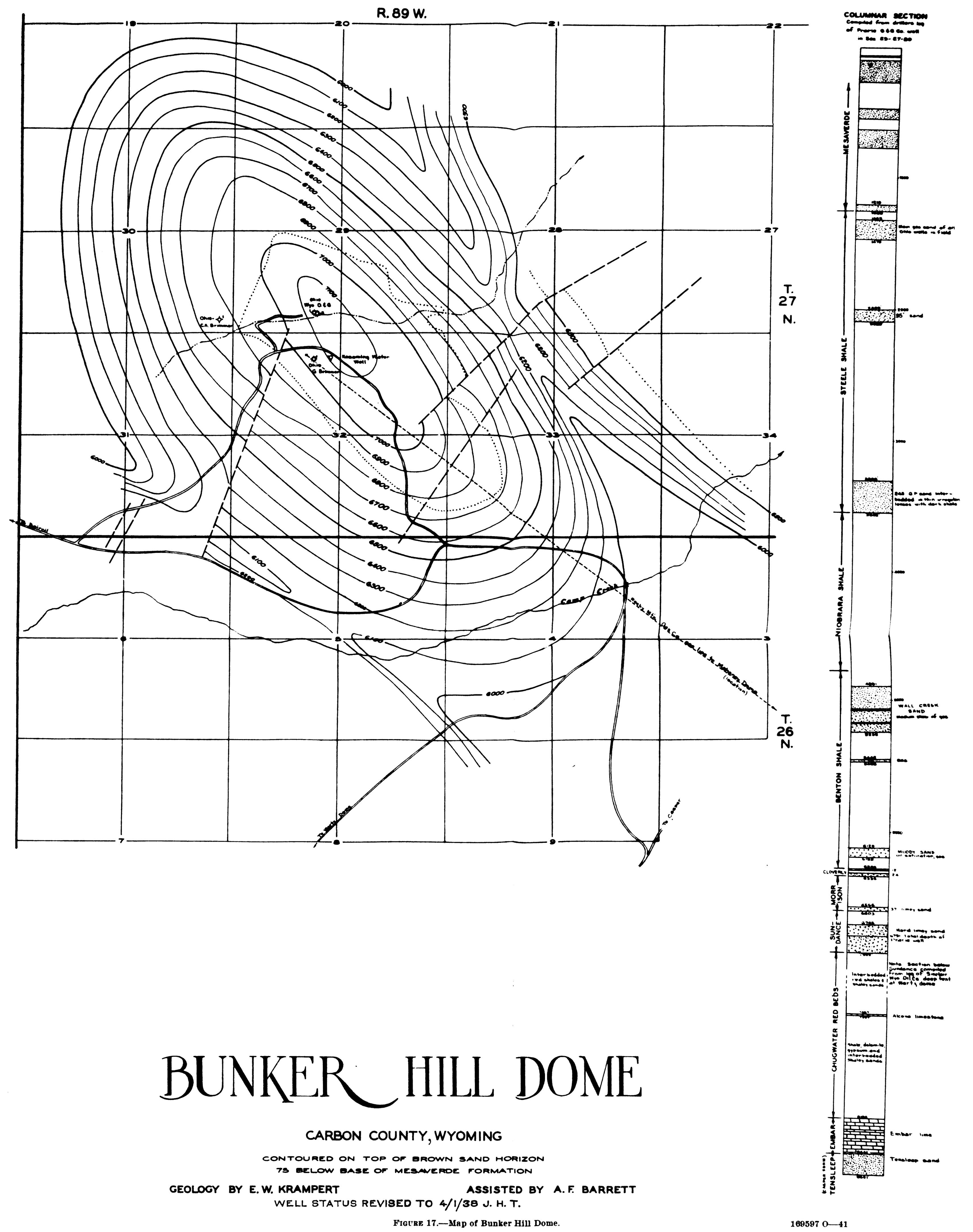


Figure 17.—Map of Bunker Hill Dome.

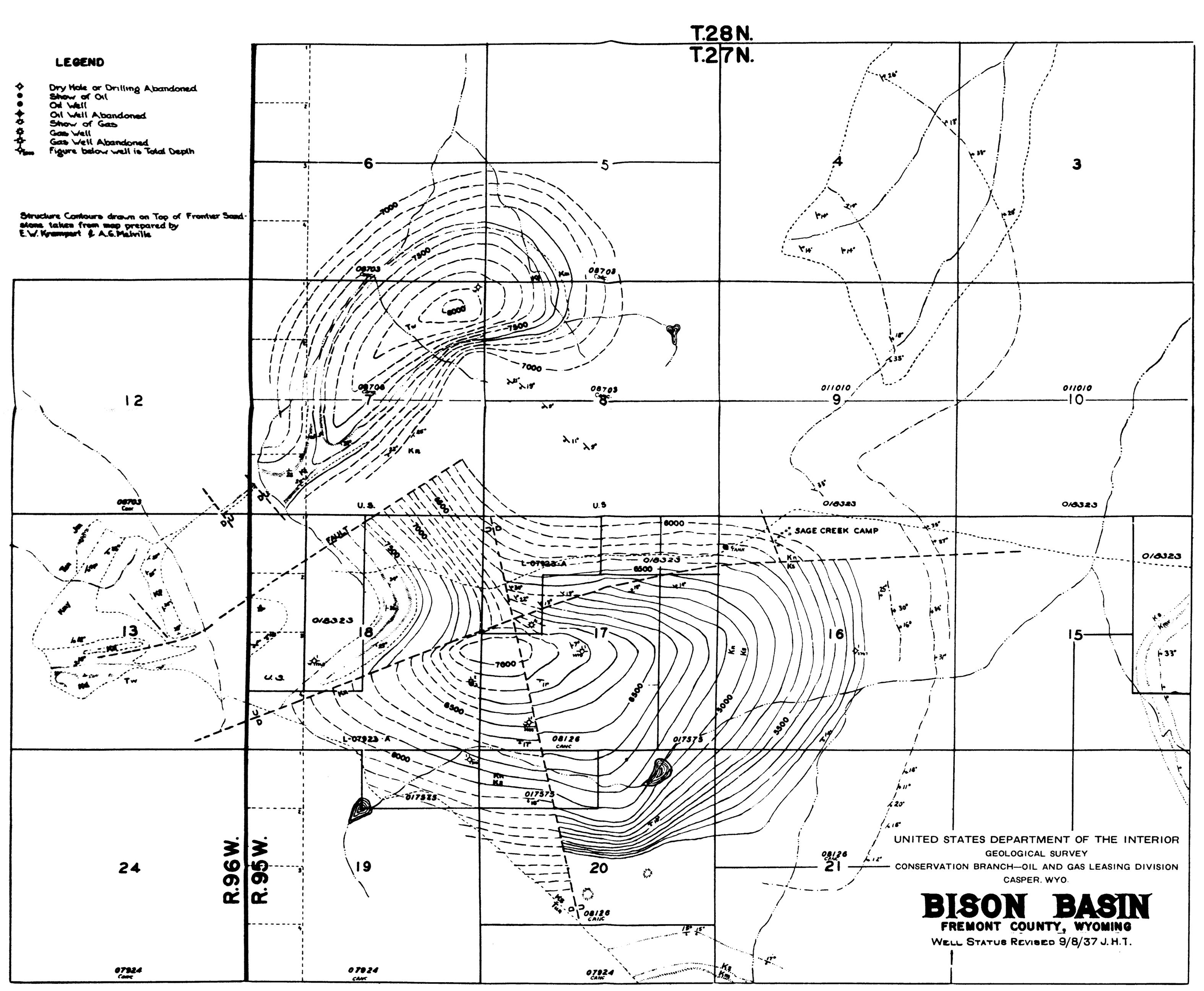


Figure 13.—Map of Bison Basin.

