and 1.5 miles wide. The bay is bordered on the northwest by post-glacial marine deposits that have been modified into cuspate projections. Remnants of kames and moraines form the border on the east and south. Most of the bay is not more than 12 feet deep, but 3 basins range in depth from 24 to 30 feet.

Sediments are composed of gravel, sand, silt, clay, and shell debris. Excess current energy of incoming over outgoing tides causes shell debris to accumulate where otherwise only fine sediments might be expected. In some areas, calcium carbonate content of fine sediments is high due to large foraminiferal populations. Therefore, calcium carbonate percentage is high in both coarse and fine sediments, whereas organic carbon and nitrogen are high only in fine sediments. Quartz is the major constituent of the sands; larger grains are characteristically well rounded and frosted.

ALFRED R. LOEBLICH, JR., California Research Corporation; HELEN TAPPAN, University of California at Los Angeles: Foraminiferal Facts, Fallacies and Frontiers

Erroneous statistics applied to foraminiferal studies have resulted in misleading statements. The notorious volume of publications is a figment of thorough bibliographic documentation. The degree of classification and number of foraminiferal taxa are relatively conservative as compared to other invertebrate groups.

Unjustified interpretations have resulted from misapplication of concepts originally developed for metazoan invertebrates or vertebrates. Geographic "subspecies" can not be differentiated on size variation, as this results from environmentally controlled delay or acceleration of the reproductive cycle. Prolonged vegetative growth, with delayed cycle, results in robust specimens, thus to be expected with depauperate invertebrate faunas. Abundant material lessens the necessity of statistical methods of determining population characteristics from a few specimens. Evidence of floating bottles used in ocean current studies, even with the present relatively emergent continents, shows the migration time for planktonic species to be negligible. Effective rate of evolutionary changes in foraminifera is relatively rapid, due to short life span, abundant progeny, and rapid production of new generations.

Many detailed faunal and biostratigraphic studies are needed, as are studies of interrelationships of benthonic faunal facies and planktonic faunal zones. For many genera and families, little is known of gross external and internal test morphology and wall microstructure or morphology, physiology, genetics, life cycle, and ecology of the living animal.

WILLIAM W. LUMSDEN, Long Beach State College; TAKEO SUSUKI, University of California, Los Angeles: Middle Cambrian Section in Vicinity of Currant Creek, Nevada

A regional study of the White Pine Range, east-central Nevada, has disclosed in the vicinity of Currant Creek a previously undescribed Middle Cambrian section. Approximately 4,000 feet of strata composed dominantly of thin-bedded limestone and shales, lies directly above the Lower Cambrian Prospect Mountain quartzite, and below the Upper Cambrian Dunderberg formation.

Though faulted, the section has yielded rich trilobite faunas representing in ascending order the Middle Cambrian zones: *Albertella*, *Glossopleura* and *Bathyuriscus-Elrathina*. The *Bolaspidella* zone may be present but is not recognizable because of structural complexities and scarcity of fossils.

The Currant Creek section has been compared with that of the Pioche District, Nevada; House Range, Utah; and the Bear River Range, Utah-Idaho. Comparisons indicate that the *Albertella* zone of Currant Creek is similar to that of the Upper Pioche shale, Highland Peak Range, and the Naomi Peak limestone member of the Langston formation, Bear River Range. The *Glossopleura* zone is particularly well-developed in the Currant Creek section and the faunal assemblage is remarkably similar to that of the Spence shale of the Bear River Range. It may represent a westward extension of the extracratonic faunal environment postulated for the Spence shale and Langston limestone.

JAMES R. MCNITT, California Division of Mines: Exploration and Development of Geothermal Power in California

From 1955 to 1962, approximately 40 wells have been drilled in 13 California thermal areas. Twenty-four of the wells were drilled in the three areas which at present seem to have the greatest potential for production of natural steam: The Geysers, Sonoma Co.; Casa Diablo, Mono Co.; and the Salton Sea area, Imperial Co.

