

Overlapping marine Jurassic rocks cover most of the state, with clastics and sandstones in the west and relatively more limestone and evaporites in the east.

Marine Cretaceous rocks cover most of the state, and more than 4,000 feet were deposited in western North Dakota. Shallow Lower Cretaceous sandstones tentatively correlated with the Newcastle of the Black Hills offer interesting possibilities where they pinch out to the east and north in the central and southeastern part of the state.

Non-marine Tertiary sediments cover most of western North Dakota.

The stratigraphy of North Dakota is inadequately known. No great tectonism or facies variations are expected to be found, but further knowledge of the details of the offlap and onlap relations of the sediments and the gentle folding during the Paleozoic may lead to further oil exploration based on stratigraphic information.

17. JOHN PAUL GRIES, South Dakota School of Mines, Rapid City, South Dakota
Stratigraphic Traps on the South Edge of the Williston Basin

The entire Ordovician, Silurian, Devonian, and upper Mississippian sections pinch out around the southern margin of the Williston basin. On the southeastern edge, the Pennsylvanian, Permian and Triassic also pinch out beneath the pre-Sundance unconformity.

Upper Cretaceous sands, whose source is to the east, pinch out on the west flank of the basin.

Variations in quality, quantity and artesian pressure within the Pahasapa, Minnelusa, and Sundance formations also suggest effective barriers to circulation of fluids within these formations.

18. WILLARD PYE, North Dakota Agricultural College, Fargo, North Dakota
Relationship of Oil Accumulation to Paleogeology and Structure in Manitoba, Eastern North and South Dakota

The eastern side of the Williston basin is bounded by the pre-Cambrian rocks of the Canadian shield. These pre-Cambrian rocks gradually slope westward toward the center of the basin. Paleogeological maps show the successive eastward overlapping of the seas upon this shelf in Cambrian and Ordovician times and the successive off-lapping during each period from Silurian throughout the remainder of the Paleozoic era. The Mesozoic era again saw a general increasing eastward overlap of sediments in each new period. A study of the lithology and isopach relationships indicates that the center of the basin has not always been located along its present axis and that the seas had a variety of generally westward connections.

Structures in the pre-Cambrian in Manitoba, North and South Dakota can be traced into the sedimentary basin and can be followed in the sediments both through structural and lithological studies. Where these structures, as well as structures originating in the sedimentary basin, cross lithological changes as shown on isopach and paleogeological maps, there is considerable promise of oil accumulation. That such accumulation may be present in certain areas is indicated in some cases by surface evidence.

19. E. H. STEVENS, South Dakota School of Mines, Rapid City, South Dakota
Surficial Faults Along the Missouri River

A fault system is described that is located in Armstrong County in central South Dakota. Superficially it is similar to the system described by Hollinger in the Ironstone district in England. The fault spacing is fairly close, the displacement usually small and the individual faults are commonly upthrown toward the Missouri River. The Ironstone faults were ascribed to the tilting of vertically jointed blocks toward the valleys under the influence of gravity. As some of the faults in the South Dakota area are fifteen miles from the major stream valley the force developed by gravity would not seem adequate. If these faults are surficial the writer suggests that a tangential stress may have been stored in the rocks since the folding of the Lemmon syncline and that the cutting of the rivers relieved these stresses permitting the adjacent rocks to move toward the valleys. Because relief would be easier near the surface there would be a tilting of joint blocks toward the river with a small fault displacement at each joint. A weak point in this mechanism is that there is some evidence suggesting that the faults extend below the bed of the Missouri River.

20. W. L. HERSHELMAN, Ohio Oil Company, Sidney, Nebraska
Developments in the Julesburg Basin During 1951

The year 1951 represented the current peak of activity in the structural basin, located in western Nebraska, northeastern Colorado, southeastern Wyoming, northwestern Kansas, and known as the Julesburg basin. Three of the four phases of finding and development reached all-time peaks during 1951. The leasing phase reached its peak in 1950 but extended into 1951 at a high level. Exploration drilling, exploitation drilling, and geophysical programming resulted in the drilling of 453 wells. 187 wells were drilled in the Nebraska part of the basin, 260 wells were drilled in the Colorado part, and Wyoming and Kansas were represented with four and two wells, respectively.

111 wildcats were drilled in the Nebraska part of the basin and resulted in the discovery of 15 new

pools. 14 of the new finds in Nebraska were oil or oil and gas, and one discovery was exclusively gas.

