CANADA

DEPARTMENT OF MINES AND RESOURCES

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BUREAU OF GEOLOGY AND TOPOGRAPHY

GEOLOGICAL SURVEY

PRELIMINARY REPORT

# TURNER VALLEY, ALBERTA

BY

G. S. Hume

Paper 38-7

OTTAWA

1938

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## Introduction

Recent developments have focussed attention on Turner Valley in the foothills of Alberta, where a large oil field is being opened. This report deals with general conditions, insofar as possible non-technical and descriptive only, and is issued to meet the demands of the public for information.

The town of Turner Valley, on Sheep river, is about 40 miles southwest of Calgary and 12 miles west of Okotoks on the Okotoks-Black Diamond road. North of Sheep river the valley is flanked by northwest-trending ridges about 2 miles apart, and it is this part of the field that was the first to be developed. Southeast of Sheep river the ridges are not so pronounced, but the valley is distinctly outlined by them both north and south of Tongue creek, 5 miles south of Sheep river. Still farther south the valley itself is abruptly terminated by the northeast-trending Longview hill, which rises to an elevation of 4,630 feet or more than 650 feet above the town of Turner Valley. The structure, however, that constitutes Turner Valley gas and oil field continues southward beyond Longview hill and is now known to cross Highwood river, 12 miles southeast of Sheep river.

In addition to the town of Turner Valley on Sheep river there are two towns with post-offices farther south. The town of Hartell is on the road south from Black Diamond about one-half mile north of Tongue creek. Three and one-half miles south of Hartell is the town of Royalties, locally known as Little Chicago, which at present is the largest centre of population in Turner Valley. Other smaller settlements have also sprung up.

Two gravel roads of fair quality connect Turner Valley with Calgary. The main road is from Calgary, south to Okotoks, and west to Black Diamond. Here the road divides, one branch going west and up Sheep river to the town of Turner Valley and the other going south to Hartell, Royalties, and the Longview bridge over Highwood river. The second road turns

off the Calgary-Okotoks highway a short distance south of Midnapore. It goes west to within one mile of Priddis and then south to Millarville where it enters the north end of Turner Valley. The road then continues to the town of Turner Valley, where Sheep river may be crossed on a privately owned bridge and road of the Royalite Oil Company. This road continues south and east and joins the Black Diamond-Royalties road north of Hartell. It is a longer route from Calgary, but traverses the whole length of the Turner Valley gas and oil field. By direct route through Okotoks and Black Diamond the south end of Turner Valley is almost 50 miles from Calgary.

To understand the history of Turner Valley it is necessary to know something of the succession of strata that have to be drilled to reach the productive horizons. Also a knowledge of the stratigraphic position of the various producing oil and gas zones is essential. Structural features, too, have played an important part in development for although the structure superficially appears simple yet it is in reality very complicated. Because the areas in which oil and gas are found are partly determined by structural conditions it can readily be understood that if dry holes are to be avoided the structure must be known. In the early history of developments in Turner Valley the extreme structural complications were largely responsible for the drilling of a number of dry holes, the deepest of which was 6,600 feet.

Historically, developments in Turner Valley may be divided into three distinct periods, as follows:

(1) Early developments, including the discovery of oil by Dingman No. 1 well, and consequent developments between 1913 and 1924.

(2) Naphtha-gas production period, beginning with the completion of Royalite No. 4 well in October 1924 and ending in 1936.

(3) Recent crude oil developments, beginning with the completion of Turner Valley Royalties well in June 1936.

## STRATIGRAPHY AND PRODUCTIVE GAS AND OIL HORIZONS OF TURNER VALLEY

The succession of strata with the oil and gas horizons is presented in the following table:

## Stratigraphy of Turner Valley Showing Oil and Gas Horizons

| Formation | Description | Thickness (Feet) | Remarks, Oil and Gas Horizons |
|---|---|---|---|
| Paskapoo | Light grey sandstone alternating with dark grey and greenish shales. Carbonaceous materials and thin coal seams; abundant Unios at certain horizons. Basal bed contains cobbles up to 3 or 4 inches in diameter, but usually smaller or locally is a conglomerate or conglomeratic sandstone. Non-marine. | | Present only to the east of Turner Valley. Well exposed on Highwood River and tributaries. |
| Edmonton | Soft, bentonitic sandstones, dark shales, ironstone bands, and coal seams in the lower part. More massive and harder grey sandstones with grey and dark shales in the upper part. Lowest bed locally a fine conglomerate or conglomeratic sandstone. Contains oyster beds more than 1 foot thick. Abundant Unios at certain horizons. On Pekisko Creek south of Turner Valley there are pink sandstones in the lower part. Non-marine. | Not definitely known, but presumed to be 1,100 to 1,500. | Not present in Turner Valley north of Longview Hill. Occurs on the southern extension of Turner Valley on Highwood River. |
| Bearpaw | Soft, grey shales alternating with some bands of hard, grey and pink sandstones. Contains some coal seams. In places some sandstones are highly glauconitic. A shore phase deposition, with marine fossils and local oyster beds. | Not definitely known, but probably 100 to 200. | Certain wells, as for example National Petroleum No. 1, Sunset, Royal Canadian, and others in the south end of Turner Valley, began drilling in this formation. |

| Formation | Description | Thickness (Feet) | Remarks, Oil and Gas Horizons |
|---|---|---|---|
| Belly River | Grey sandstones alternating with greenish grey and dark shales. A coal zone with several seams, one of which may be 3 to 5 feet thick, occurs at the top of this formation. A thin seam of coal with carbonaceous shale, in places not more than 6 inches thick, occurs 20 feet above the base of the formation and forms a very persistent horizon. Ironstone bands prominent in the upper part of the formation. Locally conglomerates and Unio beds occur. Non-marine. | 1,600 to 1,800 | Many wells on the west flank of Turner Valley began drilling in these strata. |
| Upper Alberta shale "Upper Benton" | Upper part of this formation on Highwood River near west flank of Turner Valley contains a heavy, brownish weathering sandstone band the top of which is about 300 feet below the base of the Belly River beds, but elsewhere this band may be absent. The top of this sandstone is marked by a pebble bed. The formation consists of grey shales and sandy shales with certain zones of hard, brown ironstones, usually with fossils. Marine beds of Montana age in upper part and Colorado age in lower part. | 1,800 to 1,900 | Most wells in the naphtha-gas productive area of Turner Valley began drilling in these beds. |

| Formation | Description | Thickness | Remarks, Oil and Gas Horizons |
|---|---|---|---|
| | | (Feet) | |
| Cardium | Grey sandstone and sandy shale 30 to 40 feet thick. In Turner Valley a pebble horizon about 2 inches thick of fine blue, green, and black chert and quartzite pebbles occurs 150 feet above this cardium sandstone, and another somewhat similar pebble zone 100 feet below it. To the west of Turner Valley these pebble zones are present with sandstones and the Cardium formation includes the whole thickness of beds between these upper and lower conglomeratic sandstones, a total thickness of about 350 feet. | 30 to 40 in Turner Valley | Outcrops in Turner Valley on Sheep River at the Royalite bridge near the town of Turner Valley. |
| Lower Alberta shale "Lower Benton" | Mostly dark grey shales with thin sandstone bands, some horizons finely laminated and crossbedded. One fairly prominent sandstone horizon called the "Jumpingpound sand" 300 feet above the base. At or very close to the base a coarse, quartzitic sandstone known as the "Grit". | 800 to 850 | Shows of oil in many Turner Valley wells. |

