Prospective sediments range in age from Eocene to Pliocene. They are marine, with the exception of minor amounts of lower Miocene non-marine beds near basement highs and a veneer of upper Pliocene and Pleistocene continental beds in the central portion of the province.

Commercial oil production comes from anticlinal closures and stratigraphic and fault traps.

It is probable that substantial undiscovered reserves of heavy crude exist in this province, and that lighter oils may be found in parts of the stratigraphic section or in areas not before subjected to intensive search. Stratigraphic and structural studies may well be expected to yield important discoveries.

FRIDAY AFTERNOON

Presiding: HENRY H. NEEL, Tide Water Associated Oil Company, Ventura
RUSSELL R. SIMONSON, Ohio Oil Company, Los Angeles
GRAHAM B. MOODY, Standard Oil Company of California, San Francisco

SYMPOSIUM ON POSSIBLE FUTURE OIL PROVINCES OF PACIFIC COAST REGION

9. OFFSHORE SOUTHERN CALIFORNIA

K. O. EMERY, University of Southern California, Los Angeles

The total submarine area between the 9,000-foot contour of the continental slope and the shoreline is about 31,000 square statute miles. This area is broken into a checkerboard-like arrangement of fault blocks; the upthrown blocks form banks and the downthrown ones, basins. Indications are that the basins were initiated in late Miocene time and that thick post-Miocene sediments are restricted mostly to them. The great depth of sea water eliminates most of the submarine area from consideration as possible oil provinces in the foreseeable future. It is believed that the submarine areas of Pliocene-Miocene or possible Miocene outcrops at comparatively shallow depths are the most favorable future oil provinces because of the probability that these sediments are similar in lithology, structure, and oil content to those in the Los Angeles and Ventura basins on land. Shallow areas are restricted to the near-shore zone of the mainland and island shores and to the tops of some offshore banks. No estimates of the total stratigraphic thickness nor of the volume of sediments are possible with the present state of knowledge.

10. SOUTHERN COASTAL REGION

GORDON B. OAKESHOTT, California State Division of Mines, San Francisco

The Southern Coastal region is here defined as a narrow coastal strip of sedimentary deposits extending from the vicinity of San Onofre on the north to the Mexican border on the south and from the Pacific Ocean to outcropping crystalline rocks in the Peninsular Range a few miles east. The northern part of the region is a southeastward extension of the Lost Angeles basin; the southern part of the region is the San Diego Plio-Pleistocene basin. The coastal sedimentary strip connecting the two basins is occupied by an Eocene series overlying Cretaceous sediments at shallow depth. The total area of sedimentary rocks is approximately 950 square miles and maximum depth to basement is probably not much more than 6,000 feet.

Structurally, the sedimentary strip comprising the Southern Coastal region is relatively simple; it has not been subjected to intense folding or faulting. Cretaceous and Eocene sediments dip gently westward off the older crystalline rocks making up the Peninsular Ranges and are overlain by middle Miocene San Onofre sediments in the northern part of the area, and by middle Pliocene San Diego sediments in the vicinity of San Diego. Unconformities between formations exist, but there are no great angular unconformities and formations from the Upper Cretaceous Chico to middle Pliocene San Diego are almost concordant. The northwest-trending Soledad Mountain anticline, near La Jolla, is a local exception to the simple regional structure.

The Southern Coastal region lacks the seepages of oil and gas so common in petroliferous regions elsewhere in California. More than 30 wildcat wells, several of which reached basement, have been drilled in the region without shows of oil or gas. The Soledad Mountain anticline has been tested by several wells and depth to basement at the crest of that structure has been shown to be about 3,750 feet.

11. SOUTHERN MOUNTAIN REGION

GORDON B. OAKESHOTT, California State Division of Mines, San Francisco

The Southern Mountain region, by definition here, includes the San Gabriel Mountains of the Transverse Ranges, and the Peninsular Ranges. The northern and eastern boundary of the region is essentially the San Andreas fault zone; the southwestern boundary is the contact of Cretaceous-Tertiary sedimentary rocks on the older crystalline rocks.

