ter-laminated lime mudstone, and (3) common micro-pelletoid lime grainstone (calcisiltite). The latter may show fine ripple cross-lamination. These rock types may occur in graded sequences but non-graded alternations are also common. Several kinds of minor sedimentary rhythms are recognized. The limestone types generally are dark, but light colored and even pink or red varieties are known. Distinctive monotonous bedding, consisting of planar relatively thin (½- to 2-foot) limestone beds interlayered regularly with thinner beds of dark shale, is common. Chert beds may be intercalated in such sequences. Spectacularly large cut-and-fill structures (stretching more than 100 yards) and presumably caused by submarine penecontemporaneous sliding are seen in places. Convolute bedding and flame structures indicative of soft sediment slumping are scarce.

Distinctive faunal assemblages exist in these beds. Siliceous and calcareous microplankton (radiolarians, diatoms, calcispheres, and tintinnids), sponge spicules, graptolites, pelagic or nektonic pelecypods, pelagic Foraminifera (globigerinids), pteropods, and certain ammonoids are especially characteristic.

Field observations of this limestone type show that it commonly forms a sort of apron down very gentle slopes from typical carbonate shelves and in many places regionally is peripheral to a depositional basin, the center of which contains a thin section of dark shale. Recognition of this facies permits one to predict proximity to a carbonate-shelf margin. In several locations lime mudstone mounds are seen slightly upslope from basinal lime mudstone. Both the even and regularly bedded lime mudstone and calcisiltite and the mudstone mounds contrast with characteristic limestone turbidite (allodapic limestone) which probably represents accumulations down from relatively steeper slopes, in more tectonically active environments, and perhaps downslope from shelves with higher water agitation. Numerous examples of "deeper-water" but non-turbiditic limestone are discussed from basins and geosynclinal troughs in the late Paleozoic of the western United States, the Cretaceous and Jurassic of Mexico, the Middle East, and Europe.

YEATS, ROBERT S., Shell Oil Company, Los Angeles, Calif., W. A. McLAUGHLIN, and GEORGE EDWARDS, Shell Research and Development Company, Houston, Tex.

K-Ar Mineral Age of Ash Bed in Pico Formation, Ventura Basin, California

A widespread volcanic ash layer, 1–4 inches thick, in the Pliocene Pico Formation (Wheelerian microfaunal stage) has been dated radiometrically. Twenty-five-pound samples of ash were taken from each of two localities. Each sample yielded about 4 grams of sanidine and 1 gram of biotite. These minerals are unaltered and show euhedral grain boundaries; some sanidine crystals have rims of glass. The glass matrix, comprising 95 per cent of the sample, is isotropic and apparently unaltered. Radiometric ages follow.

	West Bank of Ventura River (Million Years)	*South Side of South Mountain (Million Years)*
Sanidine	8.4±1.3	9.2±1.4
Biotite	9.3±0.9	10.2±2.1
Glass	<0.4	<0.2; 1.1

All ages were run at Shell Development Company except the biotite from Ventura River, which was run by John Obradovitch, United States Geological Survey, Denver, Colorado. The mineral ages are consistent within the range 8.4–9.7 m.y. The glass ages are discordant, apparently because of argon leakage; the glass is therefore useless in radiometric dating despite its unaltered appearance.

The upper part of the Pico is divided into two molluscan zones, a lower warm-water zone, and an upper zone containing a molluscan assemblage resembling that living today in Pacific Northwest waters. The temperature shift from warm to cold previously was correlated with the onset of Pleistocene glaciation and, because beds containing the cold-water mollusks are folded, the age of folding (Coast Range orogeny) traditionally has been considered to be intra-Pleistocene.

R. F. Meade has shown that the base of the cold-water molluscan zone is just below the ash bed near South Mountain; it is possible that the molluscan shift is not caused by glaciation but by a pre-Pleistocene change in oceanic current patterns accompanying a general late Tertiary cooling. The new radiometric age and the invalidation by Durham, Jahns, and Savage (1954) of mammalian evidence for a Pleistocene age of folding suggest that both the molluscan temperature shift and Coast Range orogeny occurred in Pliocene time.

ZENI, MILTON, Standard Oil Co. of California, Oildale, Calif., and JOHN S. CUNNINGHAM, Standard Oil Co. of California, Taft, Calif.

Railroad Gap Area—New Reserves in Old Province

The Railroad Gap area, consisting of the Railroad Gap field and the deeper pools at Northeast McKittrick and McKittrick Front, is on the west side of the San Joaquin Valley near McKittrick, Kern County, California. The discovery of the Railroad Gap field in February, 1964, by the Standard Oil Company of California led to the deeper-pool discoveries at Northeast McKittrick and McKittrick Front by the same operator during the ensuing 1½ years.

Anticlinal closure traps most of the reserves in each field. The folds differ considerably in size, configuration, and orientation. Normal and reverse faults are common, and cause differences in oil-water interfaces within the same accumulation.

Nearly all stratigraphic units from the Eocent Point of Rocks Sandstone Member to the Pleistocene Tulare Formation are productive in the area. The primary objectives and most prolific reservoir rocks are the Oligocene Oceanic and the lower Miocene Phacoides and Carneros Sands. The massive Phacoides and Oceanic Sand units differ considerably in thickness and reservoir quality from place to place. The Phacoides permeability variations are particularly surprising, because initial completions range from 100 to 9,000 BOPD at similar structural positions within the same accumulation.

The Railroad Gap area was known to be anticlinal, but conclusive evidence of critical closure on the northwest could not be documented by conventional structural studies or geophysical methods. Regional isopachous studies of the middle and upper Miocene, however, indicated the existence of thickness variations of a sufficient magnitude that potential northwesterly closure could be inferred to be present in the underlying lower Miocene sediments. The isopachous contours reflect middle and late Miocene structural growth along the trend, suggesting a favorable geologic history for the area. The lower Miocene and Oligocene, from nearby well data, were known to contain excellent clastic reservoirs, thus completing the knowledge necessary to justify in exploration program.