In the Colorado part of the basin, 132 wildcat wells resulted in 14 discoveries. 12 of the Colorado discoveries were oil or oil and gas, and two were gas.

All of the foregoing discoveries were on structural or stratigraphic traps in the Cretaceous sands of the basin. Kansas, however, was credited with a small discovery in the Pennsylvanian part of the section.

21. B. F. CURTIS AND J. H. GOTH, Continental Oil Company, Denver, Colorado
Geologic History of the Las Animas Arch, Colorado

A complex anticlinal flexure about 70 miles wide extends northeastward from central Bent County into Kit Carson County, Colorado. This fold, called the Las Animas arch, appears on structural maps of post-Permian beds to be the north-plunging nose of the Sierra Grande arch of northeastern New Mexico. But pre-Pennsylvanian structural maps show that the Las Animas and Sierra Grande arches are separated by a trough which was progressively downwarped in Pennsylvanian and Permian time. The Las Animas arch developed its anticlinal structure only because of relatively greater downwarping of regions on its flanks. Sedimentary formations extend across the arch without local facies change and with only gradual, unidirectional changes of thickness.

From pre-Cambrian through Mississippian time shallow-water-type marine beds were intermittently deposited uniformly over the arch area. In late Mississippian time these beds were tilted eastward and slightly beveled. This was followed by downwarping south and west of the arch in the Pennsylvanian and Permian. In Triassic and Jurassic the arch and the region about it had a mildly negative structural tendency and then became part of the Cretaceous geosyncline, receiving sediments similar in thickness and type to those of surrounding regions. When the Denver basin and the Hugoton embayment were formed in late Cretaceous or Tertiary time, or both, the Las Animas arch retained its positive tendency relative to the basins.

22. W. ALAN STEWART, Colorado School of Mines, Golden, Colorado
Structure and Oil Possibilities of the West Flank of the Denver Basin

A seismic survey was conducted by members of the geology and geophysical departments of the Colorado School of Mines in the summer of 1951 along the west flank of the Denver basin. Its purpose was to determine the subsurface structure and relate it to surface features. Most of the work was correlation reflection shooting with some refraction work near the mountain front. A number of pertinent structural data were obtained. The Golden fault, a major reverse fault cutting across the steep west flank of the basin is a low angle overthrust, and not a high angle upthrust as commonly believed. The diagonal and en echelon plunging folds common along the mountain front north of Denver are present in the underthrust block of the fault. At least two lines of folding exist paralleled to the axis of the Front Range, one of which is effectively concealed by thrust faulting. The deepest part of the Denver basin lies just southeast of the Denver city limits with the lowest closing contour on the Dakota sandstone at about -4,900 feet, or roughly 10,000 feet deep.

23. RALPH ESPACH, U. S. Bureau of Mines, Laramie, Wyoming
Sulfur in Wyoming

Sulfur was an article of commerce in Wyoming as early as 1906. It was not of real economic significance however until 1950 when it was produced at the rate of over 300 tons a day. The availability of hydrogen sulphide in millions of cubic feet a day as a component of some natural gases and in solution in some crude oils and the availability of a process to convert the sulphide to sulphur made this possible. The reserves of hydrogen sulphide are of such magnitude that 450 long tons a day of sulfur (or, in terms of sulphuric acid, 1,600 to 2,300 tons a day depending on concentration) can be made available over a 25-year period, totaling over 5 million tons. The raw material for a sulphuric acid industry is available in amounts that would appear more than adequate as part basis for establishing other new industries in the region.

24. L. E. HARRIS, General Petroleum Corporation, Basin, Wyoming
Manderson Phosphoria Discovery, Big Horn County, Wyoming

General Petroleum Corporation's well, Mabel West No. 1 (34-20-G), Center SE, NW, Sec. 20, T. 50 N., R. 92 W., Big Horn County, Wyoming, discovery well in the Manderson field, was completed in the Phosphoria limestone at a plugged back depth of 7,340. This well had penetrated the Madison at a total depth of 8,080. The well flowed from the Phosphoria, at an initial rate of 500 bbls./day of 37.1 gravity, brown oil, and a gas oil ratio of approximately 11,300. The gas contained 23.2 per cent hydrogen sulphide. The well is presently shut in and additional drilling deferred pending unitization of the area and development of facilities to process the hydrogen sulphide gas.

Maps are presented showing surface geology and structure. Characteristics of the Phosphoria producing zone are discussed.