Three widely separated areas in North America (central Alberta, Canada; San Juan Basin, New Mexico and Colorado; and Wheeler Ridge anticline, San Joaquin Valley, California) have anomalous potentials and salinities that may be explained by the movement of water cross-formationally through shales acting as semi-permeable membranes. Pressure and salinity anomalies from other areas possibly may be explained by shale-membrane phenomena.

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Richey Field, Montana

The Richey field was discovered in July, 1951, by the Shell Oil Company No. 1 Northern Pacific, SE. NW. NW. Sec. 19, T. 23 N., R. 50 E., Dawson County, Montana, with completion in the Charles formation of Mississippian age. Subsequent wells also established production in the Mississippian Mission Canyon formation. This was the first commercial oil discovery in the Montana portion of the Williston Basin.

Regionally, the Richey field is situated on the west flank of the Williston Basin paralleling the Calf Creek-Weldon lineament and is believed to be tectonically related to it. The local structure is a northeasterly trending anticline with a normal fault parallel with the northwest flank, and a transverse fault across its south end. A structural closure of approximately 100 feet is indicated. The oil accumulation is controlled primarily by structure, but modified by a decrease in porosity along the southeast flank.

The Charles reservoirs contain the bulk of the oil reserves at Richey and consist of three zones of fractured limestone and dolomite with intercrystalline porosity having an aggregate average net pay thickness of about 35 feet. The Mission Canyon reservoir consists of very finely crystalline to dense limestone in which porosity occurs exclusively as fractures. There is an average net pay thickness of 15 feet in this unit. An effective water drive is present in all reservoirs.

In general, the production has been characterized by a high initial potential, followed by an early and abnormally high water cut. It is indicated that with the established practice of commingling the Charles and Mission Canyon reservoirs, the highly vertically fractured Mission Canyon zone is produced beyond its maximum efficient rate of flow, resulting in a rapid water coning which suppresses oil production from the Charles zone. It is indicated the ultimate oil recovery will be considerably greater if the reservoirs are produced separately, and the Mission Canyon at a low rate.

Development is on an 80-acre pattern. There are presently 12 producing wells in the field. Cumulative production to December 1, 1959, was 1,239,000 barrels of oil. Current monthly production is about 20,000 barrels of oil. Approximately 1,700 acres are considered proved productive with an estimated recoverable reserve of 5,000,000 barrels of oil.

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Mississippian in Alberta Plains and the Reflection Seismograph

The eroded Mississippian surface is the major unconformity in the Province of Alberta. To map its erosional highs and lows is most important, because the Mississippian may be productive of hydrocarbons or may cloak the attitude of deeper sediments from which production is sought. This paper deals with the methods of presentation of reflection seismic data to that end, together with a suggested recording instrument technique. Some of the interpretive problems, and the possible significance of Mississippian porosity on the acoustic impedance of its reflection are mentioned.

Maps of similar data, one geological and the other reflection seismic, are presented for comparison. The former is obtained from drilled wells and the latter from reflection shooting performed prior to drilling.

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Mesaverde Group in Adjoining Areas of Utah, Colorado, and Wyoming

The mixed marine and nonmarine Mesaverde group (Late Cretaceous) overlies and intertongues with the marine Mancos shale or its equivalents and underlies and intertongues with the marine Lewis shale or underlies continental rocks of latest Cretaceous or Paleocene age. The area studied is approximately 200 miles square on both sides of the Wyoming and Utah-Colorado state line.

Formations and members in 7 smaller geographic subdivisions are described and related in terms of Lee's (1915) genetic units to a standard four-fold section in the Rock Springs uplift consisting from oldest to youngest of the Blair, Rock Springs, Ericson, and Almond formations.

Data from 14 measured surface sections and more than 120 wells were used to make isopach maps of individual formations, members and tongues. These maps show that basins and relative arches of Late Cretaceous time correspond fairly well with those of Tertiary time and that the maximum thickness of a genetic unit is at the zone of transition from continental to marine sedimentation.

Numerous minor transgressions and regressions of the sea are imposed on a general eastward regression during Mesaverde time followed by a major transgression during Lewis time and a complete withdrawal of the sea after Lewis time.

There are numerous cyclothems consisting of gray marine shale, tan marine siltstone and sandstone, gray and white beach sandstone, coal, brown carbonaceous shale, and gray to brown carbonaceous siltstone. Both transgressive and regressive deposits are present.

Two probable controls of intertonguing are recognized: (1) intermittent delivery of sand and mud by streams along a subsiding delta front and reworking by marine currents; (2) several rather rapid changes of sealevel or landlevel, either tectonic or eustatic.

Most of the sediments were derived from areas west of the "Wasatch line." Toward the close of Mesaverde deposition, local uplifts in the site of the present Uinta Mountains and possibly the Wind River Mountain provided a source for sediments.

Short-ranging fossils are scarce in the Mesaverde group in this area. The marine shale tongues generally contain long-ranging arenaceous foraminifera and the marine sandstones contain *Ostrea sp.*, *Inoceramus sp.*, *Halymenites major* and worm tubes; the faunas are useful as indicators of paleoenvironments, but are not useful for stratigraphic correlations.

No new formation names are proposed. Several unnamed sequences should be mapped and traced laterally before they are named. The Lazeart sandstone is raised from member to formational rank. The Rimrock sandstone and the Asphalt Ridge sandstone of Walton (1944) are considered members of the Iles formation.

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Dodsland Field, Saskatchewan

The Dodsland field is situated in southwestern Sas-