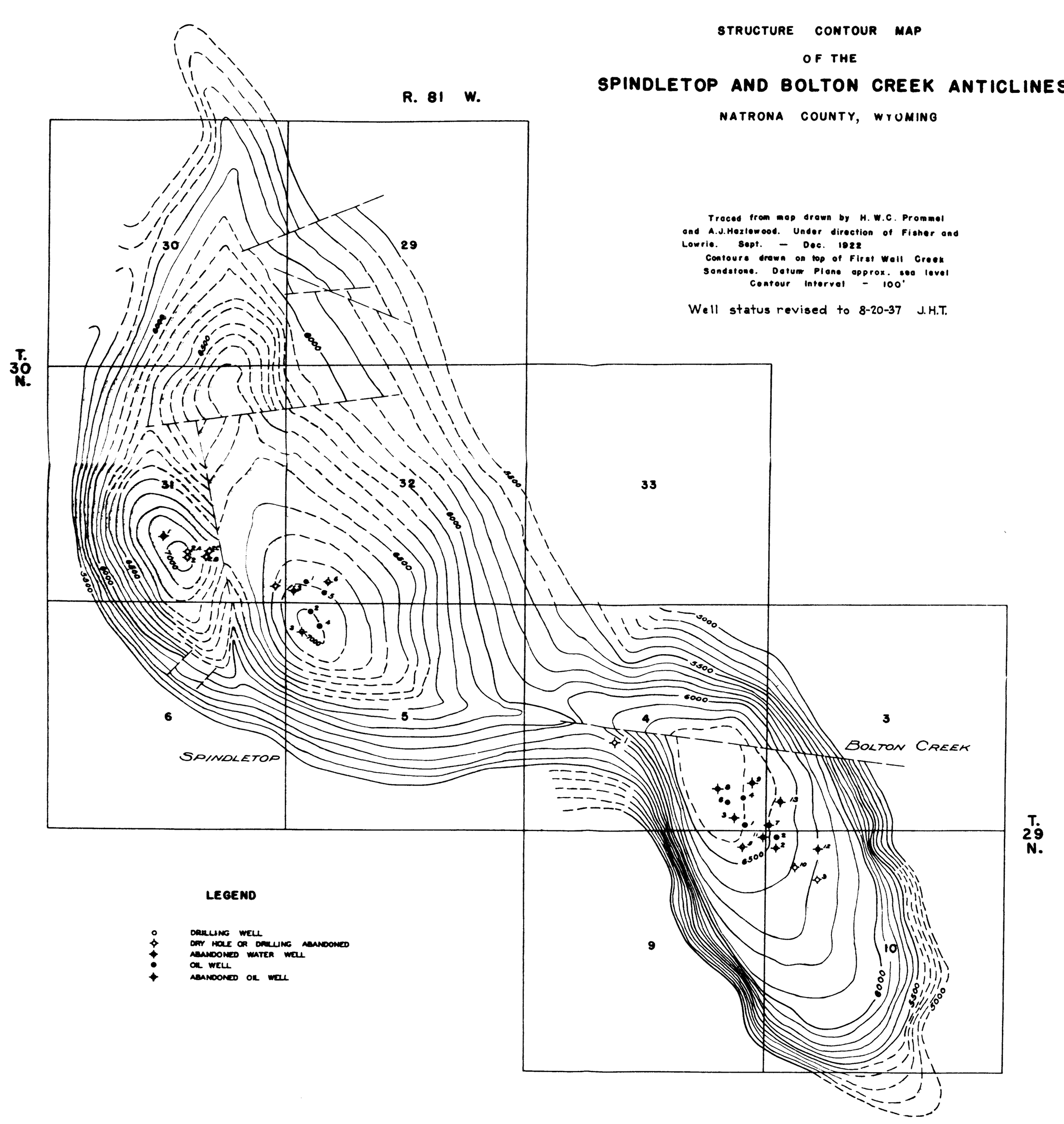


Figure 16.—Structural contour map of Bolton Creek and Spindletop anticlines.

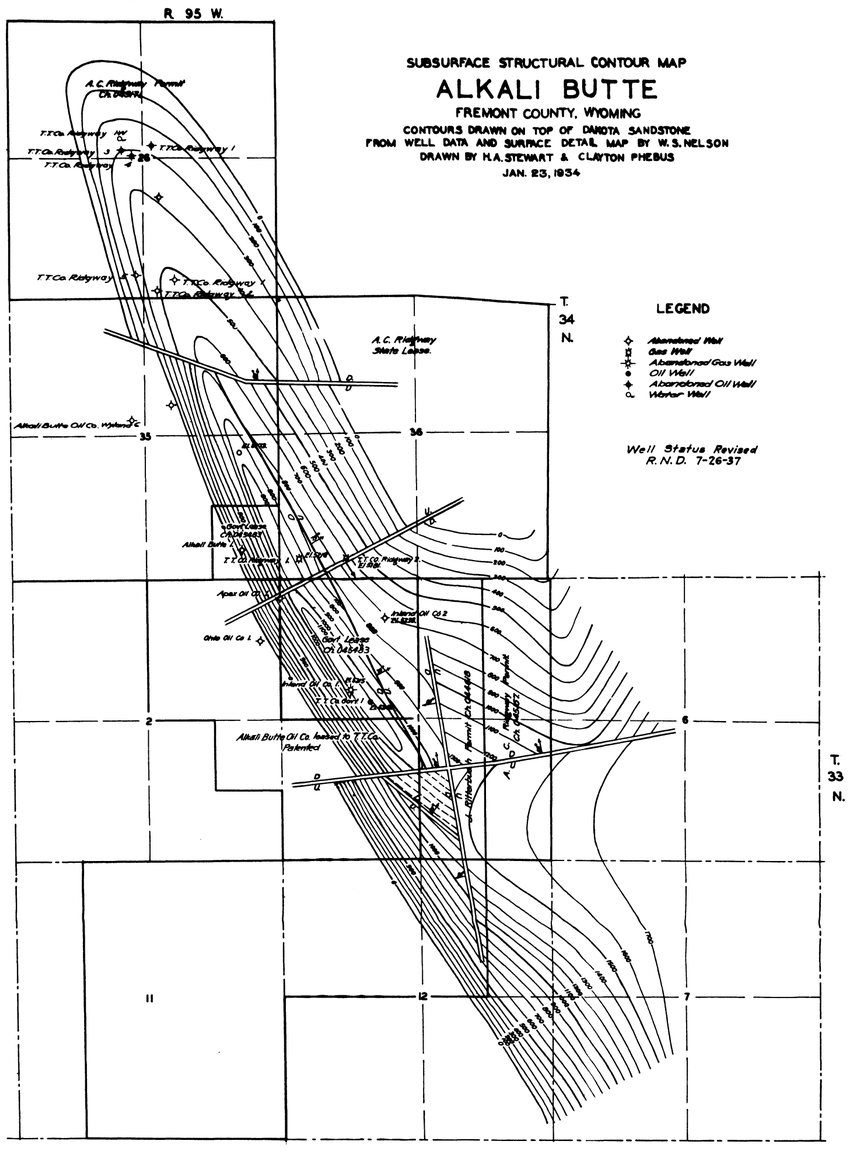


FIGURE 3.—Subsurface structural contour map of Alkali Butte.

