these new reserves. There still is ample opportunity in California for the competent and imaginative geologist who can evolve a productive program from a mass of factual information.

7. "Time of Oil and Gas Accumulation, A. I. LEVORSEN, Stanford University.

A perplexing problem in petroleum geology is whether the oil and gas originate at or very near the point of accumulation, or whether they have migrated in from some distant area of origin. Examples of both *in situ* and distant origin can be cited that seem to indicate both occur in nature.

For those pools which seem to indicate migration from a distant source, a rough guide as to the time of the accumulation is offered. It is based on the timing of the formation of the trap into which the oil and gas accumulate—the accumulation cannot occur before the trap is formed. In considering the interval between the time of formation of the reservoir rock and the present time, most producing traps can be separated into the varying component elements which go to make up the trap as it now exists. Examples of different combinations of trapmaking events are given as a guide to the time before which accumulation could not have occurred. Furthermore, the capacity of a trap is in part a function of the depth of burial of the reservoir—a phenomenon which also supports a relatively late accumulation of many pools.

8. "Permafrost and Related Engineering Problems," SIEMON WM. MULLER, Stanford University.

Permafrost or permanently frozen ground is a widespread phenomenon in the northern hemisphere. About one-fifth of all land area of the world is underlain by permafrost.

Wherever present, permafrost affects in one way or another (or is itself affected by) every field of human endeavor. The consideration of permafrost is vital in planning transportation routes, settlements, pipelines, drilling operations, etc. Roads, railroads, and buildings, inappropriately located or improperly designed and built, are likely to be damaged and rendered useless. Drilling tools may freeze in the hole, causing the abandonment of a project. In the permafrost area, the problem of water supply claims foremost attention.

Stresses that develop in freezing ground may exceed 2,000 kilograms per square centimeter. Just as the Russians have done in the past, we are learning, in the hard way, that it is uneconomical if not futile to "fight" the natural forces of frost by using stronger materials, more rigid designs, or to resort to periodic and costly repairs, which rarely if ever succeed in a permanent righting of the situation. Successful solution of permafrost problems depends on a thorough understanding and correct quantitative evaluation of the component elements and on the planning of the project in such a way that the frost forces are utilized to play into the hand of the engineer and not against it. A thorough and comprehensive survey of the permafrost conditions should therefore constitute a preliminary and an integral part of any engineering project.

9. "The Cretaceous of Colombia," J. WYATT DURHAM, California Institute of Technology, Pasadena.

During the Cretaceous varying amounts of marine and non-marine sediments were deposited in the North Andean geosyncline which passed through Venezuela, Colombia, and Ecuador. During the maximum period of flooding, all except extreme Western Colombia, part of Eastern Colombia, and a few islands appear to have been covered by the seaway. The Cretaceous sediments usually begin with a sandstone or limestone, which is followed by a thick sequence of black shales with occasional limestone members. Following the black shales, there is a more or less cherty shale or limestone, which is followed by either sands and shales or shales and limestones. The thickness of the sediments varies from around 2,000 feet to more than 40,000 feet. Marine faunas are often abundant and show marked relationships to both the Gulf Coast and the European Cretaceous faunas. From the faunas collected at various localities it appears that most, if not all of the standard Cretaceous section is represented in Colombia.

10. "Origin and Migration of Oil into Sespe Red Beds," THOMAS L. BAILEY, Rothschild Oil Company, Santa Fe Springs.

The name "Sespe formation" is applied to the non-marine red bed facies of a group of sedimentary rocks up to 7,500 feet thick. They range in age from upper Eocene into lower Miocene in the southern and eastern part of the Ventura basin but are probably confined to the Oligocene in most of the northwestern part of that basin. The lower portion becomes progressively marine westward beginning about 25 miles west of Santa Barbara, however, this marine Oligocene is mainly sandstone, low in organic material, and can hardly be a source rock.

The bulk of the evidence suggests that most of the oil was derived from Eocene shales. Upward migration across the bedding of several hundred to a few thousand feet of predominantly sandy strata seems to be required. Countless minor joints and cracks in the shaly interbeds are suggested as the principal channels of upward migration. In the southeastern part of the Ventura basin, some of the oil may have reached the lower, or Eocene portion of the Sespe by lateral migration from upper Eocene shales into which the lower Sespe may grade, followed by upward migration within the anticlines to the shalier middle Sespe where it is trapped.