upper Stevens from depths averaging 8,000 feet was orderly over $2\frac{1}{2}$ years. Structure near the upper Stevens lenticular or channel-type sands is a gentle southwesterly plunging nose with minor unimportant normal faulting. Through 1957, 5,063,000 barrels were produced from 27 upper Stevens wells.

Late in 1957 Universal Consolidated Oil Company and State Exploration Company discovered lower Stevens oil $\frac{1}{2}$ mile east of the original field limits. To date (September 10, 1958) 25 lower Stevens producers have been completed, 4 dry holes were drilled, and 3 wells are drilling. In contrast to the gentle bowing in upper Stevens rocks, there are one and perhaps two areas of structural closure at lower Stevens time. In general, greater pay thicknesses and better production are encountered high on the fold, but basin source sands are well developed downdip and additional stratigraphic traps in downdip wells have afforded commercial reservoirs.

Limits of lower Stevens production have not been reached as yet, but it is likely that principal future drilling will be in the southwest part of the pool, although northerly field limits are not entirely defined. At least 540 acres are proved in the lower Stevens pool (September 10, 1958). The ultimate size of the pool could be substantially larger. Cumulative production from lower Stevens at East Gosford through July, 1958, is 325,000 barrels from 21 wells. Average daily production, August, 1958, was approximately 3,000 barrels from lower Stevens.

(14) Fault Symposium

A. Evidence for Large Cumulative Right Strike-Slip Movement on San Andreas Fault System
Edward L. Winterer, U.C.L.A.

B. Conservative Concept of San Andreas Movement
Thomas H. Baldwin, Monterey Oil Company

C. Effects of Lateral Faulting on Oil Exploration
William Henry Corey, Continental Oil Company

D. Prepared Question on Fault Movement
Robert H. Paschall, Hancock Oil Company
Panel Discussion
Moderator: V. L. Vanderhoof

E. Proposal for Organized Study of Major California Faulting
U. S. Grant, President, Pacific Section A.A.P.G.

(15) Stratigraphy of La Honda and San Gregorio Quadrangles
R. M. Touring, Humble Oil and Refining Company

The oldest rocks exposed are Upper Cretaceous foraminiferal mudstones, graded sandstones, and conglomerates (9,500 feet) occurring in a fault slice along the coast south of Pescadero. Not in contact is the Butano formation (5,000 feet) of Eocene age, consisting of interbedded sandstones, siltstones, and mudstones. The sandstones are thicker and cleaner in the upper part of the Butano formation and produce oil in the La Honda field. Conformably overlying the Butano formation are 2,500 feet of San Lorenzo mudstones and siltstones (upper Eocene A-1 zone to lower Zemorrian) which are cut by diabase sills and dikes. These dikes were feeders to basalt flows which poured from subaerial volcanoes into shallow water. The volcanic rocks are interbedded with upper Zemorrian and Saucesian mudstones, quartzose sandstones, and organic calcarenites. This sequence totals 2,000 feet in thickness and is overlain by 500 feet of brown chert and laminated mudstone (Relizian ?). Transgressing all older rocks are the upper Miocene cherts and diatomaceous mudstones (0–9,000 feet thick) of the Monterey formation. The Pliocene Purisima formation (5,650 feet) overlies the Monterey conformably and is still transgressive. It is characterized by the first influx of andesitic debris, probably from the Sierra Nevada. The Purisima is divided into five mappable members, which from the base upward are: tuffaceous siltstone and sandstone member containing small amounts of oil in the La Honda field (2,150 feet); siliceous mudstone member (2,300 feet); pebbly sandstone member (150–350 feet); mudstone member (450 feet); fine sandstone member (400 feet). Pleistocene terraces, recent alluvium, and landslides complete the stratigraphic column.

It is believed that the Butano, the lower Miocene volcanics and the Purisima formation can be directly correlated across the present San Andreas fault into the Stanford-Woodside area. The correlation suggests that lateral displacements along the fault in this area may be a mile or two, but not hundreds of miles.

(16) Geology of Northwest Ten Section
N. H. MacKevett, Shell Oil Company

The Northwest Ten Section accumulation discovered in 1958 is between the Canal and Ten Section oil fields in Secs. 23 and 24, T. 30 S., R. 25 E., approximately 14 miles southwest of Bakersfield in Kern County, California. Shell Oil KCL 15X-24, a 15,739-foot basement test, is credited with finding two new Stevens oil accumulations; however, the first producing well in the pool was a follow-up well, Shell KCL 84-23. An upper Stevens accumulation was indicated in 15X when a formation test of the interval, 8,206–8,248 feet, recovered 68 barrels of 35° gravity oil in 4 hours, a 420 B/D rate. Side-wall samples in the lowermost Stevens sand interval, 9,475–9,664 feet, indicated this 125-foot thick net sand section to be oil stained but the interval was untested because of the washed-out condition of the hole. In the follow-up well, 84-23, this lower Stevens sand was found to be 120 feet thicker than in 15X-24. The lower Stevens interval from 9,455 to 9,545 feet was perforated and pump-tested and yielded an average of 100 B/D of 32° gravity oil, cutting 10% during an 8-day test period. Production from the upper Stevens zone was then commingled with the lower Stevens zone and flowed oil at an average of 450 B/D during the first month of production.