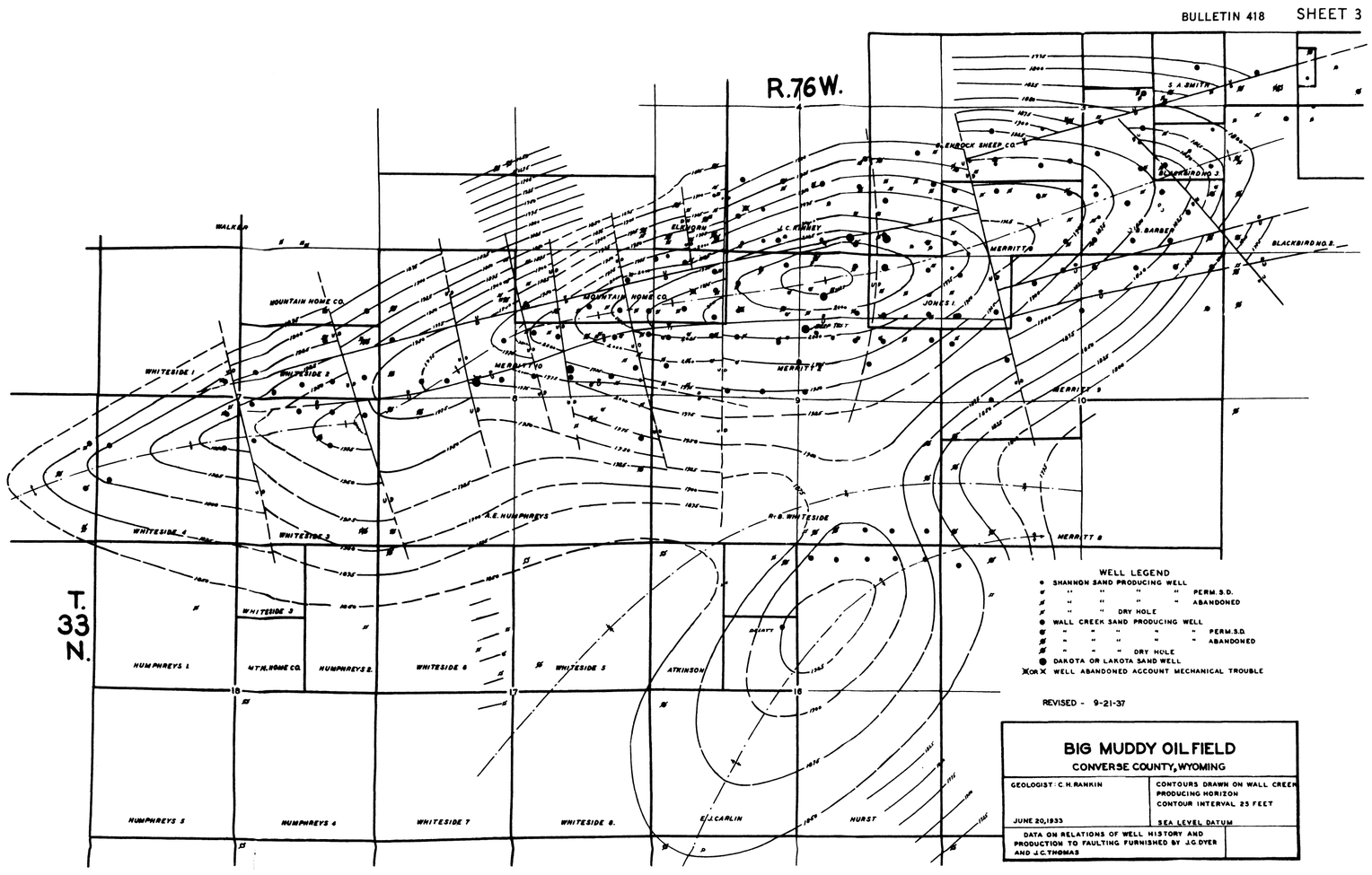


FIGURE 9.—Map of Big Muddy oil fields.

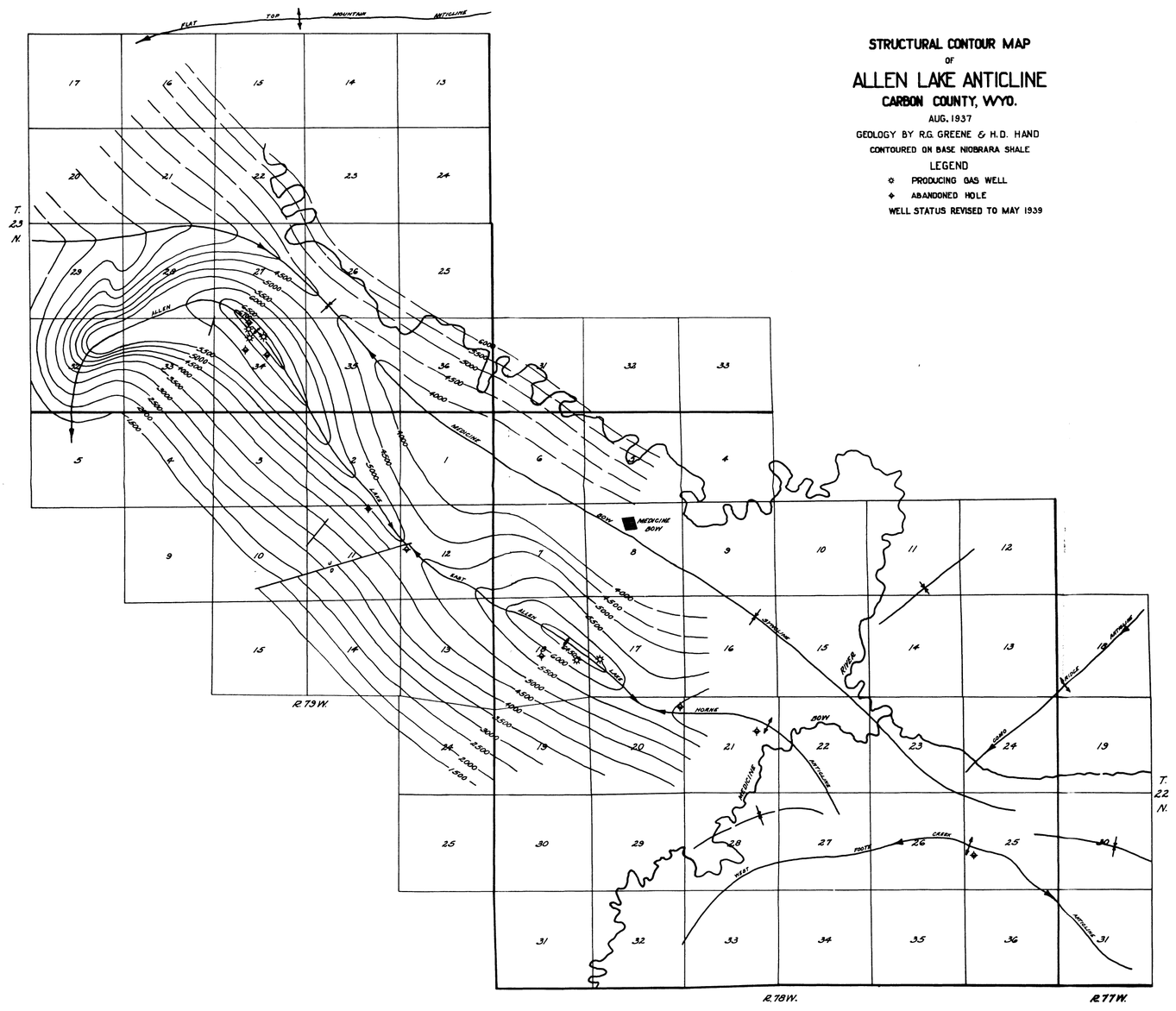


FIGURE 4.—Structural contour map of Allen Lake structure.