| Formation | Description | Thickness (Feet) | Remarks, Oil and Gas Horizons |
|---|---|---|---|
| Blairmore | In the upper part grey sandstones alternating with greenish and dark grey shales, some ironstone. The "Stockmens sand" about 100 feet below the top and the McDougall-Segur sand about 220 feet below the top. A coal seam 650 feet from the top of the formation. The lower part begins with a quartz sand known as "Home sand", 900 to 950 feet from the top of the formation, and is underlain by a series of limy sandstones alternating with dark shales. Part known as the "Crooked Hole sand". A finely conglomeratic sandstone, the "Dalhousie sand", at the base. In southern Turner Valley the Home sand is 150-180 feet above the Dalhousie sand. | Maximum thickness in northern Turner Valley is about 1,200. Less thick in the south end of the field, and minimum thickness about 1,050. | Productive sands: Stockmens sand-gas; McDougall-Segur sand-oil; Home sand - gas and oil; Dalhousie sand - gas and oil. All these horizons are not everywhere equally productive and in places are non-productive. |
| Kootenay | Coal and coaly shales with brownish sandstones - may be absent entirely. | 0 - 100 | |
| Fernie | The division between Kootenay and Fernie somewhat arbitrary. Top of Fernie considered to be a sugary textured brown sand below which is dark shale containing the belemnite conglomerate about 40 to 50 feet above the base. | 200 | Brown sand with small amounts of gas and oil. |
| Palaeozoic (Rundle) limestone | Top of limestone somewhat cherty. Grey and light-coloured limestone, in part dolomitic. | 1,400 in Moose Mountain where it outcrops | The main gas and oil horizons within the upper 450 feet. |

## EARLY DEVELOPMENTS

Turner Valley early attracted attention because of a gas seepage that occurred on the north side of Sheep river. Dingman No. 1 well was located near this seepage on sec. 6, tp. 20, range 2, and began drilling in January 1913. At a depth of 180 feet[1] a flow of gas sufficient to supply drilling fuel

[1] Ross, Victor: Petroleum in Canada.

was encountered. On October 7 of the same year a flow of light oil that tested 90 per cent gasoline was struck. This flow was soon exhausted, but such promising evidences of high-grade oil gave further encouragement to drilling and on May 14, 1914, oil was struck at a depth of 2,718 feet. This well was subsequently deepened, in 1918, to a depth of 3,924 feet, but did not reach the Palaeozoic limestone which was later shown to be the largest producing horizon in the field. The shows of oil and gas in the upper part of the well and the oil flow at 2,718 feet led to a frenzied oil boom in Calgary, and a large amount of acreage was leased from the Dominion Government. The boom, however, subsided on the declaration of war in the late summer of 1914. Drilling, however, was continued in other wells, and several were completed with gas and oil flows. From 1914 to 1924 Turner Valley produced 65,945 barrels of light crude oil. A natural gas 6-inch pipe-line 15 miles long was built from Turner Valley to Okotoks where it joined the trunk gas-line from Bow Island and Foremost to Calgary. Gas deliveries from Turner Valley began in 1922.

## NAPHTHA-GAS PRODUCTION PERIOD

In October 1924 Royalite No. 4 well on ls. 12, sec. 7, tp. 20, range 2, discovered a flow of about 17,000 M to 20,000 M cubic feet of naphtha-bearing gas at a depth of 3,740 feet, or 290 feet below the top of the Palaeozoic limestone, a formation which has since been proved to contain the main productive horizons in Turner Valley. This well was brought into production under very difficult conditions in that a string of drilling tools and another string of fishing tools were lost in the hole. Also when the gate valve at the top of the well was closed the pressure that developed was sufficient to lift the casing. Subsequently the well caught fire, but was finally brought under control and put on production. The exact pressure in this well was never accurately measured because the condition of the well would not permit of a test being made. It is presumed, however, the pressure

was 2,000 pounds and may have been as much as 2,500 pounds[1] a

[1] Ross, C.C.: Trans. Can. Inst. Min. and Met., vol. XXIX, 1926.

square inch. Royalite No. 4 well produced 911,313 barrels of naphtha and large quantities of gas during its production period from 1924 to 1931. The well was abandoned in 1934. The maximum production was in December 1927 when a record average production of 656 barrels a day was reached.

The production of Royalite No. 4 well was as follows:[2]

| Year | | Production in barrels | Average Daily production in barrels |
|---|---|---|---|
| 1924-25 | | 155,852 | |
| 1926 | | 194,078 | 531 |
| 1927 | Jan. 18,406 | | 594 |
| | Feb. 17,778 | | 635 |
| | Mar. 19,634 | | 633 |
| | Apr. 18,669 | | 622 |
| | May 18,693 | | 603 |
| | June 16,838 | | 561 |
| | July 17,141 | | 553 |
| | Aug. 16,969 | | 547 |
| | Sept. 16,487 | | 549.5 |
| | Oct. 17,347 | | 559.5 |
| | Nov. 18,043 | | 601.4 |
| | Dec. 20,338 | | 656 |
| | Total for 1927 | 216,343 | 598 |
| 1928 | | 197,500 | 541 |
| 1929 | | 112,936 | 309 |
| 1930 | | 24,237 | 66 |
| 1931-34 | | 10,367 | |

[2] Information mainly from monthly Bulletins Can. Inst. Min. and Met.

The successful completion of Royalite No. 4 well led to further drilling, but it was 2 years before any other wells were completed to the deep productive limestone. Vulcan No. 1 and Illinois Alberta No. 1 were both completed late in 1926, and both gave quite large volumes of gas with naphtha, although neither yielded the volume of Royalite No. 4 well. During the period from 1924 to 1936 one hundred and fourteen wells were drilled to the Palaeozoic limestone horizon. These wells outlined a field 13 miles long and from ½ to 1 mile wide, with the shallowest well, Royalite No. 14, finishing in the Palaeozoic limestone at a depth of 3,220 feet (786 feet above sea-level) and the deepest one, Lowery No. 2, reaching the same productive horizon at a depth of 6,058 feet (1,809 feet below sea-level). Thus the structural relief within the productive gas zone as indicated by these two wells was 2,695 feet. This is an astonishingly large amount, but with the inclusion of the oil zone now being developed on the west flank of the south end of the structure, the relief within the productive oil and gas is now extended to 3,718 feet with no evidence of edge water having been found.

## Separation of Naphtha from Natural Gas

During the early part of the period of the development of the naphtha-gas zone Smith separators were used to extract the naphtha from the gas. Originally when the pressures were high the cooling effect of the expansion of the gas was sufficient to freeze the moisture from the air, and gas temperatures of 22 degrees below zero were recorded.[1] It was a common sight at this

[1] Ross, C.C.: Trans. Can. Inst. Min. and Met., vol. XXIX, 1926, p. 323.

time to see the control head and pipes leading from the wells and also the Smith separators at some distance away covered with a heavy coating of ice even in summer. This was true also of the pipe-lines to within a few feet of the flares where the waste gas was burnt. As the pressures dropped naphtha absorption plants were built. Four of these, with a capacity of 300,000 M to 350,000 M cubic feet a day, are still operating in the field.

