dinner with the King at Fontainebleau. Present at this dinner was our ambassador to the Republic of Texas. He described that vast republic and talked about its tremendous resources. Remember, my darling, that one day, the Palace of the President of the Republic of Texas will be bigger and better than Fontainebleau."

I am telling you about this letter to show you that we French Texans have something in common with the real ones.

I would like to express my deep appreciation to The American Association of Petroleum Geologists for the privilege of being here today, and my thanks for this recognition of the contributions of Conrad and Marcel Schlumberger.

PIERRE SCHLUMBERGER

EASTERN SECTION AAPG 3RD ANNUAL MEETING Pittsburgh, Pennsylvania, April 18-19, 1974

"APPALACHIAN ENERGY"

Abstracts of Papers

BENNETT, W. E., Columbia Gas Transmission Corp.

Potential Gas Supply of Appalachians

No abstract available.

BLOOMER, G., Gulf Research and Development Co., Pittsburgh, Pa.

Significance of Deposition in Schenectady-Frankfort Formations (Upper Ordovician), New York

A petrologic and paleocurrent study of the Upper Ordovician Schenectady-Frankfort Formations does not support the commonly held supposition that the sediments were derived from the Taconic region of New England–New York.

The grain-size distribution, mineralogy, and paleocurrent direction of the Schenectady Formation indicate a complex source area south of the Mohawk Valley rather than an easterly source.

It is proposed that the source area for the Schenectady-Frankfort Formations was in the Reading Prong region of northern New Jersey–southeastern New York. It is also proposed that a southward-plunging north-south sedimentary barrier prevented the sediments on the east from penetrating as far west as the Schenectady basin.

BROWN, P. R., Hudson's Bay Oil and Gas Co., Ltd., Calgary, Alta., and H. BUCHANAN, West Virginia Univ.

Tectonic Diagenesis of Appalachian Middle Ordovician Carbonate Rocks—Significance to Resource Exploration

Middle Ordovician carbonate rocks with a variety of mud-supported to grain-supported textures have been sampled in the central and northern Appalachians. Progressive fabric alterations similar to those in older (Cambrian-Ordovician) mud-supported carbonates of the central Appalachians also are observed in the Middle Ordovician rocks. These alterations include increase in matrix (micrite) crystal size, elongation and increased preferred orientation of matrix crystals, increased twinning in echinoderm fragments, and progressive loss of original textures. Scanning electron microscopy of the Middle Ordovician carbonate rocks has revealed other progressive changes in microfabric including increased sinuosity of grain boundaries between matrix crystals.

The progressive alteration observed in these rocks evidently is related to increasing intensity of tectonic deformation. The tectonic factors responsible for the fabric alterations also act to destroy porosity and permeability and, in part, to effect the generation, migration, and ultimate destruction of hydrocarbons. Thus, studies of the fabric changes in carbonate rocks may provide valuable information on the possible occurrence of oil or gas in a basin or in a particular part of a basin being explored, regardless of whether or not the carbonate rocks themselves are potential reservoirs. A straightforward petrographic tool of this type would be especially valuable in exploration in the deeper Appalachian basins. Carbonate fabric studies also may be useful in the discovery and exploration of metallic deposits such as lead and zinc in the Appalachians.

CLIFFORD, M. J., Weaver Oil and Gas Corp., Houston, Tex., and H. R. COLLINS, Ohio Division of Geol. Survey, Columbus, Ohio

Structures of Southeastern Ohio

A review of structure data in southeastern Ohio indicates that the Burning Springs anticline and the Cambridge arch are the only valid structures of regional extent in the area. Recent mapping by the authors has clarified the relation between these elements.

The Burning Springs anticline previously has been shown to be the result of thin-skinned thrusting on a Silurian salt glide plane. The salt, now identified as the Salina F4, pinches out beneath the structure. The structure follows the western limit of the salt into southern Monroe County and there dies out.

The Cambrian arch follows the pinchout of the Salina E salt; east of the pinchout, elevations of the Pittsburgh coal (Pennsylvanian) are about 300 ft higher than in the west. There is only a gentle southeastward dip below the salt. The structure is interpreted to be the result of movement of a southeastward-thickening block of supra-Salina rocks northwestward along a salt glide plane. A postulated near vertical tear fault (or series of faults) marks the western limit of this movement.

