subsidence to middle bathyal depths occurred during Late Miocene (Delmontian) and Early Pliocene (Repettian) time. Rapid shoaling during the Pliocene is evidenced by the systematic appearance of slope, shelf, and neritic foraminiferal faunas. Abundant Pliocene macrofossils also characterize shelf-depth deposits. Shallow-water micro and macrofaunas within deep water sediments are interpreted as displaced by turbidity currents or slumping. Planktonic Foraminifera and an increase in radiolarian (*Spumellina*) diameter suggest cool surface temperatures during the Late Miocene and increasingly warmer temperatures in the Early Pliocene.

EDWARD C. JESTES, University of California at Los Angeles: Stratigraphic Study of Some Eocene Sandstones, Northeastern Ventura Basin, California

The eastern end of the Matilija Sandstone and its inferred equivalents across the Santa Ynez and Pine Mountain faults were studied. These bodies of arkose have similar average modal compositions of quartz (31%), K-feldspar (21%) and plagioclase (22%). Accessory minerals also suggest derivation from a granitic basement complex. A few grains of serpentine and chert may reflect a minor contribution from a Franciscan terrane.

Depositing currents flowed mainly northwest, especially in the center of the basin. Influx of sand was probably from southern and (or) southeastern quadrants on the south side of the basin and from the northeast on the north side of the basin.

Local sand bars may have caused brackish-water environments on the southern and northern sides of the basin. The evidence is particularly strong in the area north of Pine Mountain. Coarse-grained, conglomeratic arkose with giant cross-stratifications are interbedded with strata containing shallow offshore mollusks and probable brackish-water mollusks.

Grain size and bedding thickness generally vary in direct proportion to each other. Thicker beds are usually in the thicker sections. Maximum areas of sand deposition appear to have swung back and forth producing overlapping lenticular lobes pointing into and down the basin.

Z. V. JIZBA, California Research Corporation; W. S. CAMPBELL, Standard Oil Company of California; T. W. TODD, University of California, Davis, California: Study of Core Resistivity Profiles and Their Bearing on Dipmeter Survey Interpretation by Computers

Bedding features in cores have been compared with corresponding dipmeter log curves. Special equipment was constructed to insure a correct match for this comparison. Results suggest that occasionally apparent good picks from a dipmeter log may not correspond with actual bedding planes. The converse can also be true: valid bedding features may not have a diagnostic expression on the log. Correlations selected on the basis of peak or valley location on the dipmeter curves may provide misleading information. We may conclude that, before we can confidently process dipmeter data by means of automated computer techniques, we must be assured that our knowledge of the relationship of rock-character to dipmeter-curve development is correct and founded in fact.

THOMAS R. LAFEHR, Stanford University: Gravity and Crustal Structure in Eastern Snake River Plain, Idaho

Gravity studies have been useful in volcanic regions where buried geologic features are partly concealed by overlying lava flows. In the Snake River Plain, Idaho, recent geophysical investigations by the U. S. Geological Survey have revealed a marked contrast between the structures of the western and eastern parts of the plain. The western plain is a deep graben, whereas the eastern plain is a downwarp or shallow graben. Depth-estimation formulas and numerical integration techniques have been used to interpret the gravity anomalies. The gravity pattern in the east implies relatively shallow subsurface elongate mass distributions whose long axes seem to trend parallel to the axes of the adjoining mountains. Residual anomalies suggest that the basalt may be only a few hundred feet thick at places in the eastern plain, and that the total accumulation of lava has been much less in the east than in the west. The U. S. Geological Survey is continuing its study of this region with the aid of seismic-refraction data obtained from both chemical and nuclear explosions.

STANLEY J. LASTER, RICHARD SCHELL, MILO M. BACKUS, Geophysical Service, Incorporated: Analog Model and Synthetic Seismogram Studies of Long Range Refraction Method

Refraction mapping of a simple anticline in a high velocity halfspace overlain by low velocity overburden in an analogue model illustrates the conventional refraction method and the behavior of refraction traveltime and amplitude. In addition to first arrivals, the later arrivals on the seismogram, the "multiple refractions," which constitute the P_L mode in the reflection noise problem and long period earthquake seismograms, were studied in detail. In the absence of structure, the behavior of the later refractions on the model agrees with the predicted behavior from exact synthetic refraction seismograms obtained from the computer application of Cagniard's method to a layered half-space. Over the structure, the arrival time and amplitude behavior of the later arrivals is simply diagnostic of the structure.

ROBERT J. LESLIE, University of Southern California: Sedimentology of Hudson Bay, Canada

Bottom sediment distribution in Hudson Bay is a reflection of the water circulation pattern within the bay, tidal currents, and ice rafting. There is a gradual decrease in sediment size from coarse sand and gravel on the west to clay near the eastern coast. Adjacent land topography is not a major factor in sediment distribution since the eastern coast is much more rugged than the lowland area on the west. Ice rafting is an important agent of sedimentation in the shallow regions of the bay, and exerts its greatest influence in the areas off the western coast and around Southampton Island. The large central part of the bay is not influenced greatly by rafting.

Organic content in the sediment is highest in the fine-grained material off the east coast. Calcium carbonate content is greatest in sediments of the southwestern portion of the bay, in the region bordered and underlain by Paleozoic carbonate rocks. The surface sediment in the deeper central part of the bay is reddish brown in color. Origin of the red layer, which has a maximum thickness of 8 cm. is due to oxidation caused by the slow settling of ferruginous sediment in highly oxygenated water. This red surface layer is a common feature in the north and has been reported from the Kara, Barents, and White Seas.

LOUIS LIDZ, Allan Hancock Foundation, University of Southern California: Sedimentology of Nantucket Bay, Massachusetts

Nantucket Island is a Pleistocene terminal moraine which encompasses a bay approximately 7 miles long

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