## Natural Gas Production

During this poriod of extensivo drilling much gas was produced for which there was no market. Gas from Royalite No. 4 well contained 640 grains of sulphur per 100 cubic feet, and a scrubbing plant to remove this was built in the summer of 1925. The scrubbed gas was used to supply Calgary through a newly constructed 10-inch pipe-line, and also to supply other towns on the Calgary-Foremost pipe-line. Late in 1928 a new 14-inch pipe-line as far as Pine Creek school-house, to join the main 16-inch pipe-line from this place to Calgary, was brought into use. Formerly Calgary was supplied by gas from the Bow Island and Foremost gas fields in southern Alberta, but when a surplus of Turner Valley gas became available this flow was reversed and the Foremost gas field was shut in. Also, beginning in August 1930, gas was introduced through reconditioned wells into the almost exhausted Bow Island field which at that time was showing encroachment of edge water and in which the pressure had dropped from an original pressure of 745 pounds to 248.7 pounds. To July 31, 1937, 9,984,313 M cubic feet[1] of gas had been put back

[1] Mellon, P.D.: Personal communication.

into Bow Island field and the pressure increased by 293.3 pounds to 542 pounds. The natural gas production of Turner Valley has been as follows:

| Calendar Year | [1]Amount of gas in thousands of cubic feet sold, other than for field use. | Fiscal Year | [2]Amount of gas in thousands of cubic feet destroyed by burning. | [2]Total amount produced for all uses and wasted, in thousands of cubic feet. |
|---|---|---|---|---|
| 1922 | 998,987 | | | |
| 1923 | 1,371,181 | | | |
| 1924 | 1,631,337 | | | |
| 1925 | 1,215,149 | Jan. 1925 to Mar. 1926 | 5,075,000 | 10,865,000 |
| 1926 | 4,250,512 | 1926-27 | 5,365,000 | 9,985,000 |
| 1927 | 5,325,207 | 1927-28 | 10,310,000 | 14,270,000 |
| 1928 | 7,359,567 | 1928-29 | 13,760,000 | 23,990,000 |
| 1929 | 12,183,853 | 1929-30 | 54,480,000 | 72,480,000 |
| 1930 | 14,147,224 | 1930-31 | 126,460,000 | 143,890,000 |
| 1931 | 12,242,037 | 1931-32 | 145,210,000 | 157,320,000 |
| 1932 | 9,605,705 | 1932-33 | 85,310,000 | 95,880,000 |
| 1933 | 9,846,431 | 1933-34 | 89,640,000 | 100,870,000 |
| 1934 | 9,718,000 | 1934-35 | 76,440,000 | 87,560,000 |
| 1935 | 9,718,000 | 1935-36 | 78,020,000 | 90,250,000 |

[1]Information supplied by Bureau of Statistics, Mining, Metallurgical, and Chemical Branch.

[2]Ann. Rept., Dept. of Lands and Mines, Alberta, 1936, p. 49.

## Light Crude Oil Production

During the period of drilling for naphtha in the Palaeozoic limestone several light crude oil horizons in the higher strata were discovered. Shows of oil are in some places encountered near the base of the Lower Alberta shales (Lower Benton), but owing to lack of reservoir rocks no production has been secured from this formation. About 200 feet stratigraphically below the top of the Blairmore formation, however, there is an oil-bearing sandstone horizon containing the so-called McDougall-Segur sand. It is probable that some oil may have occurred in this sand in the early Dingman wells, and in November 1924 it was found to be oil bearing at a depth of 2,397 feet in McLeod No. 1 well, drilled on ls. 16, sec. 1, tp. 20, range 3. The oil was 54° A.P.I. Attention was definitely attracted to this

productive horizon by the completion in January 1927 of New McDougall-Segur No. 1 well on ls. 14, sec. 12, tp. 20, range 3, with oil of 55.3° A.P.I. occurring at 2,448 to 2,460 feet and from 2,468 to 2,476 feet. During February 1927 production from this well averaged 62 barrels a day.[1] Several other wells were

[1] Elliott, G.R.: Trans. Can. Inst. Min. and Met., 1930, p. 423

drilled to this zone and produced oil from it in the same general area as New McDougall-Segur No. 1 well in the northern part of Turner Valley. In some of these an initial production of as much as 100 barrels a day was secured. These wells were later drilled to the Palaeozoic limestone naphtha-gas productive horizon when production from the McDougall-Segur sands declined below a profitable operation.

Two other light crude oil horizons were discovered in the Blairmore formation in 1927. Home No. 1 well drilled in ls. 10, sec. 20, tp. 19, range 2, reached a productive oil sand at a depth of 4,560 feet. This sand became known as the Home sand. It is a white or grey, rather sugary textured quartz sand which has been widely recognized even where it is not oil or gas bearing. In Home No. 1 well it yielded an initial production of 30 barrels of 45 degrees A.P.I. oil and 6,000 M cubic feet of gas. This sand yielded 7,000 M cubic feet of gas from Royalite No. 4 well at a depth of 2,890 feet.

In Dalhousie No. 5 well, drilled on ls. 16, sec. 30, tp. 19, range 2, oil of 51 degrees A.P.I. was encountered in December 1927 in a sand at a depth of 4,310 feet. Drilling was continued to 4,901 feet. This sand became known as the Dalhousie sand and is now believed to be the equivalent of a massive conglomerate and sandstone that occurs at the base of the Blairmore in more westerly foothill areas. During the first month of continuous production, January 1928, Dalhousie No. 5 well gave an average yield[2] of 57 barrels a day. A number of

[2] Elliott, G.R.: Trans. Can. Inst. Min. and Met., 1930, p. 274

other wells obtained some oil in the Dalhousie sand, and in Highwood-Sarcee Nos. 1 and 2 wells, in sec. 21, tp. 18, range 2, casing that had been set at the top of the Palaeozoic limestone, and thus cut off the Dalhousie sand production, was gun-perforated opposite this horizon to obtain this oil. In Merland No. 1 well the Dalhousie sand initially produced[3] naphtha of 78 degrees A.P.I.

[3] Bull. Can. Inst. Min. and Met., Jan. 1930, p. 20.

with 14,000 M cubic feet of gas. On settled production a heavier oil was secured.

Production of Naphtha and Light Crude Oil in Turner Valley[1]

| Year | Naphtha (Bbls.) | Light crude (Bbls.) |
|---|---|---|
| 1925 | 165,717 | 2,926 |
| 1926 | 211,008 | 2,609 |
| 1927 | 290,270 | 38,808 |
| 1928 | 410,623 | 70,734 |
| 1929 | 908,741 | 72,480 |
| 1930 | 1,314,039 | 50,545 |
| 1931 | 1,345,689 | 26,936 |
| 1932 | 854,116 | 21,694 |
| 1933 | 952,885 | 23,822 |
| 1934 | 1,210,766 | 21,896 |
| 1935 | 1,208,321 | 18,691 |
| 1936 | 1,274,119[M] | 13,119 |
| 1937[2] | 2,756,632 | 10,589 |

[1]Department of Lands and Mines, Alberta.

[2]Bureau of Statistics, Ottawa.

[M]Includes all Palaeozoic limestone production, both naphtha and crude oil.

## RECENT CRUDE OIL DEVELOPMENTS

During the period of naphtha-gas production from 1924 to 1936 there was some indication that crude oil in quantity might be present down the west flank of Turner Valley in the same porous zones but below the level of the gas which filled the whole top of the structure. The best evidence of this was in Model No. 1 well, drilled in 1930 on ls. 8, sec. 22, tp. 20, range 3. This well reached the productive Palaeozoic limestone at 5,800 feet and finished at a depth of 5,905 feet. Its initial production was naphtha of 68 degrees A.P.I. with 9,000 M cubic feet of gas. As production was taken, however, the gravity of the oil became heavier, until at present it is 44 degrees A.P.I. The flow from this well never exceeded 175 barrels a day,

but never declined below 130 barrels. From its completion in 1930 to August 31, 1937, the well has yielded 424,273 barrels of oil, sold for $1,034,973. Other wells, as for example Advance No. 5A well on ls. 16, sec. 19, tp. 19, range 2, completed also in 1930 at a depth of 6,515 feet, and Miracle No. 2 well on ls. 16, sec. 5, tp. 19, range 2, completed in 1933 at a depth of 6,713 feet, originally produced naphtha that gradually became heavier in gravity and eventually changed to crude oil. Century Royalties well on ls. 14, sec. 28, tp. 18, range 2, completed in 1934 at a depth of 6,535 feet, at first gave naphtha, but by 1936 had changed into discoloured naphtha which "gave some evidence of containing fractions not volatile at temperatures likely to be encountered in the limestone".[1]

[1] Ann. Rept., Dept. of Lands and Mines for 1936, p. 43.