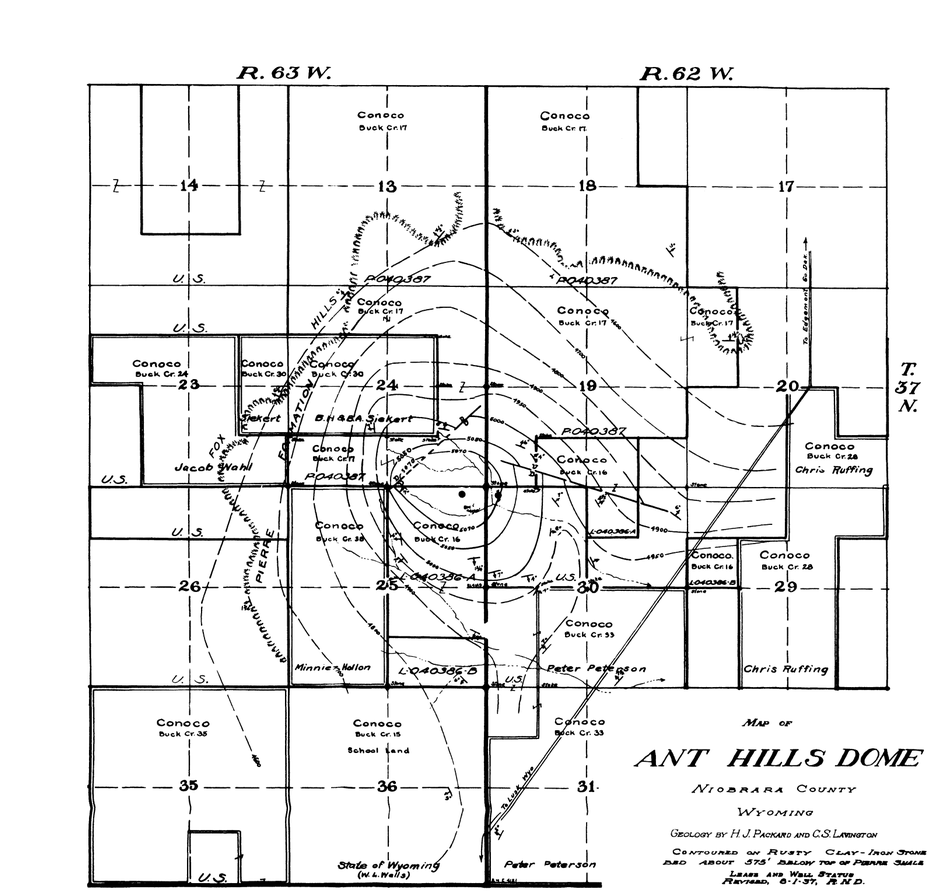


FIGURE 6.—Structural map of Badger Basin oil fields.

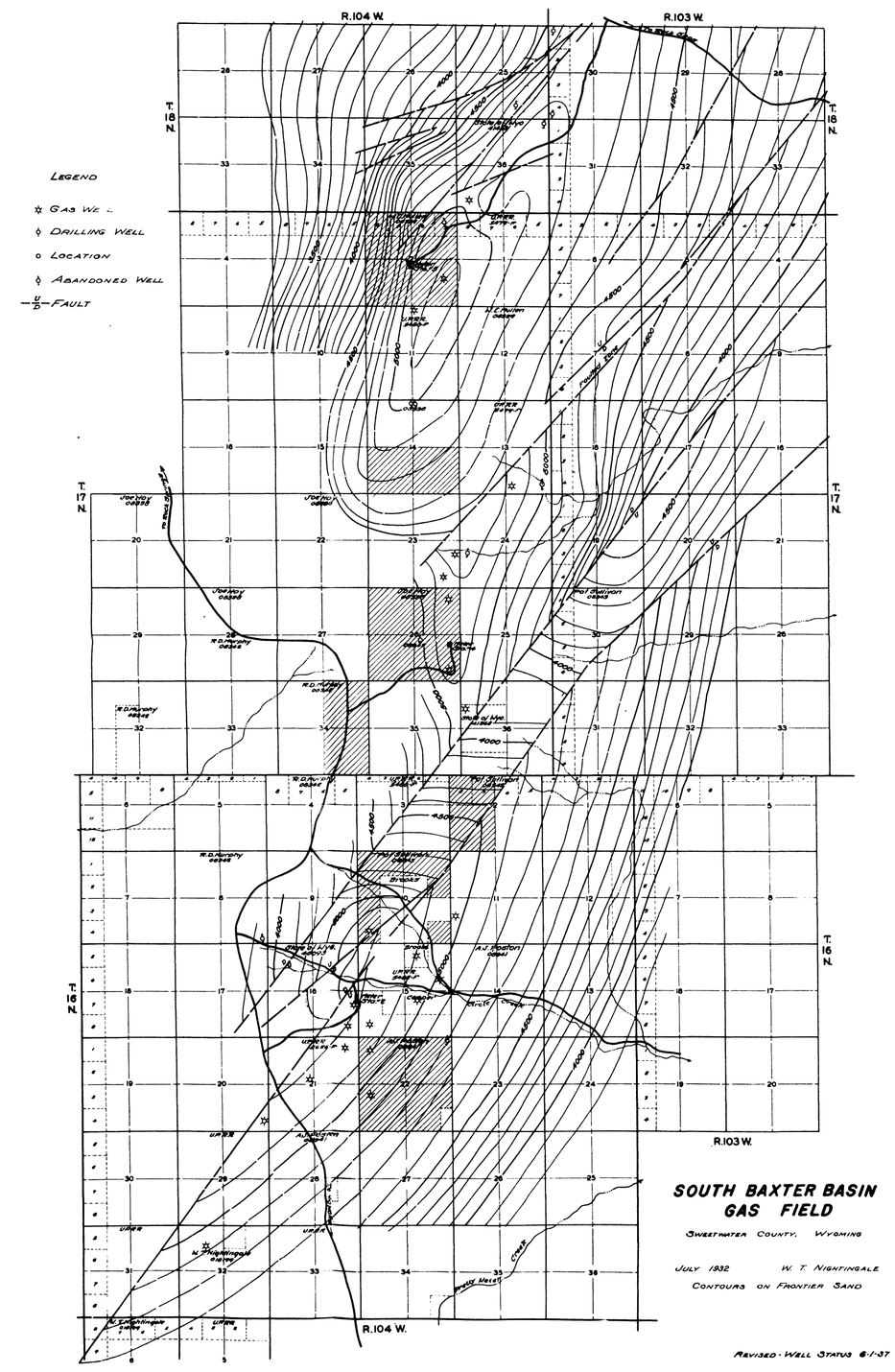


FIGURE 8.—Structural map of South Baxter Basin gas field.

