inner shelf. Below 54 m. a diverse planktonic fauna, including the many warm water species, appears in the sediments.

Hyaline Foraminifera compose fifty per cent or more of the benthic population in all but the two stations which are located near large rivers.

The beach fauna is dominated by *Ammonia beccarii sobrina* and various species of *Elphidium*. The inner shelf fauna has an abundance of various *Ammonia* species, *Hanzawaia nipponica*, and *Rotorbinella versiformis*. The outer shelf fauna consists largely of *Bolivina robusta*, *Cibicides haidingeri pacificus*, and *Epistominella pulchra*. The dominant upper bathyal species are *Cassidulina subglobosa*, *Cibicides pseudoungerianus*, and *Gümbelitria vivans*.

Size measurements of a few species indicated a tendency toward dwarfism in the fauna of the closed basin in the Gulf.

JOHN C. HAZZARD and WILLIAM R. MORAN, Union Oil Company of California: Structural Patterns Reflected in Soil Mantle Overlying Tertiary Rocks, Dasht-i-kavir Desert Basin, North-Central Iran

The Dasht-i-Kavir or Great Salt Desert of north central Iran occupies a northeast-trending elongate area of about 9,000 square miles. Its geographic center is about 225 miles southeast of Teheran. The average surface elevation of the essentially flat desert plain is close to 2,000 feet above sea-level; maximum relief within the plain is probably about 50 feet.

Structurally, the desert basin area is a graben separated from the adjoining highlands by major active faults. Metamorphic rocks of pre-Mesozoic age and Jurassic and Cretaceous sediments crop out in the bordering mountains and are presumed to underlie the graben at depth. The post-Mesozoic sequence includes a thick Eocene sedimentary and volcanic section with possibly some evaporites. Oligo-Miocene evaporites and marine limestone and Miocene red beds and evaporites overlie the Eocene. The post-Cretaceous section probably totals as much as several thousand meters in thickness. Approximately 35 salt plugs occur within a restricted area on the north side of the graben. The major part of these salt masses is tentatively considered to originate in the Oligo-Miocene evaporitic section.

Available maps show the Kavir as a salt waste apparently without topographic pattern. This is essentially true for most of the area occupied by salt pans; however, when viewed from the air the remaining area shows a striking pattern of light and dark brown bands which closely resemble form lines on a structural contour map.

On-the-ground examinations confirm this relation. In areas not covered by recent salt pans the surface is mantled by puffy, saline, "self-rising" soil which ranges from a few inches to a few feet in thickness. The underlying bedded rocks which are known to have dips as great as 50° or more do not crop out. The visible color banding is entirely a surface soil pattern which reflects the structure at the base of the soil mantle. Surface color differences do not appear to conform to color difference in underlying unweathered rocks. It is suggested that the color contrast is at least in part a function of the moisture content or "wettability" of the surface soils. This is in turn dependent on the physical-chemical properties of the particular rock layer from which the soil is derived and on the water-table level and rate of evaporation.

RONALD G. HECK and ANTHONY E. L. MORRIS, Pauley Petroleum, Inc.: Distribution of Starkey Sand, Sacramento Valley, California

The Starkey sand unit is named from the Amerada "Starkey Fee" No. 1, completed in 1944 as the discovery well for Millar Field in Sacramento Valley, California.

The sands represent a transgressive-regressive, shallow sea depositional environment and occupy an area in the subsurface approximately 85 miles long and 40 miles at the greatest width.

The northerly extension of the Starkey sand is progressively truncated by Eocene Capay shale. Capay is also found truncating the Starkey on the northwest, while the southwest portion shales into what was a deeper depositional area. Along the eastern edge the Starkey laps onto basement and does not crop out.

The Starkey sand is the youngest Upper Cretaceous unit in the Sacramento Valley and the top thereby represents the Paleocene-Cretaceous and Eocene-Cretaceous contact over a large area. Fauna are scarce and poorly preserved, but those found are included in Goudkoff's C^1, D-1 and D-2 Zones.

JOHN C. HOLDEN, San Diego State College: Upper Cretaceous Ostracode Faunule from Carlsbad, California

A limited exposure of Upper Cretaceous marine siltstones and claystones near the coastal town of Carlsbad, southern California, contains a remarkably well preserved microfauna.

Twenty-six species of ostracodes including twenty-three new species and one new trachyleberid genus occur in the upper part of the section. This faunule possesses distinct Cenozoic affinities expressed by the presence of the genera *Trachyleberis*, *Actinocythereis*, and *Idiocythere*, all of which previously have been reported from rocks no older than Lower Tertiary. Generic affinities with European faunas are also noted by new species of *Idiocythere*, previously reported from the Eocene of Germany only, and *Isocythereis*, previously from the Cretaceous of Germany only. Three species occur which also occur in Upper Cretaceous rocks of the U. S. Gulf Coast. These are *Brachycythere darensis* Swain, 1952, *Krithe cushmani* Alexander, 1929, and *Cytheropteron coryelli* Schmidt, 1948.

JAMES C. INGLE, JR., University of Southern California: Miocene-Pliocene Paleoecology of San Fernando Basin, California

Sedimentary rocks exposed along the periphery of the San Fernando Valley indicate the area was a separate marine basin during Miocene and Pliocene time. Although the surrounding geology is well known, the basin is virtually unrecognized as a major Tertiary basin of Southern California.

Structure, stratigraphy, and sedimentology indicate the basin's history is similar to that of other Continental Borderland basins. Localized subsidence in the Late Middle Miocene formed the basin as a discrete unit. Basin filling took place during Pliocene and Pleistocene time. Benthonic Foraminifera indicate that the San Fernando basin was separate from the adjacent and deeper Ventura basin but remained an integral part of the east-west Ventura embayment.

Over 900 meters of Late Miocene and Pliocene sediments are well exposed on the south side of the basin. Shales and diatomites typify the Miocene sequence whereas silts and sands are characteristic of the Pliocene. Laminated diatomite was probably deposited in a subsill oxygen-deficient environment analogous to the existing Santa Barbara basin. Coarse, arkosic continental sands interfinger with Pliocene marine sediments at the eastern end of the basin.

Benthonic Foraminifera and Radiolaria show that

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