This well is in the same section as and only a short distance northeast of Turner Valley Royalties well which reached the top of the Palaeozoic limestone at 6,396 feet, and was completed in June 1936 at a depth of 6,828 feet with a flow of 850 barrels a day of 44 degrees A.P.I. oil. This was the first well in Turner Valley that finished as a crude oil well in the Palaeozoic limestone. Its completion inaugurated a new phase of development in which operations have been directed toward the drilling for and the production of crude oil. In December 1936 crude oil was struck in Sterling Pacific No. 3 well, drilled in ls. 13/14, sec. 33, tp. 18, range 2, to a depth of 6,788 feet, and in Foundation Royalties, drilled on ls. 5, sec. 21, tp. 18, range 2, to a depth of 6,474 feet. This was followed by the completion of Brown and Brown Royalties well in February 1937 at a depth of 6,609 feet. This well is in ls. 12, sec. 28, tp. 18, range 2, about 2,000 feet south of Turner Valley Royalties. "An official test of production announced by the Minister of Lands and Mines in the daily press of February 5 was 1,975 barrels for the preceding 24 hours with a flow of 6,500 M cubic feet of gas."[2] This was

[2] Bull. Can. Inst. Min. and Met., Mar. 1937, p. 74

by far the largest well discovered either in the naphtha or crude oil part of the Palaeozoic limestone reservoir up to this time. The completion of this well led to much activity and in a short time many companies were organized and wells located in the vicinity of the proved crude oil area. Much drilling activity resulted, and up to the end of 1937 twenty-seven crude oil wells have been successfully completed, in addition to those that have

changed from naphtha to crude oil. Newfold Royalties well in ls. 11, sec. 21, tp. 18, range 2, in what is now a proved oil area, finished with an extremely small production at a depth of 6,254 feet. It is about 1,500 feet southeast of Davies No. 2 well, finished in September with an initial production as high as 115 barrels an hour. This well has proved to be the largest producer drilled to date. Apparently the Newfold well encountered a tight place almost barren of oil and gas in the limestone. In Dalhousie No. 8 well, drilled to a depth of 6,911 feet on ls. 11, sec. 30, tp. 19, range 2, no production was secured and the well was abandoned after shooting the limestone and gun perforating the casing opposite the Dalhousie and "Brown" sands. The explanation of this dry hole is not obvious. It is possible, however, there are some unknown structural conditions which cut off the oil in this area. The well is only slightly more than half a mile northwest of Advance 5A well on ls. 16, sec. 19, tp. 19, range 2, which originally produced naphtha but which now is yielding a small daily flow of crude oil.

There are now two proved crude oil areas in Turner Valley. The first of these is in the north where Model No. 1 well, on ls. 8, sec. 22, tp. 20, range 3, has been producing crude oil for some time, having changed from a naphtha well into oil of 44 degrees A.P.I. Model No. 3 well, on ls. 1 of the same section, is also now a crude oil producer. Royalite No. 29, the former Turner Basin No. 3 well, is now being drilled in this area in ls. 2, sec. 27, tp. 20, range 3, and will probably be finished early in the year 1938.

The other crude oil area is at the south end of Turner Valley on the west flank of the structure. The proved crude oil area here is about 3 miles long by $\frac{3}{4}$ mile wide. The most southerly producing well is Brown No. 1 on ls. 14, sec. 16, tp. 18, range 2, and the most northerly producing crude well is Sterling Pacific No. 3 well on the boundary between ls. 13 and 14, sec. 33, tp. 18, range 2. To the west and slightly south of Sterling Pacific No. 3 well is Royal Crest No. 1 in ls. 15, sec. 20, tp. 18, range 2. Mercury No. 8 well in ls. 3, sec. 4, tp. 19, range 2, about 600 feet almost directly north of Sterling Pacific No. 3 well, finished in September 1937 at a depth of 6,023 feet, encountered the top of the Palaeozoic limestone 656 feet higher in elevation than Sterling Pacific No. 3 well and yielded gas with naphtha. Several wells are drilling on the west flank of Turner Valley northwest of Sterling Pacific No. 3 and Royal Crest crude wells. The most northerly of these, Brown No. 3, is about 3 miles north of the proved crude oil area. Its successful completion would point to a further 3-mile extension of the crude

oil area northwest along the west flank of the Turner Valley structure. Brown No. 3 well is 1½ miles southeast of the dry Dalhousie No. 8 well.

The crude oil area is limited on the east side by the gas-naphtha content of the same reservoir rock. The limits to the north, south, or west are at present unknown. Commoil No. 1 well, drilled on ls. 15, sec. 29, tp. 18, range 2, finished in October 1937 at a depth of 7,475 feet and gave a large yield of 42.7° A.P.I. oil. This and Sunset No. 1 well, finished at the same depth, are the deepest producing crude oil wells yet completed. On the lower parts of the flank of the structure the oil becomes progressively heavier, but to date no water has been found. Several wells are being drilled south of Brown No. 1, which now is the most southerly producing well, and undoubtedly the field may be expected to extend some distance farther south.

## Acidization

As is well known limestone is soluble in dilute hydrochloric acid, and for some years now it has been the practice in limestone fields in United States to introduce acid into the reservoir limestone rock to increase production. This practice has now been applied with considerable success to the Palaeozoic limestone gas and oil reservoir rock of Turner Valley. A 15 per cent solution of acid with inhibitors to prevent corrosion of metal is used. It is the general practice to introduce the acid through tubing inside the casing of the well to the limestone reservoir rock. This is done by first pumping oil under pressure into the well until a pressure gauge shows that this oil is being freely absorbed into the porous limestone. The acid, varying in volume from 5,000 to 10,000 gallons, is then pumped in and this is followed by more oil until the acid is driven the desired distance into the limestone reservoir. After about 3 hours the well is put on production again. The last pumped in oil is recovered and the mixture of spent acid and oil blown out through a flare line and burnt. When all the acid is out the oil flow is turned into the storage tanks. The effect of the acid in the limestone reservoir is to increase the size of the channels of flow to the well and presumably to release oil in pores too small to otherwise yield it or in pores of an isolated character. Apparently, however, since gas is compressible whereas oil is not, the gas zones more readily absorb the acid than do the oil zones. The result is that there has been a larger proportional increase in gas yield than in oil yield as a result of the acidization. A great many of the crude oil wells have been acidized shortly after being

brought into production, but Turner Valley Royalties well which came into production in June 1936 with a flow of 850 barrels and 2,018 M cubic feet of gas was acidized in June 1937 after one year's production when the yield had fallen to 550 barrels a day. As a result the gas production increased to 8,000 M cubic feet, and for July 1937 the well gave an average daily yield of 1,203 barrels of oil. Other wells have shown even a much larger increase than this, and certain wells which began with a rather small flow have been made to yield good volumes of oil. In certain wells it appeared that the small initial yield was not due to lack of oil, but to lack of gas to lift it to the surface. The increase in gas flow, therefore, as a result of acidization, has proved of great value in augmenting the oil yield.

So far as the writer is aware the acidization of naphtha-gas wells has not proved satisfactory. In many cases large increases in the volume of gas occurred, but without a corresponding proportional increase in naphtha yield. As the effects of wastage of gas are already marked this further gas increase is not a desirable result.