The Parkersburg-Lorain syncline, often mentioned as lying west of the Cambridge arch, also is not present below the salt in the study area.

Production of hydrocarbons from Salina (Silurian), Oriskany (Devonian), and Berea (Mississippian) zones and from several Pennsylvanian sands appears to be associated with the Cambridge feature for at least 75 mi of its extent. The northward extension of the Burning Springs anticline into Ohio apparently localized production from Pennsylvanian and Mississippian sandstones in Washington and Monroe Counties.

DENNISON, J. M., Univ. of North Carolina, Chapel Hill, N.C.

Uranium Possibilities in Appalachians

Uranium oxides in the Chattanooga Shale constitute the largest total tonnage of uranium known in the United States, but the concentration is at best only about a hundredth of that necessary for present economic development. The highest tenors are in the upper five ft of the Chattanooga in the Highland Rim area of Tennessee.

Most large commercial uranium deposits in the United States are roll-type deposits formed in geochemical cells acting on a protore of arkosic, carbonaceous or pyritic, fluvial sandstone. The cells may concentrate uranium more than a thousandfold, but rarely exceed one-percent tenor in the narrow roll front. The best possibilities for commercial uranium in the Appalachians are in fluvial sandstones deposited after the development of abundant land plants. In addition to mineralogic composition and depositional environment, other important factors are paleocurrent trends, unconformities, changes in regional dip through time, and possible removal of uranium cells by Pleistocene glacial scouring. Significant uranium shows are present in Pennsylvania in fluvial-channel sandstones exhibiting evidence of geochemical cells, in both the Devonian Catskill Formation and the Mississippian Mauch Chunk Formation.

Out of 22 fluvial or possibly fluvial Appalachian stratigraphic units considered, the most promising ones for uranium exploration are the Devonian Hampshire and Catskill Formations from New York to Virginia, the Mississippian Mauch Chunk-Pennington Group from Pennsylvania to Tennessee, the Pennsylvanian Pottsville Group (especially in Alabama, Virginia, and southern West Virginia), the Pennsylvanian-Permian Dunkard Group in West Virginia, and the Triassic basins of the eastern Appalachians. The following units have moderate promise for uranium exploration: Cambrian Rome Formation from Virginia to Alabama; Ordovician Bays Formation from Virginia to Alabama; Ordovician Juniata Formation from Tennessee to Pennsylvania and equivalent Queenston Formation in New York; Silurian Bloomsburg Formation in Pennsylvania; Mississippian Pocono-Price Formation from New York to Virginia; Mississippian Maccrady-Stroubles Formation in Virginia and West Virginia; and Pennsylvanian Allegheny, Conemaugh, and Monongahela Groups from Pennsylvania to Kentucky.

A few uranium shows have been reported from pegmatites and other igneous rocks in the Blue Ridge, but far below commercial concentrations. None of the dikes cutting the Valley and Ridge and Plateau provinces have compositions associated geochemically with uranium, so prospecting them is probably futile.

DE WITT, W., JR., U.S. Geol. Survey, Beltsville, Md.

Petroleum Potential of Appalachian Basin

The Appalachian basin of the petroleum geologist, the birthplace of the oil industry, covers an area in the eastern United States of about 208,660 sq mi (540,450 sq km), which is divided into the oil-productive Appalachian Plateau segment of 172,000 sq mi (424,300 sq km) and the less favorable, structurally complex Valley and Ridge segment of 45,000 sq mi (116,000 sq km). The Appalachian basin contains at least 350,000 cu mi (1,460,000 cu km) of Paleozoic sedimentary rock, almost equally divided between the plateaus and the Valley and Ridge segments.

More than 2.5×10^9 bbl of oil has been produced almost exclusively from the rocks of the plateau segment; more than half of this volume, about 1.68×10^9 bbl has been extracted from Devonian rocks at depths of less than 1 mi (1.6 km).

Remaining reserves producible by present methods at existing prices for crude oil are estimated to range from 2.6×10^6 to 3.4×10^6 bbl, an amount slightly larger than one tenth the volume produced in the past 113 years. In contrast, the amount of oil originally in place that remains after efforts to extract it, is estimated to range from 10×10^9 to 12×10^9 bbl. Most of this oil, however, is locked in and economically unproducible by existing methods. Recovery of even a modest fraction of this oil will require (1) extensive drilling in the deeper, largely untested parts of the Appalachian Plateau segment of the basin; (2) exploration in the more favorable parts of the Valley and Ridge segment; (3) drilling offshore in Lake Erie; (4) application of established secondary- and tertiary-recovery methods to old and long abandoned producing areas; and (5) the development of new and imaginative techniques to extract more of the remaining oil from the rocks of the Appalachian basin.

