

RECONNAISSANCE REPORT
OF
OIL POSSIBILITIES
IN
HARNEY COUNTY, OREGON.

By L. N. C. Ford

The area covered by this examination extends roughly from the Northerly boundary of Harney County and spurs of the Blue Mountains to the vicinity of Diamond and Frenchglen on the South and from a line through Drewsey, Crane and Princeton on the East, to a line thru Suntex, Wagentire, etc., on the West and lies within the Northerly half of the County.

The central part of this area forms a great basin, confined within mountain ridges, and containing some prominent buttes and escarpments generally capped by lava flows, and is also marked at several point by volcanic vents or plugs and by some extrusive dykes.

The southern end of the area is covered by Malheur and Harney Lakes which formerly occupied most of the basin but are now nearly dried up through deficient rains and snowfall for several years, their combined water surface is about 80,000 acres, they are very shallow at present.

These lakes and the basin formerly drained through Malheur gap, and the Narrows and Crane Creek, but these outlets gradually silted up and are now closed on the surface though it seems probable that considerable flow exists through underground channels following the original outlets whenever the lakes receive larger supplies from drainage run-off of the valley.

TOPOGRAPHY, etc.

The central part of the basin is an area of very low relief showing a slight ridge with a Northwesterly, Southeasterly strike generally parallel to the encircling foothills - which appears as the apex of an eroded anticlinal fold, or dome structure.

The surrounding high ridges, mesas, etc., have been covered and preserved from much erosion by lava flows of recent geological age.

Prominent mesa-like cliffs or escarpments are in evidence at Wright's Point, Dog Mountain, the Narrows and near Crane. The basin walls are generally ridges, partly covered by lava flows and intersected by dykes, etc., which on the east and southeast are broken and faulted considerable to the West are little disturbed since their uplifting during and after the formation of the Cascade Mountain range. To the North the surface ridges are frequently faulted and at some points are tilted by recent volcanic action, and show later flows of igneous material.

GENERAL ECONOMIC FEATURES.

The valley is intersected by North-South highways now well improved and by a nearly completed East-West highway reach Burns and Crane. Railway communication

from Eastward reaches Burns by the Union Pacific Railroad and a lumbering railroad extends from the mills at Burns to Timber areas in the Blue Mountains.

The valley formerly supported a grain farming community of importance as well as extensive livestock enterprises but many dry seasons brought about abandonment of grain raising to a great extent and livestock operations have dwindled considerably.

Burns, the County seat, is a city of possibly 3,000 people and supports some good stores, it is the supply and market point of most of the valley. A large lumber mill plant has been built and placed in operation adjoining the county town, but it is not part of the corporation.

The area is easily accessible and with a few seasons of good snow and rainfall should become more populous and prosperous. Housing facilities are plentiful and living conditions favorable.

HISTORICAL GEOLOGY, etc.

This general area was originally raised from the bed of the ocean in the early part of the Tertiary age consisted of a thick series of marine sediments. These formations are subsequently covered by volcanic muds, and lava flows were out in places by eruptive dykes.

About this time the ocean was shut out of the territory by the uplifting of the Cascades and associated mountain ridges, but extensive salt water lakes remained over a large area. These lakes were later partly filled by material eroded from the surrounding mountain uplifts, forming the series of marine, brackish and fresh water sediments successively as the salt water evaporated and was replaced by fresh water from stream flows.

Toward the close of the Tertiary age further earth movements caused folding of the sediments to some extent and faults or fractures resulted East and South of this Basin. At this time a ridge was raised running Northwest Southeast crossing the Central part of what is known as Saddle Butte. This ridge was not of a continuous height but had two or more crests and "nosed down" at its Northerly and Southerly ends.

The Northerly end was fractured and broken by a volcanic eruption, the rim of this crater shows at a high point South of "Willow Creek Flat", which occupies the old crater floor and is cut by small dyke-like fumaroles.

The remains of this crater rim is now covered by lava, scoria, cinders, etc.,

and shows considerable burned shales, altered and fluxed sands, etc., brought down from below by eruption.

Extrusive material from this crater was plentiful and the ashes and mud were covered to a great extent by the lava flows which followed. This lava was basic, carrying a considerable percentage of lime and magnesia, etc. Dog Mountain and Fright's Point are capped by this flow, in addition to areas West, East and North of the main vent. Some small gas vents or blowouts also accompanied this convulsion and are now marked by cinder deposits and altered material one such vent is Northwest of Burns about two miles. Saddle Butte to the Southward is regarded as a Laccolith or neck, ejected through a fissure during this eruptive activity. Other plug vents, etc., are in evidence surrounding the valley. This eruption is considered to have occurred in the Pleistocene period at the beginning of the Quaternary age. The valley floor from Saddle Butte to Burns and between Dog Mountain and the ridges eastward near Crane exhibits no dykes, plugs, faults, etc., and appears closed in and unbroken.