## Marketing of Oil

The success of drilling in Turner Valley, with the consequent increasing production of oil, has led to the curtailment of potential yield by the Imperial Oil Company through its subsidiary, Royalite Oil Company. Proration does not apply to independent companies marketing their own products. The curtailment was made necessary by the fact that the pipe-line capacity from Turner Valley to Calgary was limited to 9,000 or 10,000 barrels a day, and the expansion in the oil field advanced beyond the needs of the Calgary market at a more rapid rate than new markets were arranged. The first proration was put into effect on September 12, immediately following the completion of Davies No. 2 well on ls. 13, sec. 21, tp. 18, range 2. This well had an initial production as high as 115 barrels an hour, and after acidization on September 25 with 10,000 gallons of hydrochloric acid was reported to have an initial yield of more than 3,000 barrels a day with 7,120 M cubic feet of gas. In the latter part of September Brown Nos. 1 and 2 wells were completed, and in October Share Granville, Model-Spooner-Reward, Four Star, Prairie, Royal Crest, Commoil, and Three Point all came into production. The result was a further proration on November 1 to 45 per cent, which was again decreased to 35 per cent on November 15 following the completion of Firestone and Sterling Pacific No. 6 wells. Since that time Westflank Nos. 1 and 3, National Petroleums No. 1, Royal Canadian,

and Sunset wells have been completed, the last four of which all have very substantial flows. No further curtailment has been made, however, in view of arrangements already made for increased pipe-line facilities. Plans have been announced for increasing the refining capacities at Calgary, Moose Jaw, and Regina.

## Potential Production of Oil Wells

Tests of potential production of crude oil wells in Turner Valley were made by the Petroleum and Natural Gas Division, Department of Lands and Mines, from December 8, 1937 to January 7, 1938 inclusive, at the request of Turner Valley Operators Association. These tests are as follows:

| Well | Depth in Feet | Gravity of oil on 5th day. Degrees A.P.I. | Potential Production in bbls. per day. |
|---|---|---|---|
| Advance 5A | 6,515 | 48.5 | 182 |
| B. and B. No. 1 | 6,609 | 48.4 | 1,012 |
| British Dominion No. 4 | 6,325 | | 30 |
| Brown No. 1 | 6,832 | 46.8 | 1,597 |
| Brown No. 2 | 6,996 | 44 | 628 |
| Century No. 1 | 6,535 | | 46 |
| Commoil No. 1 | 7,475 | 42.6 | 2,998 |
| Davies No. 2 | 6,965 | 44.3 | 2,313 |
| Firestone No. 1 | 6,917 | 47.4 | 698 |
| Foundation No. 1 | 6,474 | 51.0 | 487 |
| Four Star No. 1 | 7,070 | 44.1 | 609 |
| Granville No. 1 | 7,318 | 43.5 | 377 |
| Miracle No. 2 | | | 57 |
| Model Spooner No. 1 | 6,942 | 48.6 | 666 |
| Model No. 1 | 5,905 | 43.7 | 134 |
| Model No. 2 | 6,539 | 49.0 | 18 |
| Model No. 3 | 6,234 | | 10 |
| Monarch No. 1 | 7,007 | 45.1 | 571 |
| National No. 1 | 7,220 | 46.1 | 1,051 |
| Prairie No. 1 | 7,315 | 44.4 | 1,275 |
| Renfrew No. 1 | 6,550 | 57 | 15 |
| Richland No. 3 | 6,075 | 53 | 68 |
| Sterling Pacific No. 3 | 6,788 | 43.6 | 302 |
| " " No. 4 | 7,184 | 44.6 | 2,052 |
| " " No. 5 | 7,073 | 46.6 | 1,599 |
| " " No. 6 | 7,117 | 46 | 2,141 |
| Share No. 1 | 7,170 | 42.7 | 484 |
| Royal Crest No. 1 | 7,114 | 46.8 | 567 |
| Royal Canadian No. 1 | 7,416 | 40.3 | 920 |
| Sunset No. 1 | 7,475 | | 1,000 (est.) |
| Three Point No. 1 | 6,969 | 44.7 | 478 |
| Turner Valley Royalties | 6,828 | 45.7 | 1,221 |
| Westflank No. 1 | 7,150 | 45.0 | 320 |
| " No. 3 | 6,888 | 45.2 | 312 |
| Westside No. 1 | 6,374 | 49.3 | 545 |

Seven of these wells, namely Advance No. 5A, British Dominion No. 4, Century No. 1, Model Nos. 1, 2, 3 and Renfrew No. 1 were originally naphtha-gas wells. Subsequently, as production was taken, the product they yielded became crude oil. It will be noted in all these wells with the exception of Model No. 1 production is under 100 bbls. a day.

## Field Price of Oil and Transportation Charges

The field price for oil from September 1 to the end of 1937 was $1.36 a barrel for oil between 40 and 40.9 degrees A.P.I., increasing 2 cents for every degree to $1.84 for oil between 64 and 64.9 degrees A.P.I. On January 4, 1938 this price was reduced 22 cents a barrel.

The pipe-line charges from Turner Valley to Calgary at the end of 1937 were at the rate of 17 cents a barrel. This has now been reduced to 15 cents. An additional 5 cents a barrel charge for loading is made at Calgary. From Calgary by railway tank car to Moose Jaw the price of transportation is 18½ cents a hundredweight and 19 cents a hundredweight to Regina. Oil is being moved from Calgary to Winnipeg at the rate of 39 cents a hundredweight, or roughly $1.09 a barrel.

## Analyses of Crude Oils

Typical analyses of crude oils from various horizons in Turner Valley are as follows:

| | Degrees A.P.I. | Sp. gravity | Sulphur % | Gasoline % | Kerosene % | Gas oil % | Lubricants % | Gas-oil, lubricants and residue unsubdivided | Distillation loss |
|---|---|---|---|---|---|---|---|---|---|
| [1]Dalhousie | 50.2 | .7787 | 0.13 | 69.3 | 13.5 | 7.6 | 7.0 | 2.5 | 0.1 |
| [1]Home sand | 40.1 | .8245 | 0.12 | 33.0 | 14.6 | 21.5 | 17.4 | 13.0 | 0.5 |
| [1]McDougall-Segur sand | 52.4 | | | 71.0 | 12.0 | | | 17.0 | 0.5 |
| [2]Turner Valley Crude oil from pipe-line | 46.7 | .794 | .28 | 49.7 | 12.8 | 16.9 | 12.9 | Residium 6.3 | 1.4 |

[1]Dept. of Lands and Mines, Alberta, for 1935, p.48.

[2]Dept. of Mines and Resources, Fuel Testing Division, Ottawa.

## STRUCTURE OF TURNER VALLEY

Turner Valley lies on the east edge of the foothills, a complicated structural belt 12 to 20 miles wide lying in front of the mountains. East of the foothills on the plains the structures are for the most part simple folds with the strata dipping at low angles, but within the foothills steep dips are the rule and the strata are broken by faults of large displacement. In deformation of this kind overthrust masses have moved mostly from west to east and in moving have dragged against the underlying masses causing much drag-folding. On the surface Turner Valley appears to be a relatively simple fold. On Sheep River, Belly River strata dip rather steeply to the northeast on the east flank and similar strata dip steeply northwest on the west flank, the arrangement suggesting a simple anticlinal fold. Drilling, however, revealed a large fault underlying Turner Valley and emerging at a steep angle at the surface east of the eastern Belly River ridge. The subsurface strata on the east flank were also known from drilling to be drag-folded and probably in part overturned above and in close proximity to the fault. The eastern edge of the productive Palaeozoic limestone is sharply defined by this fault, and hence the prospective gas and oil area has been proved to be very limited in this direction. Drilling showed that the fault under Turner Valley had a relatively low west inclination, and it was inferred that should this same degree of dip of the fault plane continue westward the limestone might also be cut off on the west flank as the strata, if steeper than the fault, must necessarily be cut off by it at depth. Drilling has now definitely proved, however, that this is not the case in the south end of the field, and the inference is that everywhere the low-angle fault under Turner Valley again turns steeply downwards under the central part of the structure and hence will not be encountered in drilling on the west flank. This conclusion is of great importance in that it is now believed the crude oil areas on the west flank will only be limited by the oil-water line, which presumably must occur farther down the west flank than any wells so far drilled.