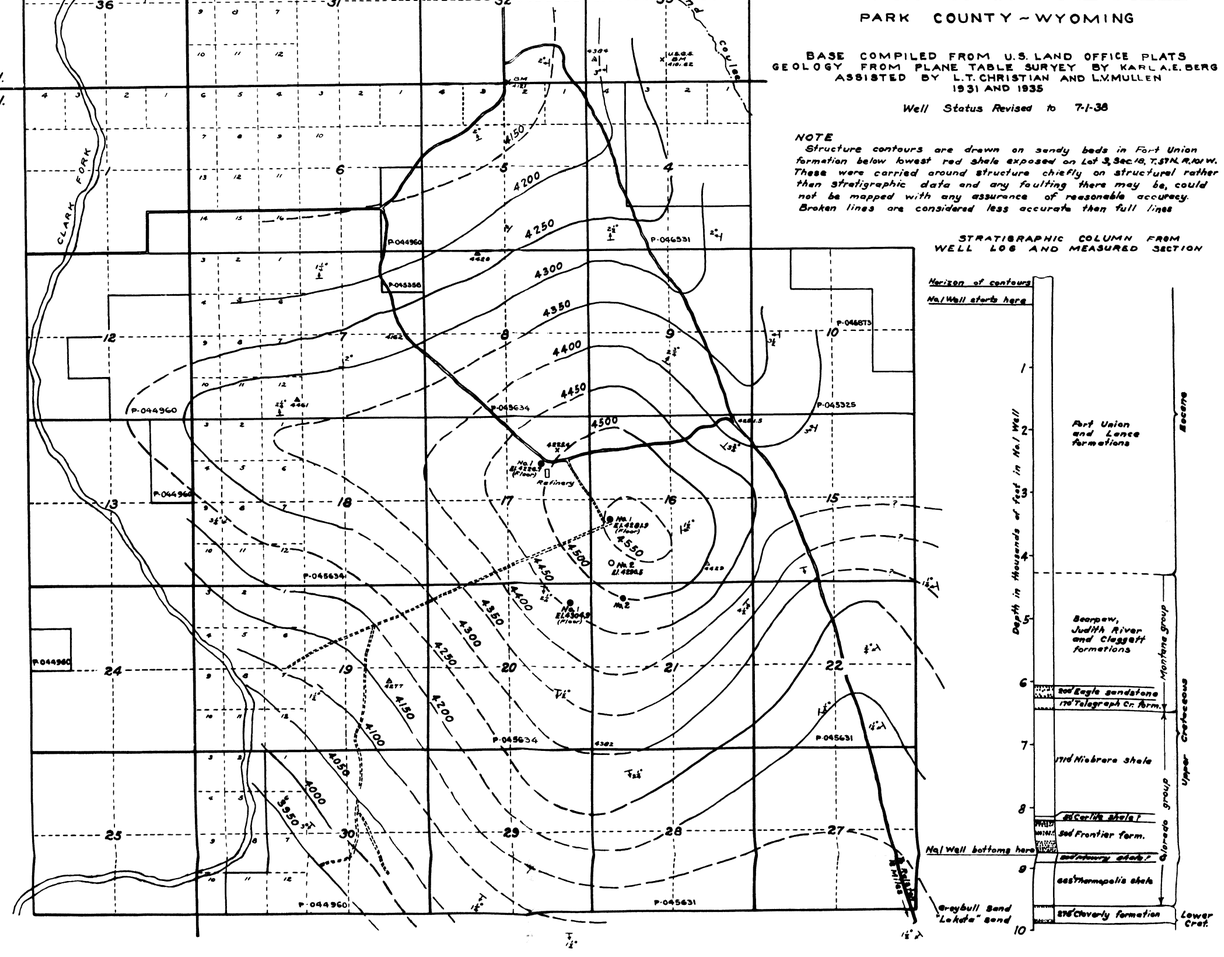
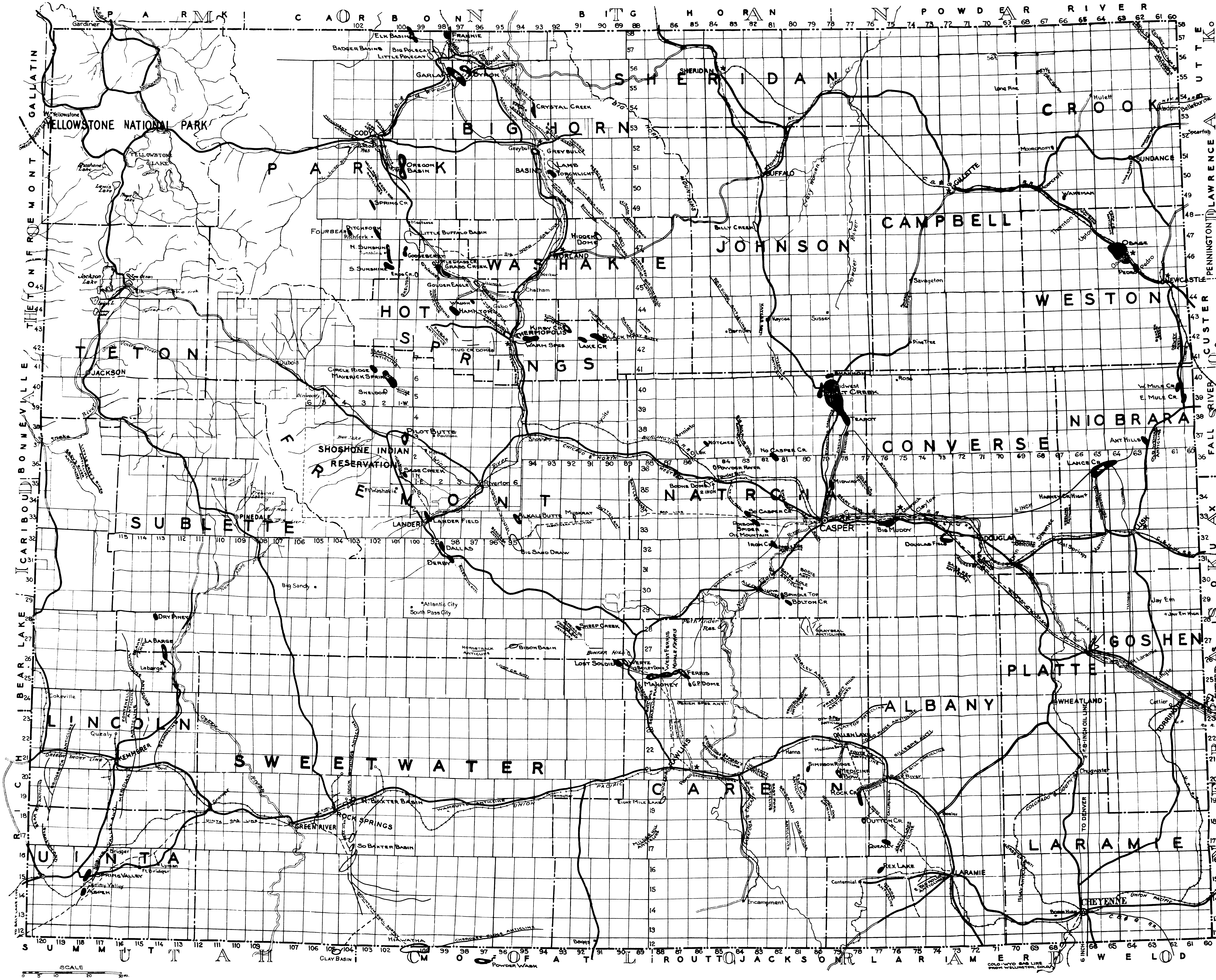


FIGURE 5.—Map of Ant Hills Dome.



OIL FIELDS — GAS FIELDS — OIL & GAS FIELD — UNPROVED STRUCTURE — OIL PIPE LINES — GAS PIPE LINES — ★ REFINING CENTERS — OILED HIGHWAYS — IMPROVED HIGHWAYS

— 1938 —

FIGURE 2.—Map of petroleum and natural gas fields in Wyoming.

