ments. Possible other deep-seated intrusives in the area domed overlying sediments, in some cases resulting in gas accumulations.

The Buttes gas field produces from lenticular Cretaceous sands in a trap which may have been further improved by the Buttes intrusion. Whereas the surface expression of the plug and distorted bordering sediments occupies an area of 20 square miles, the area beneath the surface which is influenced by this volcanic disturbance is at least 120 square miles.

J. P. Woods, Atlantic Refining Company, Dallas, Texas
Composition of Reflections

When all traces on a seismic-reflection record show about the same deflection at about the same time, the line-up is marked and called a seismic reflection. An important fact is forgotten. The fact is that the reflection seen on the record is almost invariably a composite of the various reflections caused by a set of closely spaced reflecting layers. When the arrangement of the layers in the set changes, the various reflections add together in a different way, and the character of the composite reflection seen on the record changes.

A series of artificial seismic records has been made to show this composition of reflections. The records were made by connecting a standard reflection seismograph to an acoustic model. The model was a 300-foot length of steel pipe with input and output transducers at one end. Records were made for a wedge, a pinch-out, a complex of thin layers, a sand bar, layers corresponding with well resistivity logs, and a regular layer system.

George C. Hepburn, Jr., Schlumberger Well Surveying Corporation
Geological Approach to Electric-Log Analysis

Use of electric-logging methods to gain more geological information involves knowledge of the lithologic conditions which affect logging measurements. Porosity, interstitial water resistivity, water saturation, permeability, and amount of shale have a definite relation to the recorded curves.

Recent advances in interpretive techniques make possible the determination of water saturation, porosity, and producible oil index by logging methods, even in shaly sands. Qualitative permeability is indicated by the SP curve or microlog-caliper, and under certain conditions can even be determined quantitatively.

Numerous examples are presented which indicate that every permeable formation, no matter how low its resistivity, should be considered potentially oil-bearing until a complete log interpretation has been made.

William Carruthers Gussow, consulting geologist, Calgary, Alberta
Problems of Oil Migration

Migration and accumulation of hydrocarbons conform with the simple laws of nature and logic. These governing principles are reviewed, both in the physical sense and in the sense of geologic time, and particularly from the standpoint of such concepts as distant source and regional migration, migration paths, differential entrapment, evolution of oils, and the significance of tar belts, interstitial or non-producible oil, synclinal oil, etc.

Robert B. Scott, The Texas Company, Bakersfield
Geology of North Arvin Field, Kern County, California

The North Arvin field is on the east side of the southern San Joaquin Valley approximately 13 miles southeast of Bakersfield. Production is from the non-marine (Pliocene-Miocene) Chanac formation and the marine (upper Miocene) Santa Margarita sand. A sub-commercial quantity of oil has been produced from the fractured metamorphic Basement Complex (Jurassic?). The thickness of sediments overlying the basement ranges from 5,000 to 7,000 feet, with the depth of wells averaging approximately 6,000 feet. The oil accumulation occurs on a regional southwesterly dipping homocline with closure effected primarily by the lensing of sands and to a lesser degree by faulting. The field was discovered on July 19, 1951, and has undergone almost continuous development from that date.

Robert H. Paschall, Hancock Oil Company, Ventura
Fourth Dimension in Oil-Trap Analysis

The time is past in which oil geologists needed prompting toward the search for stratigraphic as well as structural traps. However, the contemporary search for oil traps remains primarily a study in geometry. The prime requisite of a wildcat is that it be on a more or less provable closure, which may be either structural or stratigraphic in nature.

California, like many other oil-producing areas, has yielded a depressing collection of non-productive closures. It is evident that there must be a dimension, other than the three of geometry, which is critical in the formation of an oil-producing trap. It is suggested that the fourth dimension is one of time.

Field examples are afforded of two areas where presently mappable structural closures have been found devoid of commercial oil accumulations. An analysis of the time-sequence of structural deformation indicates that the barren closures were formed after regional oil migration had passed their sites.