It is thought that the fault dies out southwards between Highwood river and Pekisko creek, in sec. 33, tp. 17, range 2. Apparently, also, the fault steepens southward toward Highwood river as indicated on Figure 5. The sub-surface trace of the fault may be farther west, however, than is shown on the figure, and if so the steepening of the fault may be slight.

In addition to this major overthrust fault underlying Turner Valley there are a number of other faults within it. The Cardium sandstone between the upper and lower Alberta (Benton)

shales is a more resistant member than the surrounding shales. On deformation it broke or faulted in many places, whereas the shales more readily yielded by crumpling. The Blairmore formation also is much more competent than the overlying Alberta shales or the underlying Kootenay and Fernie formations, and hence under strain yielded by faulting. The result is that many faults of very considerable displacement in Turner Valley do not cut the Palaeozoic limestone as was formerly supposed, although the limestone to some extent is also faulted.

Lying on the west flank of Turner Valley is a higher fault plate, commonly referred to as the Outwest fault sheet. From drilling of Okalta No. 6 well on ls. 3, sec. 30, tp. 18, range 2, close to Highwood river, and the Outwest and other wells near Sheep river in tp. 19, range 3, it is known that this fault sheet is underlain by a low-angle fault. On Highwood river the fault apparently emerges in the badly deformed zone of shales, coaly shales, and sandstones on sec. 20, tp. 18, range 2. West of this the beds including the whole section of Belly River strata dip eastwards at angles of 40 to 50 degrees. Apparently, however, at a very moderate depth these beds are truncated by the Outwest fault, below which the beds dipping westward on the west flank of the Turner Valley uplift occur. The Outwest fault sheet, however, completely masks the character of the Turner Valley fault sheet underlying it, and hence information as to the precise nature of the subsurface structure of Turner Valley under the Outwest fault sheet will only become known as drilling is done. In the vicinity of Highwood river no well other than Okalta No. 6 has penetrated through the Outwest fault sheet into the Turner Valley structure under it; Scottish Petroleums No. 1 well on ls. 16, sec. 19, tp. 18, range 2, began drilling on it but as far as known has not yet reached a sufficient depth to penetrate it. Thus at present it is unknown to what distance and at what rate the strata on the west flank of Turner Valley dip westerly without interruption. There is no doubt that these factors will largely determine the extent of the oil zone on the west flank and hence are of great importance, but until correlations of strata in three or more wells penetrating the Outwest fault plane are known no precise data on the character of the fault and the inclination of the strata under it will be available.

## Index to Wells in North Part of Turner Valley, as Shown on Figure 2

Townships 20, Ranges 2 and 3

| | Well | Elev. of well | Depth to Pal. lime. | Elev. of Pal. lime. | Total depth |
|---|---|---|---|---|---|
| 1 | Freehold No. 1 | 3,993 | | | 4,825 |
| 2 | Dalfin No. 1 | 4,024 | | | 2,310 |
| 3 | Calmont No. 5 | 4,014 | | | 4,082 |
| 4 | Calmont No. 9 | 3,987 | | | 4,930 |
| 5 | Turner Basin No. 1 | 4,042 | | | 5,300 |
| 6 | Turner Basin No. 2 | 4,041 | | | 2,970 |
| 7 | Turner Basin No. 3 (Royalite No. 29) | 4,055 | | | |
| 8 | Foothills No. 1 | 4,001 | 5,353 | -1,352 | 5,915 |
| 9 | Foothills No. 4 | 4,023 | | | 4,559 |
| 10 | Model No. 1 | 4,093 | 5,800 | -1,707 | 5,905 |
| 11 | Model No. 2 | 4,083 | 5,524 | -1,441 | 6,539 |
| 12 | Model No. 3 | 4,149 | 5,730 | -1,581 | 6,234 |
| 13 | Royalite No. 26 | 4,076 | 4,893 | -817 | 5,083 |
| 14 | Royalite No. 27 | 4,135 | 5,185 | -1,050 | 5,570 |
| 15 | Midwest No. 2 | | | | 3,345 |
| 16 | Spooner No. 3 | 4,047 | | | 3,240 |
| 17 | Vimy No. 1 | 4,056 | | | 3,550 |
| 18 | Dome No. 1 | 4,044 | | | 6,005 |
| 19 | United No. 4 | 4,043 | | | 6,360 |
| 20 | Richfield No. 2 | 4,034 | 4,728 | -694 | 5,070 |
| 21 | Spooner No. 1 | 4,060 | 4,690 | -630 | 5,260 |
| 22 | Spooner No. 2 | 4,023 | 5,080 | -1,057 | 5,983 |
| 23 | Spooner No. 4 | 4,019 | 5,060 | -1,041 | 5,444 |
| 24 | Vulcan No. 1 | 4,012 | 4,862 | -850 | 5,030 |
| 25 | Vulcan No. 2 | 4,031 | | | 4,850 |
| 26 | Vulcan No. 3 | 4,040 | | | 3,100 |
| 27 | Royalite No. 9 | 4,031 | 4,860 | -829 | 5,593 |
| 28 | Royalite No. 13 | 4,000 | 4,640 | -640 | 4,946 |
| 29 | Royalite No. 7 | 4,013 | 4,100 | -87 | 4,285 |
| 30 | Royalite No. 12 | 4,002 | 5,410 | -1,385 | 5,638 |
| 31 | Dalhousie No. 3 | 4,046 | | | 3,340 |
| 32 | Dalhousie No. 4 | 4,006 | | | 3,600 |
| 33 | Dalhousie No. 6 | 4,056 | 5,023 | -967 | 5,595 |
| 34 | Royalite No. 21 | 4,002 | 4,308 | -306 | 5,034 |
| 35 | Dalhousie No. 1 | 4,002 | 4,406 | -404 | 4,565 |
| 36 | Dalhousie No. 2 | 4,015 | | | 3,600 |