Original- Courtesy of INLAND OIL INDEX

Age	Yellowstone Park	Southwestern Wyoming	Southern Wyoming: Rock Springs uplift	Southern Wyoming: Hanna Basin	Southeastern Wyoming	Northeastern Wyoming	Central Wyoming	Wind River Mtns near Lander	Bighorn Mtns (east side)	Bighorn Basin	Elk Basin
Recent	Alluvium and hot spring fm Lacustrine deposits	Alluvium, etc. 0-250 Terrace deposits 0-400	Alluvium Terrace gravels	Alluvium Terrace gravels 0-25±	Alluvium, etc.	Alluvium, etc.	Alluvium	Alluvium Terrace gravel Glacial drift	Alluvium Terrace deposits Glacial drift	Alluvium 0-40 Hot springs deposits 0-20 Terrace gravels 40-90	Alluvium Terrace gravel
Pleistocene	Glacial drift	Glacial drift 0-150			Glacial drift, terrace deposits, etc.	Terrace deposits			Tertiary (?) sand and gravel 30		
Pliocene	Lava flows, breccia, and intrusives 11,000 / Tower Creek (?) fm				Ogallala fm 0-300 (clay, sand, gravel, with calc. cement)						
Miocene			Bishop cgl. 0-200 (Miocene?)	North Park fm. (Miocene?) 0-400± (whitish sand and sh., volcanic ash, some ls.; cgl. at base)	Arikaree fm 0-700 (sand, gravel, boulder beds; locally ls. "lens")						
Oligocene					White River group: Brule clay 0-300 (pinkish sandy clay, gravelly streaks); Chadron fm. 0-100 (grey to brown ss.; sh., sand, gravel)	White River fm 0-200 (light-colored sand. and sh., soft cross-bedded sss., coarse cgl.)	White River fm 0-1500 (light-colored sand, arkose, cgl.)				
Eocene	Pinyon cgl	Bridger fm. 0-1800 (greenish sand and sh., layers volcanic ash; white beds) Green River fm 0-2000: Thin-bedded oil shale, some ss.; light colored Rhea; Light colored ls. 200 Wasatch (?) group: Knight fm. 500-1700 (Oil and gas sand, some oil shale, conglomeratic ss. and conglomerate); Fowkes fm. 0-2500 (Oil and gas sand, oil shale, ls. and ss.); Aycross fm. 0-2500 (Oil and gas sand, oil shale, coal); Alkali fm. 0-1000 (Red and yellow mot. sh. Shallow fresh water beds)	Bridger fm. 0-2000 (grey and greenish sh.; ss., white marl, ls., chert, cgl.) Green River fm.: Morrow Creek memb. 0-800±; Tower ls. 0-250; Laney sh. memb. 0-1240; Tipton sh. memb. 0-250; Wilkins Peak memb. 0-150 Wasatch fm. (main body) 1000-3600 (variegated sh., grey, buff, and pink sss., grit, cgl., coal)	Bridger fm. 0-2000 (grey and greenish sh.; ss., white marl, ls., chert, cgl.) Hanna fm. 7000± (dark-grey, yellow, and carbonaceous sh., white, grey, brown sss., some coal; bedded, cgls and conglomeratic sss.; no. of beds) Ferris fm. 6500± (light to dark-grey carbonaceous sh.; grey to brown cross-bedded and ripple-marked sss.; cgl., and thin coals) #4	Wasatch fm 0-2400 (soft grey sh., thin greyish white sss., and coal beds)	Wind River fm. 0-2900 (soft, variegated sh., coarse brown ss., arkose, and cgls) Wasatch fm. 0-2500 (yellow sss., grey sh., and coal)	Wind River fm. 0-2000+ (vari-colored sh., shaly ss.; cgl. at base)	Wasatch fm.: Light-grey sh. and ss. and somber-colored sh.; Kingsbury cgl. memb. 0-2500 (cgl. of pebbles from Medicine Bow, Righorn and Beartooth mts)	Wasatch fm. 100-3000 (variegated sh. and sss.; thin cgls and coals; conglomeratic ss. at base) Wind River fm. (red and grey sh.; sandy sh., and grey sss.)	Later Eocene barren beds 600
Eocene (?) #1-5	Early acid breccias and lavas	(?)	"Laramie" fm. 1000-3900 (white, yellow, and grey sss. and sh.; some coal). #5	Medicine Bow fm. 6200± (grey carbonaceous sh.; grey to brown cross-bedded and ripple-marked sss.; cgl., and thin coals) #5	Lance fm. 0-10,000(?) (friable sss., sh., and locally coal beds) #1	Lance fm. 0-3220 #3 Tullock memb. 400-860 (yellowish sandy sh., hard calc. sss., thin coals) #2 Hell Creek memb. 600 (grey and brown sandy sh., dark-grey gritty sh., massive buff sss.) #2	Lance fm. 0-3200 #1	Fox Hills ss. 200	Lance fm. 2000± #1	Fox Hills ss. 0-700 (white and brown sss. and sandy sh.)	Lance fm. 0-2630 (yellow and grey sss., sandy sh. some coal) #1
Upper Cretaceous	Montana group undivided. Thick (see above; sh below) Colorado group undivided 2000 (sh. with some lss)	(?) Adaville fm 2800-4000+: Sh., sss., and coal bearing; Lenore ss. memb. 0-200 Hilliard fm 3000-6500 (grey to black sandy sh.; shaly white sss) Frontier fm 2000-3000: Coal-bearing beds 400; Oyster Ridge ss. memb (coarse ss., in places conglomeratic); Sh., coal, and coals Aspen fm. 1200-2000 (grey and black sh., shaly ss., compact sss.; fish scales) Bear River fm. 500-5000+ (black sh., shaly lss. and lss.; some coal) *	Lewis sh. 750-1600 (grey and drab sh.; some shaly ss.; concretions) Mesaverde group: Almond fm 700-950; Ericson ss. 800-1100; Rock Springs fm. 600-1400+; Blair fm. 1000-1800 Baxter sh. 3350-3600 (grey and drab sh., thin-bedded sss.; many zones of calc. concretions) T Frontier fm. 70-160 (grey and white sss. and sandy sh.) Aspen sh. 3200-4800 (dark-grey to black fissile platy sh.; fish scales). Dakota ss. 110-150 (grey ss., in part conglomeratic; some grey sh.) #6	Lewis sh. 800-2300± (dark-grey sh., shaly sss., coal beds) Mesaverde fm. 1500-3600 (white to brown sss., grey sh., thin coals) Steele sh. 2000-4000± (dark-grey sandy concretionary sh., with sss. and shaly sss.) Niobrara fm. 370-850 (dark calc. sh.) Carlile sh. 150-200 (dark-grey to black sh., some sandy layers) Frontier fm 400-800 (thick sss. and thin shales above; dark-grey sh. below). Mowry sh 300-750 (fissile dark-brown to black sh.; weathers white or light grey; fish scales). Thermopolis sh. 140 (dark-grey sh.; sandy layers). (?) Cloverly fm 291-273 (usually two ss. separated by sh.; lower ss. conglomeratic)	Lance fm. 0-10,000(?) (friable sss., sh., and locally coal beds) Lewis sh. / Fox Hills ss. 0-700± (friable sss., sandy sh.; locally coal) Mesaverde fm. 2000-3700± / Teapot ss. memb.; Parkman ss. memb. Steele sh. 2300-3000 (dark-grey sh., thin sss. and sands). Niobrara sh. (or ls.) 200-300± (gray to buff calc. sh., some sandy and shaly ls.) / Pierre sh. 1200-5000 (dark sh. and thin, friable, buff to brown sss.; calc. concretions) Carlile sh. 100-425 (dark sh., thin sss., ls., concretions). / Greenhorn ls. 0-50 Frontier fm. 100-800 (sss. and sh.) / Greenhorn sh. 120-800 (grey flaky sh. with concretions; massive ss. at top). Mowry sh. 93-175 (hard bluish grey sh.; fish scales) Thermopolis sh. 200-610 (black sh.; small concretions). (?) / Dakota(?) ss. 60-300 (grey to buff and reddish massive ss.) (Hartville uplift) Cloverly fm. 50-236 (two to four grey ss. clay or sh.; cgl. in lower part) / Fuson(?) fm. 664 (sh. and sandy sh.; with ss. locally) (Hartville uplift) Minnewaste(?) ls. 0-5 (Hartville uplift) Lakota(?) ss. 100 (light-colored massive ss.). (Hartville uplift)	Fox Hills ss. 0-700± (friable sss., sandy sh., locally coal) Pierre sh. 450-2100 (dark-grey to black sandy sh. with hard fine and zones of calcareous concretions) Niobrara sh. 80-375 (chalky sh.; calcareous sh.; soft shaly ls.; impure chalk; some ss.) Carlile sh. 150-250 (dark sh.; some concretionary beds). Greenhorn fm. 40-175 (sh. and impure concretionary lss.; in places chiefly ls) Graneros sh. 800-1250: Belle Fourche sh. memb. 500-850 (dark-grey to black clayey sh.; sandy sh.; large calc. concretions; some bentonite); Mowry sh. memb 115-1302 (hard light-grey sandy sh.; fish scales; bentonite); Newcastle ss. memb. 40-60 (reddish to light yellow ss.; some carbonaceous sh.; bentonite, and coal); Skull Creek sh. memb. 200-340 (dark-grey to black clayey sh.; concretions; some ss.) Dakota ss. 40-160 (thin to massive bedded hard grey to buff ss.; some sh., sand, and coal) #6 Fuson sh. 10-100 (grey, black, and purple sh. with thin sss.). Lakota ss. 53-330 (light-colored ss., in part conglomeratic; some sandy sh.; coal beds near base)	Pierre sh. 1200-5000 (dark sh. and thin, friable, buff to brown sss.; calc. concretions) Niobrara sh. 0-1720 (light-colored sh., in places oren; some thin lss). Carlile sh. 100-425 (dark sh., thin sss., ls., concretions). Frontier fm. 800-1000: Wall Creek ss memb. 150; Gray sh and buff to white ss. 800; Torchlight ss memb.; Pkay ss. memb.; Dark sh. 2.50 Mowry sh. 250-300 (light-colored fissile sh.; fish scales). Thermopolis sh. 130-485 (soft dark to black sh.).	Montana group undivided. Cody sh. 4350 (dark-colored sh. and sandy sh., ss. near middle). Frontier fm. 400-500 (chiefly grey coarse-grained ss.). Mowry sh. (hard grey sh.; fish scales). Marcos sh. 720-6110 (upper part very rusty sandy sh.; lower part drab sandy sh.). Colorado group undivided. (?) / Dakota ss. 0-60 #6 Cloverly fm 150+ / Lower Cret. sh. and sss., cgl. locally 400-610 Shaly ss. or ss. Dark sh. Cgl. with ss. layers. Thin coal at base / Lower Cret. gray sh. 100-600; Lower Cret. cgl. 0-60	Wind River fm. 0-2000+ (vari-colored sh., shaly sss.; cgl. at base) Fort Union fm. probably present Mesaverde fm. light-buff ss. and sandy sh.). 200+ (massive Lance fm. 0-3200 #1 Lewis sh. 0-1400 (white to brown sss. and sandy sh.) Mesaverde fm. 0-1200: Teapot ss. memb. 0-200; Parkman ss. memb. 370; Sussex sh. thin coals 400; Massive buff ss. 350 Steele sh. 0-2500±: Shannon ss. memb. 0-175; Gray sh. 1100; Gray sh 1000-1045 Niobrara sh. 200± (grey sh.) Carlile sh. (grey; concretions) Frontier fm. (sss. and sh.) Mowry sh. 280-300 (hard sh. Shaly sss.; fish scales). Thermopolis sh (black and grey sh., thin sss., concretions). Benton sh. 1150	Fort Union fm. 0-6000 (vari-colored sh., white; grey. buff, and dark sss., some cgl. and coal) Lance fm. 0-2630 (yellow and grey sss., sandy sh. some coal) Meeteetse fm. 250-1400 (drab, grey, and brown sh. and cgl.; sss.; sandy sh., bentonite, and coal) Mesaverde fm 120-1470 (massive buff, grey, and white sss., thin grey and brown sh., some coal) Steele sh Cody sh. 2350-3400 (grey, green, and black sh., with buff sss. in upper part, concretions near the base). Niobrara sh. Carlile sh. Frontier fm 370-648 (grey and brown sh., sandy sh., sss., cgl., bentonite and thin coals): Torchlight ss memb 13-49; 2.50; Pkay ss memb. 100-167 Mowry sh. 180-400 (hard grey to white sh. with fish scales, some ss. and bentonite). Thermopolis sh. 400-800 (soft grey to black sh., several ss. beds; bentonite in upper part. Muddy sand near middle). #8	Fort Union fm. 4330 (sh. and sss., some ls. and conglomeratic sh.) Lance fm. 650 (sss., sh., ls.) #1 Meeteetse fm. 250-1400 (drab, grey, and brown sh. and cgl.; sss., sandy sh., bentonite, and coal) Steele sh Niobrara sh. Carlile sh. Frontier fm 450-545: Torchlight ss memb. 30-115; Sh. and ss. 175-280; Pkay ss memb. 92-100; Sh. and hard sss