The San Gabriel Mountains consist of a complex series of closely related Upper Jurassic (?) plutonic rocks including principally granite, granodiorite, monzonite, diorite, and gabbro. These include

numerous fragments of older intrusive rocks and an older metasedimentary series (Placerita) of possible Paleozoic age. The range is flanked on the north by a thick series of continental sandstones and conglomerates, interbedded with volcanics, of probable Miocene age. Intensely folded and faulted marine Pliocene sediments and continental lower Pleistocene gravels lie on the crystalline rocks along the southwest border of the range. Marine Paleocene Martinez sandstone and conglomerate occur in slivers in the San Gabriel fault zone.

In the Peninsular Ranges, rocks of the Lower Cretaceous (?) batholith are exposed, including principally granodiorite, tonalite (quartz diorite), and gabbro. In general, these plutonics have intruded Triassic and Jurassic (?) sediments and volcanics along their western border, and Paleozoic sediments along the eastern border. All pre-Cretaceous formations have been metamorphosed to some extent and are widely distributed through the areas of plutonic rocks. Upper Cretaceous sediments overlie the basement crystalline rocks near the northwestern end of the Santa Ana Mountains and in the Southern Coastal region. Marine and brackish-water sediments of the Paleocene Martinez formation are distributed along the Elsinore fault zone. Continental Miocene sediments and volcanics are found along the San Andreas and San Jacinto fault zones and in the bordering Coachella and Imperial valleys at the east.

Evidences of oil and gas have been found only along the margins of the crystalline rock masses, particularly abundant at the western and southwestern borders of the San Gabriel Mountains where there are numerous seepages. A very small amount of high-gravity oil was produced at the turn of the century from several shallow wells in crystalline rocks in the San Gabriel fault zone in the western San Gabriel Mountains 2½ miles east of Placerita oil field. Of a total of more than 70 exploratory wells drilled in the Southern Mountain region, these are the only ones which had any real shows of oil or gas.

12. IMPERIAL VALLEY

L. A. TARBET, Standard Oil Company of California, Paso Robles

The marine and continental sediments which occur in Imperial Valley may be divided into the following formations.

1. Split Mountain formation: Miocene (?) marine and continental sediments.
2. Alverson Canyon formation: Miocene (?) non-marine sediments and associated volcanic flows.
3. Imperial formation: Miocene marine sediments.
4. Palm Spring formation: Miocene and/or Pliocene marine and non-marine sediments.
5. Borrego formation: Lower Pleistocene (?) non-marine sediments.

Surface and well data indicate that at least 14,000 feet of sediments were present west of Salton Sea at the end of deposition of Borrego formation and as much as 25,000 feet of sediments may be present in the central part of Salton Sink.

Structurally Imperial Valley is a series of parallel fault blocks. The general trend of the major faults is N. 55° W. Two of these faults which are well known and extend beyond Imperial Valley are the San Jacinto and San Andreas. The sediments have two structural alignments, one sub-parallel with the major faults and the other trending east-west.

On the basis of surface data the possibility of obtaining commercial quantities of natural gas or crude oil appear to be very meager. Although a composite section of 22,000 feet of sediments is exposed at many places in the western part of Imperial Valley, only 3,600 feet are of definite marine origin. The writer has observed no indication of petroleum except for small quantities of methane gas, comparable to that in many present-day swamps, in the non-marine sediments of the Palm Spring and Borrego formations.

13. EASTERN MOUNTAIN AND DESERT REGION

W. H. EASTON, University of Southern California, Los Angeles

That part of California east of the San Andreas rift and east of the western edge of the Sierra Nevada has been consistently ignored as a possible future oil province. Nevertheless, the subdivision of the region north of the Garlock fault and east of the Sierra Nevada is worthy of some attention by petroleum geologists.

About 40,000 feet of sediments in the region range in age from pre-Cambrian to Quaternary, with most periods represented. Structural deformation is generally complex, but regional metamorphism is lacking. An oil seep is known from Paoha Island in Mono Lake. In general, geologic conditions are similar to those in northeastern Nevada where there is currently an active exploratory program.

The principal factors which would assist exploration in this region are the concepts of discovery-thinking prevalent among geologists in the Mid-Continent and in the Rocky Mountains. Carbonate rocks may be source beds and also reservoirs; the general regional geology concerns features of basins superimposed upon geosynclines; lateral continuity is prevalent; saturated zones may be thin; structural deformation largely concerns competent strata.