| | Well | Elev. of well | Depth to Pal. lime. | Elev. of Pal. lime. | Total depth |
|---|---|---|---|---|---|
| 37 | Royalite No. 4 | 3,975 | 3,450 | +525 | 3,740 |
| 38 | Royalite No. 5 | 3,984 | | | 3,527 |
| 39 | Royalite No. 14 | 4,006 | 3,220 | +786 | 3,792 |
| 40 | Great West No. 1 | 3,903 | | | 5,400 |
| 41 | Cooper Nanton No. 1 | 3,901 | | | 4,830 |
| 42 | Royalite No. 8 | 4,005 | 3,660 | -345 | 3,753 |
| 43 | Royalite No. 18 | 3,995 | 3,821 | +174 | 3,887 |
| 44 | Royalite No. 10 | 4,010 | | | 2,333 |
| 45 | Royalite No. 11 | 4,014 | 3,628 | +386 | 4,047 |
| 46 | Royalite No. 20 | 4,024 | 4,880 | -856 | 5,180 |
| 47 | Royalite No. 22 | 4,019 | | | 2,250 |
| 48 | Royalite No. 15 | 4,022 | | | 3,047 |
| 49 | Royalite No. 16 | 4,046 | 4,706 | -660 | 5,673 |
| 50 | Illinois Alberta No. 1 | 4,008 | 3,636? | +372 | 3,831 |
| 51 | Illinois Alberta No. 2 | 4,012 | | | 3,684 |
| 52 | New McDougall-Segur No.2 | 4,018 | 5,058 | -1,040 | 5,658 |
| 53 | New McDougall-Segur No.3 | 4,028 | 5,415 | -1,387 | 5,834 |
| 54 | New McDougall-Segur No.4 | 4,015 | 4,860 | -845 | 5,108 |
| 55 | Widney | 4,023 | 5,010 | -987 | 5,420 |
| 56 | British Dominion No. 2 | 4,046 | 5,064 | -1,018 | 5,180 |
| 57 | McLeod No. 1 | 4,011 | | | 3,940 |
| 58 | McLeod No. 2 | 4,005 | 3,640 | +365 | 4,420 |
| 59 | McLeod No. 3 | 4,029 | 4,749 | -720 | 4,973 |
| 60 | McLeod No. 4 | 4,007 | 3,730 | -277 | 7,751 |
| 61 | McLeod No. 5 | 4,034 | 4,950 | -916 | 5,188 |
| 62 | Regent No. 1 | 4,001 | 3,734 | +267 | 3,908 |
| 63 | Regent No. 2 | 4,010 | | | 1,978 |
| 64 | Regent No. 3 | 3,999 | 3,800 | -199 | |
| 65 | Sioux City No. 1 | 4,019 | 4,385 | -366 | 6,194 |
| 66 | Canada Southern No. 1 | 3,995 | | | 2,51? |
| 67 | Midfield | 3,980 | 3,920 | +60 | 4,205 |
| 68 | Okalta No. 3 | 3,983 | 4,142 | -159 | 4,563 |
| 69 | Foothills No. 2 | 3,971 | 4,357 | -386 | 4,940 |
| 70 | Freeman Lundy No. 1 | 4,021 | 4,891 | -87? | 5,374 |
| 71 | Okalta No. 1 | 3,955 | 4,935 | -980 | 5,040 |
| 72 | Okalta No. 2 | 3,955 | 4,755 | -800 | 5,141 |
| 73 | Calmont No. 1 | 4,015 | 5,463 | -1,448 | 5,877 |
| 74 | Royalite No. 1 | 3,931 | | | 3,924 |
| 75 | Royalite No. 2 | 3,964 | | | 3,175 |
| 76 | Royalite No. 3 | 3,916 | | | 2,830 |
| 77 | Royalite No. 17 | 3,993 | 3,463 | +530 | 4,034 |
| 78 | Royalite No. 19 | 3,951 | 4,463 | -512 | 5,020 |
| 79 | Highland | 3,986 | | | 3,020 |

| | Well | Elev. of Well | Depth to Pal. lime. | Elev. of Pal. lime. | Total depth |
|---|---|---|---|---|---|
| 80 | Big Chief | 3,993 | | | 4,370 |
| 81 | British Dominion No. 1 | 3,985 | | | 6,600 |
| 86 | Home Millarville | | | | 7,602 |
| Wells Not in Turner Valley: | | | | | |
| 82 | Weymarn No. 1 | 4,054 | | | 4,030 |
| 83 | United No. 1 | 4,175 | | | 3,150 |
| 84 | New Valley | 3,873 | | | |
| 85 | Sentinel | 3,858 | | | 5,850 |

## Index to Wells in Central Part of Turner Valley, as Shown on Figures 3 and 5

Townships 19, Ranges 2 and 3

| | Well | Elev. of well | Depth to Pal. lime. | Elev. of Pal. lime. | Total depth |
|---|---|---|---|---|---|
| 1 | Royalite No. 23 | 4,036 | 4,820 | -784 | 5,331 |
| 2 | Royalite No. 6 | 4,000 | 4,280 | -280 | 4,531 |
| 3 | Royalite No. 25 | 4,030 | 4,270 | -240 | 4,690 |
| 4 | Structure No. 1 | 4,044 | 4,733 | -689 | 5,212 |
| 5 | Midwest No. 1 | 4,029 | | | 3,740 |
| 6 | Mid Royal | 4,054 | | | 2,175 |
| 7 | Dalhousie No. 5 | 4,035 | | | 4,900 |
| 8 | Dalhousie No. 7 | 4,062 | 4,992 | -930 | 5,339 |
| 9 | Dalhousie No. 8 | 4,116 | 6,178 | -2,062 | |
| 10 | Royalite No. 24 | 4,043 | 5,255 | -1,212 | 5,555 |
| 11 | Advance No. 5A | 4,230 | 6,009 | -1,779 | 6,515 |
| 12 | Home No. 1 | 4,199 | 5,110 | -911 | 5,280 |
| 13 | Home No. 2 | 4,204 | 5,345 | -1,141 | 5,507 |
| 14 | Home No. 3 | 4,206 | 5,032 | -826 | 5,139 |
| 15 | Home No. 4 | 4,213 | 5,416 | -1,203 | 5,601 |
| 16 | Home No. 5 | 4,228 | 4,480 | -252 | 4,898 |
| 17 | Baltac | 4,217 | 5,400 | -1,183 | 5,874 |
| 18 | Calmont No. 2 | 4,200 | 4,773 | -573 | 4,927 |
| 19 | Calmont No. 4 | 4,209 | 4,824 | -615 | 5,084 |
| 20 | Calmont No. 7 | 4,200 | 5,017 | -817 | 5,414 |
| 21 | Alberta Pacific Con. No. 1 | 4,245 | 5,463 | -1,218 | 5,796 |
| 22 | Alberta Pacific Con. No. 2 | 4,271 | 5,163 | -892 | 5,840 |
| 23 | Associated No. 1 | 4,224 | 5,170 | -946 | 5,410 |
| 24 | Associated No. 2 | 4,265 | 4,952 | -687 | 5,423 |
| 25 | Hargal No. 1 | 4,192 | 5,058 | -866 | 5,348 |
| 26 | Freehold No. 2 | 4,205 | 4,058 | +147 | 4,466 |
| 27 | Wellington No. 1 | 4,248 | 4,660 | -412 | 4,988 |
| 28 | Lowery No. 1 | 4,316 | 5,110 | -794 | 5,460 |
| 29 | Lowery No. 2 | 4,249 | 6,058 | -1,809 | 6,584 |
| 30 | Mayland No. 1 | 4,216 | 5,451 | -1,235 | 6,242 |
| 31 | Mayland No. 2 | 4,136 | 4,710 | -574 | 5,017 |
| 32 | Mayland No. 3 | 4,105 | 5,820 | -1,715 | 6,177 |
| 33 | Mayland No. 6 | 4,117 | 4,656 | -539 | 5,069 |
| 34 | Homestead | 4,144 | 4,286 | -142 | 4,798 |
| 35 | East Crest No. 1 | 4,133 | 4,312 | -179 | 4,675 |
| 36 | East Crest No. 2A | 4,125 | 4,247 | -122 | 4,637 |
| 37 | East Crest No. 3 | 4,005 | 4,451 | -446 | 4,845 |
| 38 | Southwest Pete No. 1 | 4,080 | 5,478 | -1,398 | 5,493 |
| 39 | Southern Lowery No. 1 | 3,985 | 4,540 | -555 | 4,850 |

| | Well | Elev. of well | Depth to Pal. lime. | Elev. of Pal. lime. | Total depth |
|---|---|---|---|---|---|
| 40 | Southern Lowery No. 2 | | 4,350 | | 4,740 |
| 41 | Southern Lowery No. 3 | | 5,147 | | 5,622 |
| 42 | Commonwealth No. 1 | 4,004 | 4,620 | -616 | 5,000 |
| 43 | Miracle No. 2 | 4,070 | 5,940 | -1,870 | 6,710 |
| 44 | Spray No. 1 | 4,133 | | | 3,790 |
| 45 | Mercury Royalties | 4,213 | | | |
| 46 | Mercury No. 1 | 4,009 | 5,270 | -1,261 | 5,360 |
| 47 | Mercury No. 2 | 4,056 | 5,110 | -1,054 | 5,420 |
| 48 | Mercury No. 3 | 4,202 | 5,070 | -868 | 5,270 |
| 49 | Mercury No. 5 | 4,168 | | | 5,986 |
| 50 | Mercury No. 6 | | | | |
| 51 | Mercury No. 7 | 4,146 | | | 1,932 |
| 52 | Mercury No. 8 | 4,157 | 5,500 | -1,343 | 6,023 |
| 53 | Miracle No. 1 | 4,030 | 5,170 | -1,140 | 5,395 |
| 54 | Miracle No. 3 | 4,039 | 5,490 | -1,451 | 6,150 |
| 55 | Mill City No. 1A | 4,025 | 4,510 | -485 | 5,065 |
| 56 | Hylo No. 1 | 4,051 | 5,500 | -1,449 | 5,665 |
| 57 | Kermac No. 1 | 4,475 | | | |
| 58 | Brown No. 3 | 4,354 | 6,319 | -1,965 | |
| 59 | Vulcan Brown | 4,304 | | | |