Lower Cretaceous	Kootenai fm. 250± (sh., sandstone, ss.) (Mapped under Cloverly color on Wyoming State map.)	(?) Beckwith fm. 200-3500 (vari-colored sh. and sss.; some dark-grey or black sh., ls. and cgl.) (Correlation of upper part uncertain.) Twin Creek ls. 1400-2800 (black and grey shaly ls.; some yellow ss.)	Morrison fm. (variegated sh., thin lenses of ss.; cgl.) #7 Twin Creek ls. 125 (grey thin-bedded ls. above; grey sh. below)	Morrison fm. 250-850 #7 (variegated sh., sandy lss.) Sundance fm. 85-100 (green, olive, drab sh., with some thin sss.)	Morrison fm. 100-430± (vari-colored sh., thin sss. and lss., some limy concretions). Sundance fm. 0-300 (gray, blue, and pink calc. sh., thin lss., lower part largely buff to reddish sss.)	Morrison fm. 40-160 (variegated sh., thin white sss., nodular light-grey ls.) #7 Sundance fm. 300-400 light-grey to dark greenish grey and pinkish sandy sh.; ss. at top and near middle)	Morrison fm. 100-280 (maroon and green sh., with several hard sss.) #7 Sundance fm. 150-300 (dark-grey to green sh.; several beds of argill. ls.; white ss. in lower part)	Morrison fm. 232-620 (variegated sandy sh., cgl., thin lss.) #7 Sundance fm. 200-350 (olive green or gray ls. and calc. sh.)	Morrison fm. 100-300 (massive variegated sh. and thin grey sss.) #7 Sundance fm. 250-450 (green sh. and soft buff and grey sss).	Morrison fm. 130-580 (variegated sh., soft sss.) #7 Sundance fm. 300-530 (glauconitic green and grey sh., calc. sss., gypsum, some ls.)	Morrison fm. 180 (variegated sandy and clayey sh. and sss.) #7 Sundance fm. 400-550 (sh., sss., thin lss.; thick gypsiferous member at base)
Jurassic	Ellis fm. 500± (lss., marl, sh.)	(?) Nugget ss. 50-1300 (red and light-colored sh. and sss.; dark ss. and lss.)	Nugget ss. 960 (white and grey cross-bedded ss.; red sandy sh. in upper part)								
Triassic	Teton fm 200-600 (sh., sss., some ls. and chert)	Limestone like Thaynes ls. Red sandy sh. 800 Shaly brown ls. (Dinosaurian fossils) Ankareh sh. 500-1000± (brown to dark-red sss. and sh.) (Triassic?) Thaynes ls. 1000-2600 (dark-grey, shaly ls.; some yellow sss.) Woodside sh. 400-500 (red and brown shaly sss. and sh.).	Thaynes (?) fm. (red ss. and sh., thin and thick lss.) Woodside sh. (red to greenish sh., drab calc. sh., thin sss.) 760	Chugwater fm. ("Red Beds") 1000-1100 (red sh. with vari-colored sss. and several beds of gypsum)	Jelm fm 230 (red beds including ls. cgl. with wood fragments and fresh-water vertebrates) Chugwater fm 550-1150 (red sh., soft sss., thin lss., gypsum) ("Red Beds.") Forelle ls. 0-30 (bluish grey compact lss. much gypsum) Sulcanka sh. 0-240 (sandy red sh., thin lss. and sss., some gypsum) Spearfish fm. 450 (dark reddish brown thin-bedded ss., ls. lenses; thin beds of gypsum in lower part). (Triassic ? "Red Beds") Minnekahta ls. 0-20 (Permian?) (grey to purplish thin-bedded platy ls) Opeche fm. 60 (Permian?) (bright-red sss. and red sandy sh.).	Spearfish fm. 430-650 (alternating red sh., sandy sh., red sss., and gypsum) (Triassic ? "Red Beds") Minnekahta ls. 30-50 (light-grey to pinkish or purplish thin-bedded ls.). (Permian?) Opeche fm. 30-80 (red sss. and sandy sh.; purplish at top in some areas)	Chugwater fm ("Red Beds") 800-1800 (red sss., sandy sh., gypsum; ls near top to east and near middle to west). Embar fm. 280-300 (light-grey ls., sh., chert, gypsum, and phosphate).	John(Pope Agie) fm. 2005 (variegated sh. and sss.; gypsum at top) (Upper Triassic vertebrates in lower part.) Chugwater fm. 300-1200 (red sandy sh., massive sss., thin lss., and gypsum). Dinwoody fm. 30-324 (greenish grey sh. and shaly lss.) (Lower Triassic) Embar group: Phosphoria fm. 200-300 (lss., phosphatic sh., some chert and dol.)	Chugwater fm. ("Red Beds") 600-1400± (red sh., soft sss., thin lss., and gypsum).	Chugwater fm. ("Red Beds") 600-1300 (red sandy sh. and sss., some gypsum and lss.) Dinwoody fm. 30-40 (calc. sh., ss., gypsum). Embar group 80-480: Phosphoria fm. 200± (thin sss., red sh., ls).	Chugwater fm. ("Red Beds") 400-530 (red sh. and sss., Thick gypsum near top). Embar fm. 50±
Permian		(?) Park City fm. 700-1400 (grey sandy ls.) #9 Phosphoria fm. 100-340 (ss., glauconite, chert, and phosphatic rock) Phosphoria fm. 450-1200: Bee chert mem. 250-300; Phosphatic sh. and phosphatic rock Wells fm. 2000-2300: Limestone 200; Quartzite 1000; Cherty ls. and ss. 1400 Tensleep ss. 300-1000 (gray to white glassy ss., in places calc. and brecciated) Brazer ls. 1500± (massive light-colored ls.)	Park City fm. 115 (white and grey lss., chert, sss., sh. and phosphate beds) #9 Embar fm.	(?) Tensleep ss. Amsden fm. 330 (?) Madison ls.	(?) Minnelusa ss. 300-1000 (light-gray to buff calc. sss., massive and thin bedded, sandy sh.; some dolomitic ls. and concretions). (?) Pahasapa ls. 300-1100 (white, pale buff, pinkish and gray ls. in nodular beds) Englewood ls. 0-50 (thin-bedded pinkish ls. or dol.)	(?) Tensleep ss. 200-500 (fine-grained, white, cross-bedded quartzose ss.). Amsden fm 350± Madison ls. 100-700 (gray to light-gray massive ls.)	(?) Tensleep ss. 250-550 (fine-grained friable ss., white, buff, pink, cross bedded). Amsden fm. 230-385: Sh., ss., thin dol., and lss.; Darwin ss. memb. 20-70 (cream-colored ss., cross bedded). Madison ls. 250-800 (dark-grey lss., some dol. and calc. sh.) Limestone. A few feet.	(?) Tensleep ss. 200-350 (white to buff ss., massive and cross bedded). Amsden fm. 130-350 (red sh. and sss., and white lss., some cherty). Madison ls. 600-1100 (chiefly massive light-colored lss., some shaley beds)	(?) Tensleep ss. 30-230 (massive buff to grey cross-bedded ss., some thin lss.) Amsden fm. 80-300 (red sh. and sss., thin lss., and chert). Madison ls. 350-1000 (massive grey ls.) Devonian 150 (sh. and thin lss).	(?) Tensleep ss. 150 Amsden fm. 160 Madison ls. 1000
Upper Devonian	Three forks ls 170-220 (grey, cherty ls.) / Darby fm in Teton Range	Three forks(?) sh. 80 (drab sh. and ls.)	Devonian (?)								
Middle Devonian	Jefferson ls 80-300 (dark to bleak crystalline ls.)	Jefferson ls. 200-1000 (buff to grey ls.; much mag. ls. in upper part).									
Lower Devonian	(?)	(?)									
Silurian		Silurian (?) in Labarge Ridge.									
Upper Ordovician		Upper Ordovician in Labarge Ridge				Whitewood ls. 0-80 (massive hard ls. or dol., mottled pink)	Bighorn dol.	Bighorn dol. 100-300: Leigh dol. memb. 0-115 (blotchy white, pink, and buff dol.; leaves as limy)	Bighorn dol. 250-300 (chiefly hard, massive white to buff lss., white or grey ss. at base)	Bighorn dol. 40-300 (massive hard grey siliceous dol. and ls).	Bighorn dol. 250
Middle Ord.		(?)									
Lower Ord.		(?)									
Upper Cambrian	Gallatin ls 110-400: Massive lss., shaly lenses and brecciated beds; Calc. and argill. sh.; Mottled ls 100-150 (black, grey)	Limestone and green sh.	Shale, calc. sh., sss., and pinkish gizzly			Deadwood fm. 50-300 (green sh., brown ss. and gizzly, some ls. and breccia)	Cambrian ls., sh., gizzly.	Gallatin ls 200-250± (chiefly ls.; sh. and ss. in middle). #10 Gros Ventre fm. 430-580 (green and grey sh., lss.; calc. cgl. and ls cgl.) Flathead ss. 300 (grey or brown, shaly ss., sandy ss., lenses ss. or cgl.)	Deadwood fm. 800-1500: Grey slabby ls with flat-pebble ls. cgl. at top; Greenish sh. and sss; Brown ss., mostly coarse 80-400	Gallatin ls. 150 #10 Gros Ventre fm. 600 Flathead ss. 250	Deadwood fm. 700-1500 (ss., sh., cgl., ls.)	Deadwood fm. 800
Middle Cambrian	Gros Ventre fm (sh., thin lss. toward top) 700 to 1100 Flathead gizzly (ss. or gizzly; cgl. at base in places)	(?)	Reddish gizzly ss. or ss.	Quartzite							
Lower Cambrian		(?)									
Algonkian	Sheridan gizzly c-	(?)	Reddish sss and cgls		Sherman granite and other igneous rocks	Whalen group (gizzly, schist, siliceous ls. and gneiss).	Schist and granite.	Pre-Cambrian schist 1000± Archean granite, etc.	Quartzite, slate, schist, granite, and gneiss	Granite, schist, and gneiss	Granite, schist, and gneiss
Archean	Granite and gneiss	Gneiss and granite	White gizzly, schist, etc.	Granite					Granite		Granite