This uplift has been subjected to erosion and its crest has furnished material to fill up the flanks until the ground surface is now nearly level.

The visible rocks in the area comprise a wide variety of igneous and sedimentary formations running from the Cretaceous period of Mesozoic Time through the Eocene Oligocene, Miocene and Pliocene periods of Tertiary age and into the Pleistocene and recent periods of the Quaternary age.

STRATIGRAPHY.

Measurements of successive series in this area and close classification by vertical section is not at present feasible due to snow covering mountain exposures and uplift.

At one point on Silvies River some 20 miles North of Burns a tilted section of Cretaceous limestone, sandstone and shale showed a thickness of some 1200 feet and contained an abundance of Cretaceous fossils (Hxogra, Costa, Gryphea, Inocerami, Ammonidae, Scaphites and Belemnites).

The Strawberry Range, a spur of the Blue Mountains uplifts a thick section of the Cretaceous series but snow prevented close examination or measurement thereof.

The Tertiary rocks of the area are largely re-deposited sands, tuffs, etc., partly marine, and part lacustrine. Diatomaceous shales and earths are widespread regional deposits originally covering the whole area and still remaining in the rim rocks of the Basin.

Many old beaches are in evidence some appearing to be Marine and others Lacustrine and many terraces are shown in the surrounding hills.

STRUCTURE, etc.

The above described ridge running through this basin from Northwest to Southeast was originally a long anticline carrying two domes, the Northerly one subsequently was fractured by volcanic action and one side of its rim nearly destroyed, the remaining rim and flanks were preserved by lava flows. The Southerly dome was not covered by these lava flows, and its comparatively soft surface has been eroded away through a long period but its base remains, appears unbroken and is regarded as a closed dome structure.

In examining the area a Tertiary sandstone was observed at various points: East and west showing a N.W.S.E. strike and a low dip away from this ridge. These exposures appear around the valley rims but are not sufficiently continuous to form a reliable key bed. A similar sandstone considered to be the same is formed under a considerable area in Townships 23 and 24, Ranges 31, 32 and was used as a key bed in this examination, pits or holes being sunk at many points into this sandstone, exposures were also found in slough, ditch and stream beds. Correlation of these exposures, distance and surface and elevation of the surface prove the presence of this domed ridge and present an index of its form, position and direction which is roughly outlined in the accompanying sketch map.

The dome is several miles in width, apexes along a defined N.W.S.E. line and within one mile of the apex dips Westerly and Easterly at a moderately steep angle. Its length is in excess of ten miles.

The Tertiary formations come near the surface and are overlaid by Cretaceous formations. Some lava sheets of thin section are interbedded in the Tertiary rock sediments but that these altered the underlying formations to any material extent is not believed, as surrounding mountains show only thin flows of lava in this area.

SEEPAGES AND DEVELOPMENT WORK.

A large number of wells have been dug or drilled for water in the valley. The Hines Lumber Company well, drilled to a depth of about 400 feet at the N.W. end of the valley was mainly in sandstone and shale. It is reported to have encountered some gas and oil seepage which was cased off.

The Clemmens well in Section 10, Township 23 S. Range 31 East, 410 feet deep was drilled mainly in sandstone and shale. It gives a flow of artesian water with no gas, oil or salt, and is mentioned because of formation drilled.

Several shallow wells drilled on Hanely's Ranch, and on the Pacific Live-stock lands showed oil and gas and were filled up. Three or four shallow wells on the Fay place in Section 6, Township 24 S. Range 32 East, show some gas and oil colors, these were drilled for water.

The Catterson well in Section 30, Township 24 S., Range 32 $\frac{1}{2}$ East, ran into gas and was drilled through into the water at 140 feet depth. The water raised to about 30 feet from the surface but was rather saline, etc. Gas now comes up through 100 feet of water and earth in the hole.

The Johnson well in Section 8, Township 25 S., Range 32 $\frac{1}{2}$ East, is 268 feet deep, it is cased, and has a hand pump installed in the house. When pumped this well produced gas in quantity which burned as long as pumping continued. Slight oil seepage was observed in this water when pumped for a few minutes.

A well sunk on the Culp place to a depth of 410 feet was diamond drilled. Gas reported plentiful and some oil seepages. The core shown indicated very sharp bedding angle, indicating that the location was on the extreme flank of the anticline or near the end of the nose.

The Leake well drilled in Section 26, Township 25 S., Range 32 East, was drilled to 307 feet and struck a heavy flow of gas, reports are, that this gas burned for months but the hole was plugged and filled by Leake who feared he could not get his homestead papers. The place is now vacant.

The Howell well drilled to 1468 feet depth in Section 15, Township 26 S., Range 32 East, got gas and oil seepages but was ruined by mechanical troubles and finally abandoned. The owner died recently. Gas shows in water flowing from this hole.