Index to Wells in South Part of Turner Valley, as Shown on Figures 4 and 5

| | Well | Elev. of Well | Depth to Pal. lime. | Elev. of Pal. lime. | Total depth |
|---|---|---|---|---|---|
| 1 | West Turner Petroleum No. 1 | 4,236 | | | |
| 2 | West Turner Petroleum No. 2 | | | | |
| 3 | Westflank No. 1 | 4,227 | 6,694 | -2,467 | 7,150 |
| 4 | Westflank No. 2 | 4,231 | 6,542 | -2,311 | 6,973 |
| 5 | Westflank No. 3 | 4,260 | 6,429 | -2,169 | 6,880 |
| 6 | Westflank No. 4 | | | | |
| 7 | Westflank No. 5 | | | | |
| 8 | Westflank No. 6 | | | | |
| 9 | Royalite No. 30 | | | | |
| 10 | Royal Crest No. 1 | 4,185 | 6,645 | -2,460 | 7,114 |
| 11 | Royalite No. 28 | 4,198 | 6,429 | -2,231 | |
| 12 | Sterling Pacific No. 1 | 4,214 | 5,153 | -939 | 6,510 |
| 13 | Sterling Pacific No. 2 | 4,222 | 5,562 | -1,340 | 5,720 |
| 14 | Sterling Pacific No. 3 | 4,221 | 6,230 | -2,009 | 6,788 |
| 15 | Sterling Pacific No. 4 | 4,228 | 6,709 | -2,481 | 7,184 |
| 16 | Sterling Pacific No. 5 | 4,257 | 6,610 | -2,353 | 7,073 |
| 17 | Sterling Pacific No. 6 | 4,243 | 6,686 | -2,443 | 7,117 |
| 18 | Sterling Royalties | 4,232 | 4,977 | -745 | 5,657 |
| 19 | Livingstone | | | | 3,880 |
| 20 | Rand | | | | 3,891 |
| 21 | Merland No. 1 | 4,274 | 4,965 | -691 | 5,530 |
| 22 | Merland No. 2 | | | | 2,690 |
| 23 | C. and E. Longview | 4,452 | 5,592 | -1,140 | 6,220 |
| 24 | Marjon No. 1 | 4,366 | 5,402 | -1,036 | 5,854 |
| 25 | Publex No. 1 | 4,399 | 4,900 | -501 | 5,520 |
| 26 | Spooner Anaconda | 4,503 | 5,510 | -1,007 | 6,305 |
| 27 | Carleton | 4,600 | 5,460 | -860 | 6,110 |
| 28 | Pacalta | 4,410 | 5,045 | -635 | 5,498 |
| 29 | Marjon No. 2 | 4,324 | 4,930 | -606 | 5,870 |
| 30 | Director Royalties | 4,289 | 4,963 | -674 | 5,644 |
| 31 | Anaconda No. 2 | 4,251 | 5,080 | -829 | 5,548 |
| 32 | Century Royalties | 4,235 | 5,839 | -1,604 | 6,530 |
| 33 | Richland No. 3 | 4,251 | 5,608 | -1,357 | 6,060 |
| 34 | British Dominion No. 4 | 4,360 | 5,838 | -1,478 | 6,217 |
| 35 | Renfrew Royalties | 4,581 | 6,010 | -1,429 | 6,550 |
| 36 | Richland No. 2 | 4,281 | 6,410 | -2,129 | |
| 37 | B. and B. Royalties | 4,255 | 6,195 | -1,940 | 6,609 |
| 38 | Richland No. 1 | 4,253 | | | |
| 39 | Turner Valley Royalties | 4,241 | 6,396 | -2,155 | 6,828 |

| | Well | Elev. of Well | Depth to Pal. lime. | Elev. of Pal. lime. | Total depth |
|---|---|---|---|---|---|
| 40 | Four Star | 4,234 | 6,640 | -2,406 | 7,105 |
| 41 | Three Point | 4,258 | 6,551 | -2,293 | 6,969 |
| 42 | Model Spooner No. 1 | 4,285 | 6,461 | -2,176 | 6,942 |
| 43 | Model Spooner No. 2 | | | | |
| 44 | Sunburst Royalties | 4,243 | | | |
| 45 | National Petroleum No. 1 | 4,287 | 6,786 | -2,499 | 7,200 |
| 46 | Share Royalties | 4,287 | 6,730 | -2,443 | 7,170 |
| 47 | Granville Royalties | 4,251 | 6,846 | -2,595 | 7,318 |
| 48 | Commoil | 4,235 | 6,999 | -2,764 | 7,475 |
| 49 | Command | | | | |
| 50 | Globe Royalties | 4,257 | | | |
| 51 | Davies Petroleum No. 1 | 4,172 | | | |
| 52 | Scottish Petroleum No. 1 | 3,998 | | | |
| 53 | Okalta No. 6 | | | | |
| 54 | Royal Canadian No. 1 | 4,106 | 6,958 | -2,852 | 7,410 |
| 55 | Sunset No. 1 | 4,085 | 7,017 | -2,932 | 7,475 |
| 56 | Spy Hill | 4,117 | 6,603 | -2,486 | |
| 57 | Monarch Royalties | 4,096 | 6,538 | -2,442 | 7,007 |
| 58 | Brown No. 2 | 4,080 | 6,525 | -2,445 | 6,997 |
| 59 | Davies No. 2 | 4,180 | 6,512 | -2,332 | 6,965 |
| 60 | Barsac No. 1 | 4,116 | | | |
| 61 | Foundation Royalties | 4,096 | 6,020 | -1,924 | 6,474 |
| 62 | Brown No. 4 | | | | |
| 63 | Westside No. 1 | 4,073 | 5,938 | -1,865 | 6,378 |
| 64 | Newfold | 4,171 | 5,810 | -1,639 | 6,254 |
| 65 | Sovereign Royalties | 4,340 | 5,792 | -1,452 | 6,234 |
| 66 | Highwood Sarcee No. 1 | 4,497 | 5,348 | -851 | 5,755 |
| 67 | Union Freehold | 4,226 | 5,595 | -1,369 | 6,462 |
| 68 | Highwood Sarcee No. 2 | 4,101 | 5,699 | -1,598 | 6,560 |
| 69 | Hoffar-Lundy | 4,299 | | | |
| 70 | United No. 5 | | | | |
| 71 | Coronation Royalties | | | | |
| 72 | Prairie Royalties | 4,063 | 6,830 | -2,767 | 7,315 |
| 73 | Sundance Royalties | | | | |
| 74 | Firestone Royalties | 4,066 | 6,354 | -2,288 | 6,917 |
| 75 | Brown No. 1 | 4,051 | 6,346 | -2,295 | 6,817 |
| 76 | Frontier Royalties | | | | |
| 77 | Richwell | 4,029 | | | |
| 78 | National Petroleum No. 2 | 4,017 | | | |
| 79 | Mid-Royal No. 2 | | | | |