In light of data from these three areas, three fundamental problems of geothermal power development can be considered: (a) preliminary evaluation of a thermal area; (b) locating exploratory wells; and (c) estimating steam reserves. Preliminary evaluation of an area is usually based on natural surface heat flow. By drilling wells in a thermal area, however, the heat flow may be increased from 3 to more than 100 times the observed natural surface heat flow, depending on the permeability and structural characteristics of the thermal fluid reservoir, as well as the initial enthalpy of the thermal fluid. The efficiency of well location can be greatly increased by geophysical methods, including gravimetric, magnetic, resistivity, and thermal. Steam reserves and life expectancy of the field depend on rates of heat and fluid flow in an open system rather than on the more familiar condition of mechanical equilibrium associated with a sealed petroleum reservoir.

BRUCE D. MARTIN, University of Southern California: Rosedale Channel—Evidence for Late Miocene Submarine Erosion in Great Valley of California

West of Bakersfield in the Great Valley of California, 8 wells drilled below the Upper Miocene-Middle Miocene boundary penetrated an anomalous sequence of middle Late Miocene (Middle Mohnian) sediments, principally sandstones. These coarse sediments, within the widespread lower Fruitvale Shale of early Late Miocene age (Early Mohnian), are interpreted to be fill within an early?—Middle Late Miocene submarine canyon eroded and filled during a time interval of about 700,000 years. The names, Rosedale Channel and Rosedale Sandstone, are proposed respectively for the canyon and the fill.

Electric log correlations, microfossil data, and sedimentary characteristics are used for interpretation. Only a remnant of the originally more extensive canyon is described, owing to difficulties encountered in the recognition of the headward and seaward extensions. Seismic data are inadequate for recognition.

Microfossils show that filling occurred entirely in the marine environment in a depth of water probably greater than 1,300 feet. *Uvigerina subperegrina* and *Cyclammina sp.* in the channel fill attest to this depth during the time of deposition of the Rosedale Sandstone.

The ecology of the foraminifer *Epistominella "Pulvinulinella" gyroidinaformis* in the lower Fruitvale Shale, the regional stratigraphy suggesting little or no uplift, and the comparatively short time interval between cutting and filling indicate that erosion was not effected in the subaerial environment; therefore the channel was eroded entirely in the marine environment at a depth greater than 1,500 feet.

Cores from the Rosedale Sandstone exhibit many characteristics analogous to turbidites. Turbidity currents or gravity flows of sediment caused the erosion. Downcutting was facilitated by the poor induration of the lower Fruitvale Shale.

M. N. MAYUGA, Long Beach Harbor Department: Geologic Highlights—Easterly Extension of Wilmington Oil Field

An offshore seismic survey in 1954 revealed a continuous anticlinal structure extending from the presently developed area of the Wilmington oil field easterly to an undetermined area beyond the Belmont Offshore Field. A number of normal faults transverse to the axis of the anticline were recognized. In 1961, the Long Beach Harbor Department Petroleum Division estimated that an oil reserve of approximately 800 million barrels of oil can be recovered under a water-flood pressure maintenance operation in the undeveloped offshore and townlot area of the City of Long Beach. Recent core hole data from eight wells drilled in 1962 in the offshore area showed possible production from five zones (Ranger, Upper Terminal, Lower Terminal, Union Pacific, and Ford). All the stratigraphic units in the developed portion of the field are present in the undeveloped area with possibly some older sediments overlying the basement rock. Based on the core hole information, the reserve estimate was revised to a range of 1.1-billion to 1.5-billion barrels of oil recoverable under a water-flood pressure maintenance operation. A development program is under consideration to produce the townlot and offshore area under a unit plan with drill sites to be provided from four, 10-acre, man-made islands.

RICHARD A. MILLS, Petroleos Hondurenos; K. E. HUGH, consultant, Tegucigalpa, Honduras; D. E. FERAY, Texas Christian University; H. C. SWOLFS, consultant, Huntington, New York: Mesozoic Stratigraphy of Honduras

The Honduras basin is an intracontinental salient of a large marginal geosyncline that borders the southern side of the geanticline which divides northern Central America. During Mesozoic and Cenozoic time, 10,000–25,000 feet of sediments were deposited in the Honduras basin. No thick evaporite deposits have been found, suggesting the geosyncline was an open communication with the Pacific and Atlantic oceans.