Wells at and near Lawen station show gas and oil seepages.

The Davey wells in Section 10, Township 26 S., Range 31 East, show gas and light oil seepage. The gas was ignited when visited.

Baker's well in Section 27, Township 25 S., Range 31 East, is stated to show oil and gas.

The Red "S" well in Section 16, Township 25, S. Range 32 East, was drilled for oil last year and carried to a depth of about 1,000 feet. It is reported that gas was found and some oil seepage shown. Mechanical troubles caused abandonment of this hole, it was considered to be off of the structure.

The Dog Mountain well in Section 10, Township 25 S. Range 31 East, obtained water and some gas and a number of similar wells have been sunk and abandoned in the territory.

The water of these wells is frequently saline, and the central part of this structure shows considerable salt on the surface.

Several of the wells appear to produce a wet hydrocarbon gas. Others show dry gasses of similar character.

The gas wells are nearly all off structure and have produced from recent alluvial fills which have trapped gas and fluid escaping from very small fissures below.

These showings are not attributable to other than petroliferous shales, sands, etc., existing below the surface of this area.

CONCLUSION.

The fact that the immediate surface of this basin is made up of sands and tuffaceous sedimentary deposits, lava flows and alluvium does not indicate the absence below these formations of oil in quantity, the reverse is proved in Mexico, Texas and elsewhere; Metamorphism from lava flows does not penetrate very deeply.

The basin carries a thick, or deep series of sedimentary rocks, largely Cretaceous and Tertiary, the first entirely marine, and the last named partly marine and partly lacustrine.

These rocks are among the greatest sources of oil on the Pacific Slope and elsewhere. The organic remains found in the course of this investigation are of sufficient extent to furnish materials for producing oil in quantity in the sedimentary rock series existing here.

The texture of sands, limestones and shales in this territory cannot now be determined closely, but it is not doubted that suitable porosity exists in certain strata to catch and retain oil.

FINAL RECOMMENDATIONS.

The general area is very interesting from a geological standpoint. The fact that it contains this large apparently perfect dome structure gives promise of great economic value through oil development.

All conditions are present to fully warrant the expenditure for drilling a test well on or near the structural high point as mapped and I would recommend that this should be done.

Very truly,

(signed) L. N. C. Ford

Dated at Portland, Oregon,
December 2, 1930

GEOLOGY OF HARNEY COUNTY

Findings of Charles F. Stone

"An inspection of the Harney County oil structure near Burns, Oregon, has convinced me we have something really worth while and worthy of real effort. I will give some of my views on formations and the theory upon which I base my opinion as to the merits of the country."

"The age of the formations is about as follows: The upper and lower Cretaceous, Jurassic, Permian, Pennsylvanian, Mississippian and Cambrian are all within reach of the drill. In those ages there are several changes all belonging to the same age in which they occur. On the contact of these various changes oil and gas will no doubt be found if folding and other conditions are favorable which they appear to be."

"The apparent formations within the various ages are approximately as follows: The surface is upper Cretaceous in the Niobrara formation to the depth of 1400 to 1600 feet where it should contact with the Frontier. The Frontier should contact with the Mowry at 650 feet deeper. The Mowry is about 350 feet thick and the Thermopolis 90 feet which takes us to the end of the Upper Cretaceous at which point the Dakota sand should occur with good chances for production. This, then, should be from 2,500 to 2,700 feet deep and at this point the Lower Cretaceous should begin with the Dakota sands 40 to 60 feet thick (and remember that five feet of this sand is sufficient for commercial production if properly saturated). This is followed by 100 feet of Fuston and 50 feet of Lakota at the bottom of the Lower Cretaceous."

"The Lakota is almost sure to produce Oil and Gas if folding is favorable."

"At the bottom of the Lakota the Jurassic age begins with the Morrison about 250 feet thick and the Sundance following about 600 feet thick at which point the Permian and Pennsylvanian begin. Following this about 1,200 feet of Chugwater, 650 feet of Embar and 450 feet of Tensleep at the bottom of which the Mississippian begins and is 350 feet thick which consists of limestone."

"The formations above the Mississippian all consist of shales and sandstones with small quantities of limestone and there are production possibilities on the contact of nearly all of them if proper folding occurs which the surface indicates to be a fact."

"The formations in this field are of the same character as those of Wyoming fields upon which the above data is based. Further, it is significant that these formations produce a high grade of paraffine base oil".

"At various points where excavations or cuts have been made oil sands may be seen very close to the surface, proving the formation to be oil bearing. Fossils exposed on the hills above the fold prove the various ages of formation."

"Considerable quantities of gas continually coming up with the water as it is pumped from numerous water wells within a very definite area, and the very clear globules of oil on top of this water when left standing, certainly prove the presence of oil structure."

"Further, there is nothing to indicate that the structure has been broken up, while on the contrary there are many indications of the existence of a very large field."