The upper Miocene-Stevens is a prolific oil-producer in many fields of the southern part of the San Joaquin Basin. The estimated ultimate is over 800,000,000 barrels. The Stevens sequence in this area is over 1,500 feet thick and as the many shale breaks are thin and facies changes abrupt, correlation in this unit is difficult even where wells are closely spaced. Recent oil discoveries in the lower Stevens have focused attention on the fact that localization of structural trends and stratigraphic changes at this horizon are commonly different from upper Stevens prospects. The Stevens sand is an arkose containing abundant acid igneous rock fragments and a kaolinitic matrix. The upper Stevens sands are typically medium- to coarse-grained and the lower Stevens sands are typically fine- to medium-grained with permeabilities averaging 200 md and 50 md, respectively. Individual sands within the Stevens may appear massive on the electric log but a study of cores reveals that these sands are made up of numerous, usually thin, graded beds. The lower Miocene and Eocene sandstones lack sufficient permeability and porosity to provide an economic reservoir.

The basement wildcat was planned to explore the Stevens (upper Miocene), the Media sands (middle Miocene), the Vedder sands (lower Miocene), and Eocene sands. Stratigraphic changes in the lower Stevens section and Eocene section were also considered in locating the 15X well. Eocene sands were topped at 15,540 feet with the base at 15,639 feet. A formation test of the Eocene in the interval, 15,560–15,650 feet, for 18 hours recovered water at 140 B/D rate. A formation test of the lower Miocene-Vedder in the interval, 13,090–13,165 feet, for 12 hours recovered water with a trace of oil at a 55 B/D rate. Basement was topped at well depth 15,718 feet. It should be pointed out that the planned total depth of the well was 15,000± feet although our seismologists advised that they were picking the uppermost possible basement reflection and that a second or third possible basement event might be more reliable. Prior to drilling, a depth of 15,800 feet was considered the maximum depth to basement. Similar experiences 2 miles north-northeasterly in Shell's Posuncula 1 at Strand dictated that this uppermost reflection event would probably be basement; however, this was not the case at 15X-24.

Several points of interest concerning the upper Stevens accumulation are: (1) the oil-water contact appears to be near the same level as in the Canal oil field, and (2) the low hydrostatic pressure which is approximately 1,000 pounds below virgin pressure suggests these sands are in fluid communication with the producing measures in Canal or Ten Section, or both.

This oil find is an example where detailed seismic shooting and study have defined a small, structurally closed accumulation in a densely prospected area. The actual areal extent and size of the oil reserves will need definition by development wells. Current estimates of the upper Stevens pool are that the accumulation will cover 300–500 acres with maximum height of oil column, 150 feet, and oil reserves of the order of 5 million barrels. There are insufficient data to predict reserves from the lower Stevens.

(17) BRIDGE POOL OF SOUTH MOUNTAIN OIL FIELD

E. A. Hall, Union Oil Company of California
R. M. Grivetti, The Texas Company

The Bridge pool is south of Santa Paula, directly across the Santa Clara River from the city. It underlies the northwestern part of the South Mountain oil field and extends 1½ miles southwesterly beyond the productive limits of the old field. A one-mile gap, currently being narrowed, separates the Bridge pool from the Saticoy field. The pool was discovered by Texas-Union in late December, 1955, following the formation of a 560-acre 50/50 land pool, with The Texas Company as operator. The Shell Oil Company is also an operator, in partnership with General Petroleum Corporation.

Production is from Pliocene, upper Pico and middle Pico sands, the middle Pico being most prolific. The productive section consists of thick sands, locally conglomeratic, separated by minor clay shales and siltstones. Bridge pool wells penetrate Oligocene Sespe beds and a fault wedge of Miocene shale before reaching the Pliocene beneath the Oakridge fault.

Oil is trapped in beds dipping 70° northerly beneath the 69°–80° southerly dipping fault zone. Lateral closure is believed due to bowing against the fault plane, although the east and west limits have not been reached to prove this. Several deep tests in the 11,000–13,500-foot depth range have been disappointing due to tight sands and low pressures.

Directional drilling has been extensively used to maintain structural advantage, and to save location costs in a Citrus area. Several wells have been redrilled to get out of a variable thickness