in these fields have been in progress for more than 2 decades, and, with the aid of Federal funds, now are expanding at a rate designed to insure adequate supplies of oil and gas at low cost in the future. Synthetic oil processes under development include a variety of coal-hydrogenation and gas-synthesis processes. To supplement natural gas, several processes are being studied for pipeline gas production by means of hydrogasification, or by partial or total gasification of the coal and converting the synthesis gas to high-BTU pipeline gas.

In support of these and many other coal-utilization development activities, fundamental studies are conducted in many universities, research institutes, and private and government laboratories.

12. DONALD S. STONE, Chevron Oil Company, Denver, Colorado

THEORY OF PALEOZOIC ACCUMULATION IN BIG HORN BASIN, WYOMING

A theory of hydrocarbon accumulation has been developed to account for the interrelations of stratigraphy, structure, and fluid distribution in the Paleozoic oil fields of the Big Horn basin, Wyoming. The proposed theory explains the common oil-water contacts observed in the majority of the multi-zoned Paleozoic anticlinal fields and the associated correlation between vertical oil column, formational thickness in the crestal area, and number of Paleozoic formations which are productive of hydrocarbons. Similar chemical composition of all Paleozoic crude oils (despite selective alteration effects) and of the associated formation waters, severe vertical density stratification of fluids in the multi-zoned fields with large oil columns, and some unusual reservoir-pressure relations are considered in support of the concept of a "common pool state." Several exceptional fields are explained as the result of post-accumulation modification of an original common pool.

The primary conclusion of this study is that essentially all the commercial hydrocarbons trapped in Paleozoic and Triassic reservoirs in the Big Horn basin (and probably all of western Wyoming) were generated in the euxinic, dark-colored, organic-rich and phosphatic, fine-grained rocks of the marine facies of the Permian Phosphoria (Park City) Formation. Similar dark-colored "source rocks" are essentially absent from the rest of the Paleozoic section in the Big Horn basin. Also, important intersystemic unconformities representing long periods of erosion appear to have eliminated effectively all sub-Phosphoria formations (except, locally, the underlying Tensleep Sandstone) as possible storage reservoirs for Paleozoic oil that might have migrated before the Laramide orogeny. Thus, considerable importance is attributed to the fact that stratigraphic accumulations of commercial significance occur only in Phosphoria rocks, whereas all production from pre-Phosphoria formations is associated with structural closure.

The proposed theory states that, as a consequence of early generation and probable pre-Middle Jurassic flush migration within the Phosphoria marine facies, indigenous hydrocarbons became stored in the ideal primary stratigraphic trap of the western Wyoming shelf area. In the Big Horn basin area, this trap was created by facies change updip toward the east and south, and pinch-out and truncation of the widely distributed reservoir carbonates of the Phosphoria Formation toward the north. In addition, some hydrocarbons probably were expelled during early diagenesis into the underlying Tensleep Sandstone and, because of eastward lateral migration beyond the area covered by marine Phosphoria rocks, became caught mainly in several truncational subcrop traps at the Phosphoria-Tensleep unconformity.

As a result of the formation of many large anticlinal traps, and concomitant fracturing and faulting, during the Late Cretaceous-early Tertiary Laramide orogeny, the hydrocarbons held within the regional Phosphoria stratigraphic trap were released and spread into older Paleozoic reservoir rocks until they were adjusted fully to structure in common pools with common oil-water contacts. Segregation of an original common pool into several separate pools was accomplished in some exceptional fields of the basin by (1) selective hydrodynamic tilting within the Tensleep zone, (2) leakage or redistribution of fluids through fault zones, or (3) escape of hydrocarbons to the surface and inspissation resulting from the breaching of the original Triassic cap rock.

13. RAYMOND G. MARVIN, King Resources Company, Denver, Colorado

FACIES CONTROL OF OIL OCCURRENCE IN MANNVILLE FORMATION IN SOUTHERN ALBERTA, CANADA

The Early Cretaceous Mannville Formation and its equivalents are widely distributed in the subsurface in the Western Canada basin east of the Rocky Mountains. The formation is divided into the lower Mannville, which ranges from marine in the north to non-marine in the south, and the upper Mannville, which is a mixture of marine and non-marine sediments. The Mannville Formation is of considerable economic importance, because the sandstone reservoirs contain substantial oil and gas reserves. This paper deals primarily with that part of southern Alberta from the International boundary to Twp. 30.

The surface on which the Mannville Formation was deposited developed during a long period of erosion. An angular unconformity separates the Mannville from the underlying Mississippian and Jurassic. The pre-Cretaceous erosion surface, though of low relief, influenced considerably the depositional pattern of the Mannville. Variations in the thickness of the Mannville are primarily the result of irregularities on this surface.

The lower Mannville of southern Alberta was deposited under fluvial conditions in a well-developed drainage system in which the streams flowed toward the north. Lower Mannville sediments are confined mostly to the channels of this drainage system. Production is from porous and permeable sandstone bodies which were deposited as the streams migrated across broad floodplains.

Lower Mannville sediments filled most of the low areas on the erosion surface, thereby leveling the surface by late Mannville time. By the end of this time, the filling of the drainage system was complete and uppermost Mannville sediments were distributed across the entire area. The lowermost unit in the upper Mannville is the "Glauconitic sandstone," which appears to be non-marine in southernmost Alberta, but becomes marine toward the north. The "Glauconitic sandstone" contains most of the upper Mannville hydrocarbons. The remainder of the upper Mannville appears to be non-marine.