Palinspastic restorations of another area, in which wildcatting has failed to find production along a belt of major overlaps, place these overlaps in their proper perspective relative to geologic history.

PARKE A. DICKEY AND RICHARD E. ROHN, The Carter Oil Company, Tulsa, Oklahoma
Facies Control of Oil Occurrence

Oil occurs in several different rock associations, but follows particular facies subdivisions within each type. In the micaceous sand and shale association, linear trends of pools are well developed and are parallel with lithologic ratio contours. Oil occurs also in similar rocks deposited in birdfoot deltas resembling the delta of the Mississippi. The zones favorable to the growth of reefs or bioherms are rigidly controlled by environment, and the occurrence of reefs can be related to the nature of their enclosing rocks. The widespread quartzose sands found associated with shelf limestones are permeable over large areas, and local pools are structurally controlled. This rock association is poor in organic matter, and the location of oil pools can be related to belts of oil-source facies in associated beds.

Lithologic conditions are important in deciding whether to lease and drill a prospect. In a large and growing number of cases where structural closure is absent, they are the only geological considerations. All types of lithologic and stratigraphic information can be shown quantitatively by contours in the same manner as structural data. Quantitative expressions provide the best means of presenting lithologic data areally. Such presentations permit the definition of areas lithologically favorable for oil occurrence.

JOHN P. LAVERY, JR., Reserve Oil and Gas Company, Bakersfield
Recent Developments—Tejon-Grapevine Field

The Tejon-Grapevine field is in the Tejon Embayment which is located in the southerly part of the San Joaquin Valley. The embayment is bordered on the south by the Tehachapi Mountains and on the east by the Sierra Nevada Range.

The mountainous areas consist of Jurassic basement rock with a border of Pleistocene to Eocene sediments exposed between basement and valley alluvium. The forces that uplifted these mountain ranges, nearly at right angles to each other, and the rapid drop off of basement developed complex fault patterns and numerous unconformities.

The Tejon-Grapevine field, central area, has six major producing zones of Miocene age: Transition, Santa Margarita, *Pulv.*, *Valv.*, Olcese, and JV sand. Prior to discovery of Olcese production in June, 1954, production was 1,285 B/D. In July, 1955, after Olcese and JV sand discoveries, production was 7,615 B/D. To date, no production has been found below the lower Miocene volcanics.

G. MOSES KNEBEL, president, A.A.P.G., Standard Oil Company of New Jersey
Habitat of Some Oil

Detailed statistics have been prepared and studied for 236 or all of the major fields of the free world. They represent 217 billion barrels, which is 82.5% of the free world's expected ultimate. The study shows the bulk of our oil occurs: (1) on the stable side of basins, (2) in anticlines, (3) in sandstone and carbonate reservoirs, (4) from formations of Mesozoic age or younger, and (5) from a depth range of 2,000 to 8,000 feet.

Most of the world's ultimate oil is 30° API or above, with mixed and asphaltic base oils predominating. The discovery of the big giants has been cyclic with 10-year intervals starting with the Lake Maracaibo discovery in 1917.

ROBIN B. WILLIS, Beloil Corporation, Ltd., Los Angeles
Huntington Beach Field—Townlot Extension

Beginning in January of this year and lasting into the summer, the City of Huntington Beach saw a flurry of townlot drilling much like the early townlot booms of Signal Hill and Huntington Beach. Wells were drilled on leases consisting of one or more 25×117-foot lots, averaging two wells to the acre. The reserves do not seem to justify this close spacing, a large part of the wells having already declined to near the economic limit. The geology uncovered gives a little more insight into the mechanics of the Inglewood fault, which in this case is a lateral-slip fault with associated vertical-slip "feather" faults, and a small fold related to the faulting. This small system resembles larger systems along the Inglewood fault line and is a near-replica of another system on the lateral-slip fault.

C. R. BALL AND S. F. FINE, Richfield Oil Corporation
Information vs. Cost in Exploratory Drilling

This is a two-part paper consisting of an analysis by an engineer of the costs of obtaining information in exploratory drilling, and a statement by a geologist of the basic information desired.