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ROCKY MOUNTAIN SECTION MEETING
 BILLINGS, FEBRUARY 14-16, 1955
 ABSTRACTS

I. PREJUDICE, PROGRESS, AND PROMISE IN ROCKY MOUNTAIN OIL EXPLORATION.
 L. L. SLOSS, Northwestern University, Evanston, Illinois.

The evolution of an exploration philosophy in the Rocky Mountain area can be reviewed in terms of the new areas involved in each successive wave of exploratory vigor. Such an analysis indicates an exploration history which comprises five episodes, each dominated by a set of guiding principles, controlled by the available data and tools, and governed by the economics of the times: (1) discoveries related to seeps and other near-surface indications; (2) the location of major surface structures and the establishment of production in the majority of Rocky Mountain provinces; (3) detailed surface mapping, leading to the discovery of further anticlinal accumulations; (4) widespread application of geophysical tools, coupled with deeper drilling on known features; (5) geophysical and subsurface geology applied to the refinement of deeply buried structures and structural-stratigraphic traps. Signs of the emergence of a new era can be seen.

During each of these episodes certain areas and certain parts of the stratigraphic section were condemned without trial; some for economic reasons which no longer pertain, others on the basis of a variety of geologic concepts developed to satisfy a local situation and then applied broadly as sweeping generalizations. Examination of the complex tectonic and depositional history of the Rocky Mountain area suggests that at least six successive and different patterns have been impressed upon the structural and stratigraphic record. In terms of oil accumulation each pattern may be shown to have its own internal constitution, governed by tectonics, environment, and sediment-source, and an independent set of potential truncation and permeability traps related to post-depositional events. No condemning generalization arrived at through experience with one of these varying patterns may safely be applied to the others and no area may be considered non-productive until the inherent possibilities of each pattern represented are tested.

It may be shown that every major oil accumulation in the area is related to a combination of structural and stratigraphic conditions with increasing evidence to indicate that stratigraphic controls are dominant. Many of the stratigraphic factors can be analyzed through study of the rocks themselves and by interpretation of their geophysical responses. With the abundant outcrops of the Rocky Mountain area, the increasing availability of subsurface data, and the developing know-how whereby these data may be related to oil occurrence, there remains a broad and encouraging field for an expanding exploration program.

2. BEAVER LODGE AND TIOGA FIELDS, MOUNTRAIL AND WILLIAMS COUNTIES, NORTH DAKOTA.
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This report reviews the history of exploration on the Nesson anticline leading to the discoveries of the Beaver Lodge and Tioga fields. The point is made that the discoveries were the result of good geological and geophysical work combined with economics, geology, and good fortune.

The structure of these fields is thought to be due to faulting in the basement which has been intermittently active since Ordovician time. Indirect evidence also suggests cross faulting to the main Nesson anticline trend.

The producing reservoirs are now entirely in porous zones in the upper part of the Mission Canyon formation of the Madison group of Mississippian age. Productive reservoirs are known in the formations of Devonian and Silurian age although they are not producing at present. The Mission Canyon formation is light gray to brownish gray limestone with oölitic and fragmental to finely crystalline texture. The porosity is most marked in the upper 200 feet of the formation.

The reservoirs of the Beaver Lodge and Tioga Madison pools appear to be water-drive and possible gas-expansion types. The reservoirs are still above bubble point and no secondary gas cap is believed to be forming. Gas-oil ratio for both fields averages about 1,100:1, and reservoir pressures at present are 3,270 for Beaver Lodge and 3,188 pounds for Tioga. Reserves in the Mission Canyon pay for Beaver Lodge are estimated to be 155 million barrels; for Tioga 57 million barrels. API gravity of the oil in Beaver Lodge is 43.1°; in Tioga 42.5°. The MER of the fields is not known positively, but it has been suggested that the MER for Beaver Lodge is 15,000 barrels daily and a MER of 10,000 barrels per day for Tioga.

Conservation laws were in effect when these fields were discovered and the fields are being developed along sound lines of conservation. Production is limited to an amount which does not exceed the reasonable market demand.

3. NORTHWEST SUMATRA FIELD, ROSEBUD COUNTY, MONTANA.
J. THOMAS LLEWELLYN, Honolulu Oil Corporation, Billings, Montana.

The Northwest Sumatra oil field, located on the Central Montana uplift, was discovered in July, 1952. The discovery well, The Texas Company's Grebe No. 1, was located on the basis of seismic investigations by The Texas Company. This geophysical work indicated slight seismic closure on one of the *en echelon* folds characterizing the Central Montana uplift between Ragged Point Dome on the west and Ingomar Dome on the east.

The surface formation in the field is Upper Cretaceous in age. The stratigraphic section drilled in the area consists of Cretaceous, Jurassic, Pennsylvanian, and Mississippian rocks. Oil is obtained from lenticular sands developed in two zones in the Upper Heath transition zone of Upper Mississippian age. The origin of these lenticular sands is attributable to sand-bar and dune development associated with estuarine and lagoonal conditions of deposition.

The maximum thickness of effective sand penetrated in any well is 148 feet, and the average effective sand thickness throughout the field is 46 feet. The production of oil is stratigraphically controlled by sand development, rather than structural position.

On December 1, 1954, 58 wells had been drilled in and adjacent to the field, of which 42 were producing, 15 were abandoned, and 1 was drilling. The 42 productive wells were producing about 3,900 barrels of oil a day. Production was restricted due to market outlet. There were, at that time, 1,680 acres, with an estimated recoverable reserve in excess of 30,000,000 barrels of oil with the field limits still undefined.

4. MANDERSON FIELD, BIG HORN COUNTY, WYOMING.
LOY E. HARRIS, Consultant, Basin, Wyoming.

The Manderson field on the Manderson anticline, which is a plunging structural nose about 12 miles long, is located on the eastern flank of the Big Horn basin in Big Horn County, Wyoming.

Seismic and subsurface information indicates no effective structural closure along the axis of this anticline to form a trap for the accumulation of oil and gas.

The facies change in the Phosphoria formation, from carbonates to redbeds takes place in an easterly direction across the southern end of the Big Horn basin.

By establishing a chert horizon as the dividing line between the productive and non-productive zones of the Phosphoria formation, the problem of locating stratigraphic traps is simplified. Isopach