of movement was generally northward and that greater movement occurred in the eastern part of the area than in the western part. Incompetent shale zones constituted gliding planes along which thrust movement took place, with the principal ones being the Womble shale, Springer formation, Caney shale, Stanley shale, and Johns Valley shale. One can postulate from indirect evidence the existence of an early period of faulting along the north margin of a late Mississippian-early-Pennsylvanian geosyncline. However, the structural development of the frontal Ouachitas started in Atoka time and continued until middle Pennsylvanian time and possibly as late as early Permian time.

Rocky Mountain Association of Geologists Symposium on Pennsylvanian Rocks of Colorado

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The Rocky Mountain Association of Geologists, Denver, Colorado, published in 1958 a volume with this title in conjunction with its field conference on Pennsylvanian rocks of the Maroon basin.

Pennsylvanian tectonism was dominated by vigorous growth of northwest-trending mountain ranges (Frontrangia and Uncompahgria) and their attendant depositional troughs. These obliterated the amoeboid patterns of gentle epeirogeny in Colorado established during early and middle Paleozoic time. Pennsylvanian depositional history began in Colorado with the accumulation of a red clay regolith, the Molas formation, upon the maturely dissected Mississippian Leadville limestone. Four Pennsylvanian basins (or troughs), the Denver, the Maroon, the Paradox, and the Raton, between and adjacent to Uncompahgria and Frontrangia, contain abundant thicknesses of all lithologic types common to cratonic sediments. Two basins in western Colorado, the Maroon and the Paradox, exhibit extensive evaporites, the Paradox and Eagle sequences. All the basins contain large volumes of red, arkosic conglomerates and finer clastics (the Fountain, Maroon, Cutler, and Sangre de Cristo formations) which grade laterally into marine limestones, shales, and sandstones with or without passing through an evaporite facies.

Western Colorado marine sequences bear the names Hermosa group, Morgan formation, and Weber sandstone. In the Raton basin the Sangre de Cristo and Madera formations, predominantly clastic, comprise the section. In the Denver basin, only the Fountain arkose facies crops out (except for a trace of Glen Eyrie claystone near Colorado Springs); the series terms Morrow, Atoka, Des Moines, Missouri, and Virgil have been borrowed from the Mid-Continent region as subdivisions.

The uplifts attained maximum development in the Des Moines epoch and continued tectonically active into middle Permian time. Pennsylvanian deposition carried over without hiatus into the Wolfcamp epoch of the Permian period. The existing Uncompaghre uplift and the Frontrange uplift (now masked by the Laramidian Front and Park Ranges) are part of the present tectonic pattern of Colorado.

The bulk of Colorado oil has been produced from three reservoir classes: (1) Cretaceous sandstone lenses scattered across the Denver basin, (2) the Weber sandstone of the Rangely pool in the Maroon basin, (3) the Hermosa carbonate reservoirs in the Paradox basin. The latter two, Permo-Pennsylvanian in age, are outstandingly important. The size and youth of Pennsylvanian carbonate pools indicate large reserves in these rocks.

Recent Developments in Alaska

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The discovery of commercially recoverable oil on the Kenai Peninsula by Richfield in 1957, coupled with the prior oil and gas discoveries made by the Navy in and adjacent to Naval Petroleum Reserve No. 4 in Northern Alaska, and the subsequent opening to public leasing of Interior Department lands east of the Reserve have caused the oil companies to renew their interest in Alaska.

A general review of Alaska indicates that there are nine potentially productive areas in the newest of the forty-nine states. The Cook Inlet area, which includes the Kenai Peninsula, is receiving the most active interest. Additional areas of interest are the Gulf of Alaska area which includes the now abandoned Katalla field, the Shelikof Strait area in which wells with shows of oil and gas have been drilled, and the North Coast area which contains Naval Petroleum Reserve No. 4 and adjacent lands. As yet no wells have been drilled in the Bristol Bay, Bethel, Yukon-Koyukuk and Upper Yukon areas; however, each is believed to contain favorable structures and sediments. The Copper River basin, in which one well has been drilled, is also included as a potential oil area.

The entire geological section from Precambrian to Recent is represented in Alaska. Numerous seeps have been reported in most of the potentially productive areas. In addition, oil and/or gas shows have been reported in the majority of the wells drilled in Alaska.

The geological section in each area is discussed briefly and a review is made of exploration to date.

The market and supply outlook for Alaska and the west coast of the United States is examined in order to illustrate the importance of Alaska as a potential source of crude oil for the west coast market.

A brief review is presented of the logistic problems encountered in Alaska, including transportation facilities, weather conditions, etc.

## New Upper Devonian Reef Producing Horizon, North-Central Alberta, Canada

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In early 1957 several oil and gas-distillate discoveries were completed in a large, previously untested area in central Alberta, 100–150 miles northwest of Edmonton. All of these discoveries were in a reef member of the Beaverhill Lake formation, the oldest formation of the Upper Devonian series. The area where reefing in the Beaverhill Lake is known to occur is 60 miles east and west and 50 miles north and south and includes the Swan Hills, Virginia Hills, and Kaybob oil fields.

When first encountered the reef was correlated with the Slave Point formation of Middle Devonian age, but subsequent detailed studies indicate this reef to be of slightly later age. George Fong, stratigrapher for Home Oil Company has proposed the name Swan Hills member for this reef developed in the Beaverhill Lake formation. Typically, this reef occurs in the lower part of the Beaverhill Lake formation and is a porous limestone composed of bioclastic material containing abundant stromatoporoids and amphiporoids with a notable lack of corals. The enclosing rock consists of interbedded calcareous shales and dense argillaceous limestones. As indicated by difference in water levels in the various fields, the reef member is discontinuous. The thickness of the reef ranges widely with maximum thickness of 475 feet in the area.

The base of the Swan Hills reef coincides with the base of the Beaverhill Lake formation and where developed to its maximum, extends up to the top of that formation. The Beaverhill Lake is underlain with no obvious nonconformity by the Elk Point Middle Devonian formation composed of dark green and red shales, sandstones, and minor anhydrite and limestones. The beds overlying the Beaverhill Lake in this area are locally referred to as the Shale unit, consisting of green calcareous shales and minor dense argillaceous limestone, equivalent to the Cooking Lake, Leduc (D-3), and Ireton of the Edmonton area.

At present insufficient drilling has taken place to permit speculation concerning factors that influence the location and build-up of reefs in this new producing area.