and well developed in the lower and middle Eocene. Upper Eocene and younger volcanics are largely confined to the southern part of the state bordering the Columbia River.

Seepages of oil and gas are most abundant in the coastal belt but evidence of petroleum is found in Eocene and Oligocene rocks inland, ordinarily from water wells.

The most important wells, as far as evidence of oil and gas, are the Union State No. 1 and No. 3, located on the coast west of Gray's Harbor.

3. OREGON

H. J. BUDDENHAGEN, Shell Oil Company, Portland, Ore.

Oregon's prospective oil territory is considered to be limited to two areas where thick sections of unmetamorphosed marine sediments occur, namely, the Coast Range province of northwestern Oregon, and a part of the Ochoco Mountains region in central Oregon.

The former, with an area of 14,000 square miles, contains more than 15,000 feet of clastic sediments mostly of marine origin, together with several thousand feet of interbedded volcanics. These rocks range in age from middle Eocene to Pliocene.

In central Oregon more than 35,000 feet of Mesozoic and Paleozoic predominantly marine sediments, with no interbedded lavas, are exposed in windows in the regional cover of Tertiary and younger volcanics. Their extent below the volcanic cover is unknown.

The detailed structure and geologic history of neither region has been adequately deciphered. The Coast Range area seems to be essentially a broad, undulating northerly plunging geanticline, but it is modified and complicated by many lesser structural features. Dips are generally gentle and folds symmetrical. The central Oregon area is closely and complexly folded and numerous unconformities are present.

No oil seepages or oil sands are known in Oregon although oil and asphalt have been found in basalt vesicles, fossil cavities, and drusy cavities in quartz veins.

Ninety-five to 100 wildcat wells have been drilled in Oregon: 45–50 in the Coast Range Province; 3 in central Oregon; 25–30 in the Harney Basin and Vale areas of southeastern Oregon, with the remainder at scattered locations. Non-commercial amounts of gas were encountered in some of these wells, but no authenticated oil indications are known. Wildcatters have been attracted to the southeastern Oregon areas apparently by the occurrence of natural gas in the lacustrine and other continental sediments which occupy structural basins in this area.

4. NORTHERN COAST RANGES, CALIFORNIA

G. C. GESTER, Standard Oil Company of California, San Francisco

The California Northern Coast Ranges include the mountainous and semi-mountainous areas and intermontane valleys from the Oregon-California boundary on the north to San Francisco Bay on the arbitrary sinuous line which approximately follows the Southern Pacific Railway from Oregon southward to a point about 10 miles southwest of Redding, thence the boundary approximates the western limits of the Cretaceous of the Sacramento Valley province to a point a few miles northeast of Napa and thence, southward to Carquinez Straits.

It represents an area of approximately 19,938 square miles, of which about 8½%, or 1,700 square miles, are underlain by sedimentary rocks which are common to oil-field provinces. This total of 1,700 square miles is made up of a number of widely separated areas, in many of which the basement is relatively shallow. The calculated volume of sediments of the California Northern Coast Ranges, which might be placed in the classification of possible future oil provinces, is of the order of 500–550 cubic miles.

The sedimentary formations, herein considered, are of Tertiary and Cretaceous age, but some of the latter has not been included in our calculations. As explained in the body of the paper, there is an indeterminate quantity of Cretaceous sediments so intimately associated with steeply folded and faulted Franciscan rocks that a separation has not been made and it is believed that such phases of the Cretaceous and the Franciscan sediments of the California Northern Coast Ranges should not be considered in the areas of possible future oil provinces.

To date, no major oil or gas fields have been developed in this area; a small dry-gas field containing about 1½ square miles with only three producing wells supply gas to the Eureka district. Also, a little oil and gas have been developed in the vicinity of Petaluma but there is no sustained production, and the oil development is included within an area of 20–30 acres and the gas area covers about ½ square mile. The oil production from this area amounted to 1,186 barrels during 1949 and the total cumulative production to date amounts to 3,475 barrels.

5. SACRAMENTO VALLEY REGION

H. D. HOBSON, General Petroleum Corporation, Los Angeles

The Sacramento Valley province covers an area of 11,578 square miles in the northern part of the great interior valley of California. The eastern part is underlain by a complex series of Paleozoic and Mesozoic metamorphic and granitoid rocks, and the western part is underlain by tightly folded and partially metamorphosed sediments and basic intrusions of Jurassic age.