The Triassic and Jurassic periods are represented by 3,000 feet of deltaic, littoral clastics. The Lower Cretaceous is composed of 2,000 feet of black, shaly limestones containing oil seeps; 2,500 feet of red clastics; 2,000–6,000 feet of massive rudistid and miliolid limestones; and 2,000 feet of conglomerates and clastics derived from the lower formations.

The Laramide orogeny divided the Honduras basin into the Ulua basin on the west and the Mosquitia embayment on the east. The main trough of the marginal geosyncline shifted south, and 35,000 feet of sediments were deposited in the area of Lake Nicaragua during Upper Cretaceous and Tertiary time.

The Ulua basin received 2,000 feet of Upper Cretaceous and Eocene redbeds and limestones and then remained a positive area during the remainder of Cenozoic time. Compressive folding during the mid-Tertiary Antillean revolution, formed distinct east-west geanticlinal belts. Volcanism, beginning during this period and continuing until recent time, was responsible for the thick cover of flows and tuffs along the Pacific coast of Central America.

The Mosquitia area of northeast Honduras and northern Nicaragua became a major embayment during Upper Cretaceous and Tertiary time. Thirteen hundred feet of Upper Cretaceous limestones and shales and 15,000 feet of Tertiary flood-plain and marine clastics underlie the broad Mosquitia continental shelf and extend eastward into the Caribbean Sea 150 miles.

The Pliocene-Pleistocene Cascadian orogeny was responsible for the present-day topography of northern Central America. Wrench fault tectonics probably explain the complex structure of this region.

H. W. OLIVER and D. R. MABEY, U. S. Geological Survey: Regional Gravity Anomalies in Central California

A Bouguer gravity map of central California east of the Coast Ranges has been compiled from over 11,000 observations made by the U. S. Geological Survey, the U. S. Naval Ordnance Test Station, and several oil companies. The Bouguer reductions are based on a rock density of 2.67 g/cm^3 and include terrane corrections in all mountainous areas.

Regional gravity lows in the west and south parts of the San Joaquin Valley are produced by a maximum estimated thickness of more than 30,000 feet of Upper Cretaceous and Cenozoic deposits. Gravity lows also occur over local basins south and east of the Sierra Nevada which, in conjunction with limited seismic refraction measurements, indicate the following maximum thicknesses of Cenozoic deposits: Mono Basin and Long Valley—18,000 feet; Death Valley and Cantil Valley—10,000 feet; Owens Valley—9,000 feet; Indian Wells Valley—8,000 feet; Searles Basin, Saline Valley, and Panamint Valley—3,500 feet.

Bouguer gravity values corrected for the effect of the Upper Cretaceous and Cenozoic deposits show a broad, asymmetrical gravity low centered over the eastern Sierra Nevada with the steepest gradients and greatest relief on the west side. This major anomaly disturbs the earth's gravity field from the western San Joaquin Valley to the California-Nevada border. It can be explained by isostatic compensation of the Sierra Nevada and high areas to the east plus the relatively low-density rocks of the Sierra Nevada batholith.

A gravity ridge that extends for several hundred miles along the east side of the San Joaquin Valley shows excellent correlation with a similar magnetic ridge, suggesting that both anomalies are caused by a dense, magnetic mass buried at an estimated depth of 5–10 miles. This depth approaches the approximate 12 mile thickness of the earth's crust under the valley indicated by seismic refraction measurements.

SAMUEL A. PATTERSON, Security-First National Bank: Economic Trends in California Oil Industry

This is an over-all look at our local industry, relating historical trends with current conditions and generalized forecasts of the future.

District V is no longer isolated from the rest of the United States, but is an integral part of the total international oil industry. Our competitive position in this industry is not expected to deteriorate further.

Radical changes in the make-up of our local industry will take place. Secondary recovery and well stimulation operations will become increasingly important as onshore exploration declines. Large numbers of technical people so oriented will be required.