FALKIE, T. V., Director, U.S. Bureau of Mines, Washington, D.C.

Energy Reserves of Appalachian Area

No abstract available.

HAAS, M. W., Exxon Co., Houston, Tex.

Energy: The Future is Now

No abstract available.

HARRIS, L. D., U.S. Geol. Survey, Knoxville, Tenn.

Cambrian Facies Trends—Tool for Estimating Shortening in Southern Valley and Ridge Province

Regional stratigraphic study of the Nolichucky Shale (Upper Cambrian) northwest of the Saltville thrust fault in the Oak Ridge–Knoxville area, Tennessee, delineated the areal extent of a large lobate algal stromatolite bank. Because the bank has limited geographic distribution, it was possible to identify its edge from northwest to southeast, in the Pine Mountain, Wallen Valley, Clinchport, and Copper Creek fault belts. These thrust faults strike at an oblique angle to the original trend of the algal bank, so that from northwest to southeast different parts of the bank are juxtaposed. Facies changes within the bank sequence permit palinspastic restoration of the original bank that indicates the total movement of the Pine Mountain, Wallen Valley, Clinchport, and Copper Creek thrust faults is about 40 mi (64 km). Although these data are limited to the west half of the Valley and Ridge, continuing study toward the south and east may lead to an estimation of total shortening across the entire Valley and Ridge province.

HEA, J. P., Weaver Oil & Gas Corp., Houston, Tex.

Exploration Concepts in Deformed Belt of Appalachians

The deformed belt of the Appalachians consists of the fold-and-thrust structures of the Valley and Ridge and the adjoining Appalachian Plateau provinces. The Blue Ridge and Piedmont provinces are excluded from this belt as being unprospective for petroleum. The deformed belt contains four morphostructural zones, from northwest to southeast, the *folded foreland* (southeastern Appalachian Plateau), the frontal imbricates (Nittany anticlinorium, Wills Mountain–Friends Cove anticlinorium), the *interthrust syncline* (Broadtop synclinorium, Greendale-Kimberling syncline) and the *back imbricates* (North Mountain-Pulaski system). Major types of potential hydrocarbon traps were formed by thrusting in these zones; these include opposed-thrust anticlines, step fold- and anticline-forming thrust sheets, concentric folds, stack-thrust anticlines, and leading- and trailing-edge imbricates. The role of salt, rock competency, sheet thickness and length, tectonic transport, and thrust ramping are the critical factors in the formation of the traps.

Along the strike of the Appalachians, the deformed belt consists of three main arcs which are convex northwestward and display changes in strike and dominant structures. The *southern arc* extends southwest of Roanoke, Virginia; the *central arc* extends from Roanoke to the Hudson River; and the *northern arc* extends from New York to the Gulf of St. Lawrence. A fourth arc begins offshore of western Newfoundland and extends into the Atlantic Ocean where it terminates at the continental margin. Main and secondary arcs are linked at basement nodes. These include the Anticosti platform, the Quebec arch, and the Adirondacks in the north, and the Roanoke(?) and Cartersville recesses in the south.

The component arcs of the Appalachians evolved with different histories subsequent to the quiescent, carbonate-shelf deposition of the Cambrian and Early Ordovician Periods. The *northern arc* was deformed by the Taconian orogeny, has thick Upper Ordovician to Devonian flysch, and was intensely thrusted during the Acadian orogeny. The *central arc* was moderately deformed during the Taconian orogeny, was a source proximal, thick depocenter during the Late Paleozoic and principally was folded and thrusted during the Appalachian orogeny. The *southern arc* was an unstable platform until the Appalachian orogeny, when it was intensely thrust-faulted.

The petroleum potential of the deformed belt is described in relation to its structures and reservoirs. Beginning in the Ordovician, the southeast mobile flank of the Appalachians was deformed and uplifted. Hydrocarbons may have been trapped in the reservoirs of early formed folds which subsequently were relocalized by later thrusting into antiform traps. Thrust structures form large "slab" traps having a high drainage volume for early and late hydrocarbon accumulations. The structures con-