About 44,000 cubic miles of unaltered sediments, ranging in age from Lower Cretaceous to Pliocene, occupy the basin. Of this volume, three-quarters is marine Cretaceous, and the remainder is marine Eocene covered by a veneer of non-marine Miocene and Pliocene rocks.

More than 300 exploratory wells have been drilled in the province, resulting in the discovery of 28 commercial gas pools, from which more than 1¼ billion M.c.f. of gas had been produced by December 31, 1949. The average explored density is 38 square miles per exploratory well with the greater concentration in the southern part.

Producing zones range in age from Pliocene to Upper Cretaceous. Eocene sediments have furnished the major part of the production. Anticlinal closures are the predominant type of discovered trap with minor accumulations due to fault closures and stratigraphic discontinuities.

Oil seeps in the outcrop and oil showings in Lower Cretaceous sediments in shallow wells in the western part of the province suggest the possibility of undiscovered oil reserves. Additional gas reserves, resulting from deeper and more intensive drilling are a distinct possibility.

The variable distribution of formations and sand facies within the basin, together with the regional eastward overlap of Middle and Lower Cretaceous sediments, suggests that some type of stratigraphic trap may be instrumental in the accumulation of the major part of the discoverable reserves in this province.

6. SAN JOAQUIN VALLEY

J. E. KILKENNY, Chanslor-Canfield Midway Oil Company, Los Angeles

The San Joaquin Valley sedimentary basin is approximately 250 miles long and averages 50 miles in width, comprising an area of 14,100 square miles. Maximum depth to basement is close to 35,000 feet. Volume of sediments is estimated at 31,000 cubic miles of which about 85 per cent is marine.

Acreage productive of oil and gas amounts to 369 square miles, 2.62 per cent of the sedimentary area. There were 23,768 wells drilled of which 3,106 have been dry holes and 92 oil fields and 14 gas fields have been discovered.

Future fields will probably be found primarily in traps where the stratigraphic element is predominant, although there are very likely a number of undiscovered fault traps and perhaps a few closed anticlines that have escaped detection.

Deep prospects are better on the west side of the valley as numerous east-side wildcats have been drilled to basement in contrast to very few on the west side. The lower Miocene and older beds on the west side are probably devoid of oil and gas showings at great depths due to low-grade metamorphism.

7. CENTRAL COAST RANGES

J. E. KILKENNY, Chanslor-Canfield Midway Oil Company, Los Angeles

In this arbitrary division are situated the Cuyama Valley, Carrizo Plain, Salinas Valley, San Andreas trough, Halfmoon Bay-Santa Cruz area, and the Livermore-Contra Costa basin.

Combined area of these basins is 4,500 square miles with an estimated volume of sediments of 6,500 cubic miles. Seventy-five per cent of the sediments are believed to be marine.

Commercial oil production was not discovered until 1948. There are now four substantial producing fields in the Cuyama Valley and two in the Salinas Valley. There were 377 exploratory wells drilled to December 31, 1949.

The complex structure and stratigraphy of these basins make them difficult to prospect and many more wildcats will have to be drilled to explore thoroughly the oil and gas possibilities.

8. SANTA MARIA REGION

B. C. LUPTON, General Petroleum Corporation, Los Angeles

The Santa Maria province is a roughly triangular area in the California coastal belt which is bounded on the west by the Pacific Ocean, on the south by the Santa Ynez Mountains, and on the north and northeast by the Santa Lucia Range. The province consists of several more or less isolated structural basins with similar sedimentary histories and related types of objective zones and traps.

Many types of rocks underlie the zones of present and prospective production. The term, basement, as used in this paper, refers to rocks older than Eocene that consist of Jurassic metamorphics and basic intrusives and Cretaceous and Jurassic sediments that have undergone various degrees of alteration.

The Santa Maria province has an area of 2,126 square miles, of which 1,824 square miles are underlain by objective sediments. The volume of unaltered sediments is estimated at 1,112 cubic miles and the maximum depth to basement rocks is approximately 16,000 feet.

About 400 exploratory wells have been drilled in the province, resulting in the discovery of 14 productive areas with a cumulative production to December 31, 1949, of slightly more than 300 million barrels of oil.

Production is largely from Miocene sands, shales, and cherts. Significant amounts of oil have been produced from lower Pliocene sands and in one area from fractured sandstones of Jurassic age. This Jurassic production is considered to have migrated from overlapping Miocene beds.