the Monument upwarp in southeastern Utah, contains several biostromal layers, one of which changes laterally into small bioherms with typical reef-limestone breccia making up the greater part of the deposit.

A bioherm excellently exposed in the San Juan Canyon walls was examined just above river level in Sec. 4, T. 42 S., R. 18 E., between Mendenhall Loop and Honaker Train. At least eight bioherms have been breached by the San Juan River, several of which are exposed on only one canyon wall. The reef limestones are present approximately two-thirds of the Hermosa thickness below the Hermosa-Rico gradational contact, and the fossils suggest that the bioherms are of Des Moines age.

Regionally, the biohermal trends may be controlled by a shelf related to the Paradox-Salt Valley Basin in southeastern Utah and southwestern Colorado. Valid predictions as to possible distribution of these reefing limestones must be based on further surface examination, subsurface analysis, and an appraisal of regional controls exerted by the Paradox evaporite basin in relation to the Colorado Mountain highlands (Uncompahgre).

22. Porosity and Permeability of Oil Sands: Age and Depth. By Kenneth P. McLaughlin, Department of Geology, University of Montana, Missoula, Montana.

Porosity and permeability data available from the literature have been surveyed to determine as quantitatively as possible the relationships which may exist between these two properties of oil-producing sandstones, their geologic ages, and their present depths of burial. Thorough quantitative analysis of the data was not possible because (1) only ranges of porosity and permeability are available from some references, and (2) many references do not specify as to whether porosity and permeability averages are weighted or are only arithmetic means on thicknesses cored.

The results verify existing belief that the depths from which oil may be produced in the future will be governed primarily by the depths to which sedimentary troughs have been filled and by progress in deep drilling techniques. The data provide some bases for additional speculation concerning the rate of compaction and consolidation of sediments and the relative time of migration and accumulation of petroleum and natural gas.

23. Zones of Stratigraphic Thinning in Relation to Oil and Gas Possibilities in Wyoming. By J. D. Love, United States Geological Survey, Laramie, Wyoming.

Isopach maps of upper Paleozoic and Mesozoic rock units in Wyoming show that there are long zones in which many of these units are thin. Younger zones of thinning are not always superimposed on older zones but most zones trend northwest or north. Each zone may be the result of slight folding and subsequent erosion prior to deposition of the next younger rocks, or it may represent merely non-deposition, slower deposition, or deposition of sediments that differ slightly in volume from those in the surrounding areas. Many zones may be the result of a combination of these factors.

These zones of thinning are of possible economic significance where they are crossed by Laramide folds, for the amount of closure in older rocks beneath the Laramide folds may be materially increased. In areas where the rocks have very gentle monoclinical dips at the surface, some zones of thinning are of such magnitude that there is closure in older rocks at depth.

Zones of thinning developed as early as Pennsylvanian time and as late as Montana time and can be recognized in rock units of most of the intervening epochs. The basic data necessary for construction of adequate isopach maps are lacking in many areas, so not all the outlines of even the major zones of thinning are known. After the zones are located, detailed studies of lithologic changes, porosity and permeability changes, grain-size changes, and other features of the rocks present on and around the zones of thinning would be necessary to determine the effect of zones of thinning on oil and gas possibilities. Such studies will help determine whether most of the oil and gas has accumulated as a result of Laramide folding or whether some may have accumulated earlier along zones of thinning whose structural expression has been obscured by Laramide folding.

24. Geological History of Denver Basin. By Alex W. McCoy III, Gulf Oil Corporation, Tulsa, Oklahoma.

The gross sediments of the Denver basin from Cambrian through Cretaceous are discussed. Isopachous and facies maps are presented. From these the tectonic history of the Denver basin is reviewed and its structural development is reconstructed.

25. Oil and Gas Exploration in Utah. By George H. Hansen, Brigham Young University, Provo, Utah.

Since 1891 more than 600 wells have been drilled for oil and gas in the state of Utah. Commercial gas or oil has been developed in the Uinta Basin, Clay Basin, and the Utah corner of the San Juan Basin. Potential producing horizons have been discovered in rocks of Mississippian, Pennsylvanian, Permian, Triassic, Cretaceous, and Tertiary ages. Extensive oil land leasing and present drilling commitments promise increased activity for the near future.

26. Morrison Formation of Colorado Plateau Region—Progress Report. By L. C. Craig and Clifford N. Holmes, United States Geological Survey, Craig, Colorado.

An intensive study of the Morrison formation in the Colorado Plateau region is being made by the U. S. Geological Survey on behalf of the Atomic Energy Commission. This report summarizes some of the results of three years' work.