into Montana. The dimensions are 1,065 miles in length and an average width of 80 miles. Structurally, and thus scenically, they are unique as compared to the Mackenzie Mountains to the north and the central and southern Rockies to the south; this striking difference is principally due to an origin of extreme shortening by means of a series of flat, superimposed thrust faults as opposed to an origin dominated by vertical uplift both to the north and to the south.

The age of the Rocky Mountains has been determined as Eocene-Oligocene on the basis of very extensive studies of the derived sediments. By comparison, the age of the plutonization of the Western Cordillera is principally Jurassic-Cretaceous transition on the basis of recorded geological relationships or 100 plus or minus 10 m. y. on the basis of extensive radioactive dating.

The Rockies are made up of shelf sediments aggregating 20,000 feet at their eastern edge; by contrast, the Western Cordillera is typified by extensive plutonization of the thick sediments and volcanics of a eugeosyncline.

Shortening of the shelf sediments across the southern part of the Canadian Rockies is probably in excess of 100 miles, which has been accomplished by stacking of sediments on a rather uniform system of superimposed thrust faults, but without disrupting the underlying shield to any known extent. The restoration of these sediments to their pre-Laramide position requires that the adjacent plutonized complex of the Western Cordillera must also be restored a somewhat similar distance to the west. Such a restoration sets back the indented western continental margin of Canada and the Alaska panhandle and puts it into alignment with the western continental margin of the United States. The realization of such differential movement along the western continental margin of North America in the Tertiary and the attendant tensional junctions explains many anomalous conditions in the northwestern states and southern Alaska. The cause of such differential movement is much more speculative. An acceptable explanation appears to be that the rigid, simatic Pacific plate has underthrust the continental margin of the United States whereas it has pushed the continental margin of Canada ahead of it.

The eastern slope or "Foothills" of the Canadian Rockies has been an active exploration area for oil and gas since the turn of the century. Western Canada's "original" oil discovery of 1902 was made in Waterton National Park. The historic Turner Valley oil and gas field was Canada's first major discovery. Since then more than 20 gas and condensate discoveries have made the Foothills one of Canada's main gas supply areas, and as a consequence of the more than 60 years of exploration, an unusual amount of factual, three-dimensional information can be applied to structural interpretation.

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December 14, 1964

EDWARD F. HAYE, Photogravity Co., Inc., Houston

"Photography and Geophysics"

There are many ways in which surface geology can be useful to geophysics, not only as an aid to structural interpretation, but in refining the accuracy and improving the efficiency of geophysical methods. That the vast majority of geophysical work has been accomplished in relative ignorance of the surface geology is unfortunate. Many specific examples of misinterpretation and waste can be attributed to a lack of consideration of surface geology. Because of this historical lack of surface geologic consideration, there is a large reservoir of data which can be high-graded and refined inexpensively. Photogeology is by far the most rapid, effective and inexpensive way to obtain surface geology.

Possibly the geophysical tool most critically affected by the surface geology is gravity. Newton's first Inverse Square Law states that density changes closest to the gravimeter affect it most critically. Practical ways in which gravity and seismic data can be refined by coordination with photogeology are cited and slides used to demonstrate the problems.

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January 4, 1965

WILLIAM H. McGUIRE, Consultant, Lexington

"Recent Developments in Eastern and Central Kentucky"

The renewed interest of the oil industry in deeper possibilities of the Appalachian basin, and the discovery of Cambrian production in Ohio, have resulted in leasing and drilling activity in Kentucky. The amount of acreage already under lease in-

dicates that 1965 will be an active exploration year in the state.

One well, in Montgomery County, drilled to the Cambrian basal arkose, and several wells drilled into the Knox dolomite in eastern and central Kentucky, have provided new subsurface information. The geological significance of recent drilling results is illustrated by structure and isopach maps, and by cross sections.

The Trapp gas field in Clark County is soon to be connected to central Kentucky markets by pipeline. This will be Kentucky's first commercial production from the St. Peter Sandstone. Possibilities of extending St. Peter production in the area are shown by isopach and structure maps.

Relationship of recent leasing activity to regional geology is discussed, and the need for geophysical surveys emphasized.

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January 18, 1965

ROBERT L. FOLK, Univ. of Texas, Austin

"Electron Microscopy of Carbonate Muds and Carbonate Rocks"

Electron microscopy reveals that modern caronate muds show great variation in properties and origin. Mud examples are shown from Yucatan, Florida Bay, Bahamas and the Deep Caribbean. Lithified limestones show many curious features, most of which are at present not easy to explain.

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February 1, 1965

J. A. KORNFELD, Kornfeld International, Tulsa

"Geology and Economics of North Sea Basin"

The North Sea basin represents the most active geophysical and drilling exploration area today in northern Europe. This petroliferous province comprises the offshore waters of seven nations which share offshore mineral rights including: England, Scotland, The Netherlands, Belgium, West Germany, Denmark and Norway.

The area encompassed by the North Sea basin comprises 220,000 square miles, comparable in size to the State of Texas.

The depth of water ranges from 100 feet in the south to 320 feet in the central portion, to 840 feet in the extreme northern portion.

Economic factors leading to the heavy concentration of exploration, exploitation, and capital investment in this vast, undrilled basin are:

1. Proximity to rich petroleum markets in the EEC (European Economic Community) and EFTA (European Free Trade Association) in the bordering countries;

2. Proximity to major crude-oil tanker terminals for marketing such as the port of London, Rotterdam-Europoort, Amsterdam, Antwerp, Hamburg, and Wilhelmshaven;

3. Existence of a series of major Paleozoic, Mesozoic, and Cenozoic basins with a maximum thickness of sedimentary beds of possibly 20,000 feet to the Precambrian basement;

4. Existence of a new, undrilled salt-dome province, comprised principally of piercement-type domes which are interspersed with highly-faulted horsts and grabens, accompanied by numerous facies occurrences in the Permian and Carboniferous systems, which are hydrocarbon-bearing peripheral to the basin in land areas in West Germany, The Netherlands, England, and Scotland; and

5. Existence of relatively shallow waters, averaging only 180 feet.

By the end of 1965, 14 rigs are expected to be active in the North Sea, of which 3 lie off West Germany, and the remainder off Great Britain. By the summer of 1966, at least 20 rigs will be at work.

Paleozoic targets range between 8,000 and 16,000 feet and up to 20,000 feet.

As to the overall investment, $300,000,000 has been pledged to date. This figure could rise to $500,000,000 for a single year in the event of successful and commercial discoveries of hydrocarbons.

Western European crude-oil demand, which exceeded 6,000,000 barrels a day during 1964, is expected to reach 10,000,000 barrels a day during 1975, and 13,500,000 barrels a day during 1985.

Western Europe consumes more than a billion barrels of petroleum a year or more than ten times as much hydrocarbons as she produces. Europe holds less than one per cent of the world's proved developed petroleum reserves and produces less than two per cent of the world's oil.

Discovery in 1959 by N. A. M., a Dutch company owned jointly by Jersey Standard and Royal Dutch-Shell, of one of the world's largest natural-gas fields at Groningen province, which borders the sea, aroused interest in the adjacent underwater area.

Three major sedimentary and structural basins are known from geophysical surveys: the Zechstein basin extension from West Germany, the British basin, and the Norwegian basin. Maximum depths to the