*Probably includes considerably more than equivalent of Dakota ss.

Waved lines indicate unconformities.

The following important changes in classification have been made by the Geological Survey since the preparation of this chart:

(1) The Lance fm. of Wyo. (except in NE. part of State) is now classified as Upper Cret.
(2) The Hell Creek and Tullock deposits of NE. Wyo. are now treated as formations, the Hell Creek fm. being classified as Upper Cret. and the Tullock fm. as Upper Cret. or Eocene.
(3) In areas in Mont. and NE. Wyo. where the Hell Creek and Tullock are not recognizable, the Lance fm. is classified as Upper Cret. except where Eocene fossils are found above Cret. fossils, in which case the Lance is classified as Cret. and Eocene.
(4) The Ferris fm. is now classified as Eocene and Upper Cret.
(5) The Medicine Bow fm. and contemporaneous deposits are now classified as Upper Cret.
(6) The Cret. ss. in NE. Wyo. that was formerly called Dakota ss. is now called Fall River ss., and classified as Lower Cret.; in other parts of Wyo. Dakota (?) ss. is at present used for the ss. of supposed Upper Cret. age.
(7) The Morrison fm. is now classified as Upper Jurassic.
(8) The Greybull ss. is now treated as top memb. of Cloverly fm., the overlying "rusty beds" being included in Thermopolis sh.
(9) Park City fm. is no longer used in Wyo.
(10) The Gallatin ls. is now classified as wholly of Upper Camb. age.

October, 1937, G. F. Loughlin, Chief Geologist.

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FIGURE 1.—Tentative correlation of geologic formations in Wyoming. Compiled by M. Grace Wilmarth, secretary of Committee on Geological Names, Geological Survey, April 1925.