11. FRED S. HONKALA, Montana State University, Missoula, Montana, and KENNETH P. MCLAUGHLIN, Montana State University, Missoula, Montana, "Central Montana Tectonics."

The major tectonic elements of Central Montana include: (1) the Little Belt-Big Snowy-Porcupine anticlinorium, (2) the northern High Plains region with its igneous intrusions, (3) the Sweetgrass arch, and (4) a southern area that consists of the Crazy Mountain syncline, Lake Basin fault zone, and the northern end of the Bighorn-Pryor uplift. The economic and academic significance of these features and their important subdivisions are reviewed.

The literature is reviewed in an effort to present a picture of the geological development of these tectonic elements. In order to do this, outstanding contributions including those by Erdmann, by Sloss, and by other geologists have been slightly modified by use of new information available at this time. Revised isopach maps and generalized lithofacies maps are presented for central Montana for the Madison-Colorado shale interval.

The effect or significance of certain features or conditions is discussed. These include: (1) the generally positive Sweetgrass arch, (2) the generally negative Beltan (Montana) trough-Big Snowy axis, (3) shallow and deep-seated igneous intrusives of the High Plains, (4) *en échelon* faults in central Montana, and (5) thrust faulting east of the main Rocky Mountain front.

12. PAUL J. LEWIS, Billings Geological Service, Bismarck, North Dakota, "Ordovician of the Williston Basin."

The discovery of oil in sediments of Ordovician age in the Williston basin has required detailed analysis and correlation of various recognizable units. The outcrop areas on the fringes of the basin show Champlainian and Cincinnatian sediments.

The central area of the Williston basin contains a much greater thickness of Ordovician sediments. Possible correlations of the central area and the outcrops are discussed. Change of facies within the carbonate formations are noted.

The textural characteristics of the producing section and other zones are presented by microphotographs.

13. MILES T. RADER, JR., U. S. Smelting, Refining and Mining Company, Billings, Montana, "Silurian Carbonates in the Williston Basin."

Following a brief discussion of the history of the recognition of the age of these beds in the basin, isopach and cross sections are presented in an effort to delineate their present extent and to infer their original extent. A description of the rocks is followed by an attempt to explain the environment of their deposition. Fields in which these beds produce (or produced) oil are noted and discussed.

14. ANDREW D. BAILLIE, Manitoba Mines Branch, Winnipeg, Canada, "Devonian System of the Williston Basin Area."

The Devonian system in Manitoba, Saskatchewan, North Dakota, and eastern Montana comprises four major lithologic units of group rank that are named in ascending order: Elk Point, Manitoba, Saskatchewan, and Qu'Appelle. Isopach, lithofacies, tectonic, and environmental maps are employed to present the gross lithologic character and depositional history of each group.

The Elk Point group consists principally of carbonate and evaporite strata and exhibits marked tectonic differentiation into shelf and basin areas. The shelf areas are characterized by normal marine carbonate deposition that includes biohermal-type reefs. The basin area, sharply delineated by isopach and lithofacies patterns, consists of strata that include salt and anhydrite (Prairie evaporite) as much as 600 feet thick. The thickness of the Elk Point group exceeds 700 feet in the basin and thins to a few feet in peripheral areas on the south where near-shore and transitional deposits are recognized.

The Manitoba group consists predominantly of normal marine carbonate strata with several thin persistent argillaceous zones and beds of anhydrite. A basin of limited areal extent contains as much as 300 feet of salt and anhydrite (Davidson evaporite) in central Saskatchewan. Repetitive lithologic sequences suggest a cyclical type of deposition and rhythmic environmental changes. The lowest complete cycle is named the Dawson Bay formation. The group ranges in thickness from 200 to 800 feet.

The Saskatchewan group consists of shelf-type carbonate strata as much as 1,000 feet thick. Two fragmental and reefoid units exhibit marked lateral persistence throughout the area. The upper reefoid unit is correlated with the Nisku member of the Winterburn formation of central Alberta.

The Qu'Appelle group consists of an assemblage of red argillaceous siltstone and dolomitic shales in the east and becomes anhydritic in the west. A persistent silt zone marks the base of the unit. The upper contact is placed at the base of a widespread black bituminous shale that constitutes the lowest black shale zone of the Exshaw formation.

15. H. MACK COX, consultant geologist, Billings, Montana, "Williston Basin—Mississippian Reservoir Characteristics—and Proved Reserves."

Since the Clarence Iverson Madison discovery in December, 1951, the Williston basin has indi-