The widespread use of chemicals on oil and gas reservoirs composed of limestones has attracted the attention of engineers and geologists to the many wells producing from sands. The early attempts to treat wells producing from sands were not uniformly successful. During the past several years the authors have been collecting cores from various producing horizons; most of them have been studied in the laboratory. In certain areas chemicals have been used on sands with good results. This paper discusses the results of the laboratory work and contains a compilation of well treating data. Of the more than 300 cores studied, over 80% showed an increase in permeability when acidized in the laboratory. The average permeability increase was over 500%. The average acid solubilities of the more than 80 different oil-producing sands was 8.5%.

The authors have also included data on compressive strength of the cores before and after acidizing and chemical and x-ray analyses of typical sands.

35. WILLIAM L. RUSSELL, Wells Surveys, Inc., Tulsa, Oklahoma
Applications of Radioactivity Logging

Radioactivity logging is the only known method of making accurate lithologic records through casing and cement. At present, radioactivity logs are used chiefly to determine exactly where to perforate the casing and cement, and the process has been highly successful in this use. Other applications consist in determining sample lag, making correlations and cross sections, locating faults, mapping subsurface structure for deeper drilling, logging beds too thin for electric logs to record, making detailed lithologic records of oil sands for use in connection with the recovery of oil by water flooding, and surveying potash deposits in cased wells. Well Surveys, Inc., has also developed a method for determining the radioactivity of cores and samples which has proved its value in interpreting the logs and in solving problems of sedimentation.

36. F. H. LAHEE, Sun Oil Company, Dallas, Texas
Wildcat Drilling in 1940

Statistics on wildcat drilling during 1940 indicate that approximately 12.8% of the holes drilled, and 13.5% of the footage drilled, was successful in discovering oil or gas. The average depth of hole was over 3,640 feet, or more than 300 feet greater than in 1939.

Figures on the relative success of the various technical and non-technical methods of selecting wildcat locations are presented.

37. J. C. BARCKLOW, Lane-Wells Company, Oklahoma City, Oklahoma
Radioactivity Well Logs, Their Use and Application in Fields of Petroleum Geology, Economic Geology, and Petroleum Engineering

Much experimental work has been done in the past on radioactivity as applied to making well logs. Recently, about June, 1940, such logs were offered to the industry on a commercial basis. Since that time great strides have been made in the technique of producing these logs. With the advent of logs of this sort many uses and applications for them have suggested themselves. They no doubt will occupy a prominent place in the petroleum industry as the members of that industry become better acquainted with them.

ROCKY MOUNTAINS

38. C. E. DOBBIN, U. S. Geological Survey, Denver, Colorado
Developments in Rocky Mountain Region in 1940

There were no major discoveries of oil and gas in unproved areas in the Rocky Mountain district in 1940, most of the drilling being restricted to inside locations in major fields.

In Wyoming, good shows of oil encountered in the Shannon sandstone member of the Steele shale (Upper Cretaceous) in the Cole Creek field during deeper drilling in 1937 were tested further in 1940 and commercial production found; one relatively small oil well was drilled in the North Labarge field, Sublette County, about two miles northwest of the nearest production in the Labarge field; and wells deepened a few feet in the Tensleep sandstone (Pennsylvanian) in the Mahoney field, Carbon County, and to the basal member of the Tensleep in the Lost Soldier field, Sweetwater County, were good oil wells. During 1940, commercial amounts of oil were first found in the Tensleep in the East Mahoney (West Ferris) field, Carbon County. No new producing zones were found elsewhere in the Rocky Mountain district during 1940. However, in February,

1941, commercial amounts of oil were first found in the Sundance formation (Upper Jurassic) in the Wilson Creek field, Rio Blanco County, Colorado.

In Wyoming the Frannie field, Park County, was extended almost one-half mile northwestward into Carbon County, Montana; Sundance production was extended eastward and southeastward about one location in the Lance Creek oil field, Niobrara County; the Labarge oil field was extended westward by relatively active drilling; and Tensleep sandstone production was extended about $\frac{1}{4}$ mile northeast in the Wertz oil field, Carbon County. Gas production in the Frontier sandstone (Upper Cretaceous) was extended about $\frac{1}{2}$ mile northwestward in the Muskrat field, Fremont County, and less than $\frac{1}{2}$ mile southeastward in the near-by Big Sand Draw field. In the Hiawatha field, Sweetwater County, commercial gas was found in the Wasatch formation (Eocene) about a mile north of the nearest producer.

In Colorado, a good Morrison (Upper Jurassic) sand well was found in the Wilson Creek oil field, Rio Blanco County, $\frac{3}{4}$ mile southwest of the nearest producer; and on the east side of the Hiawatha oil and gas field, Moffat County, one relatively large oil well and one relatively small one were found in sandstones of the Wasatch formation.

During the year, very few important wildcat wells were drilled in the district. In Montana, a 7,116-foot dry hole was drilled through the Sundance sand on the Absarokee structure, Stillwater County. In Wyoming, a 6,302-foot dry hole was drilled to Pennsylvanian beds in the Middle Baxter Basin area, being the first well to test certain lower zones in the Baxter Basin fields; a 4,243-foot dry hole was completed in the Deadwood formation (Cambrian) on the Bull Creek structure, Crook County; and an 8,343-foot dry hole was completed in the Tensleep sandstone on North Geary dome, Natrona County.

A new depth record for drilling in Wyoming was established at 10,121 feet in the Badger Basin field, Park County.

Several relatively short pipe lines were built in the district during 1940, one of the larger ones being the 100-mile line between the Billy Creek gas field, Johnson County, Wyoming, and the Big Sand Draw gas line at Casper.

39. HARRY OBORNE, consulting geologist, Colorado Springs, Colorado
Paleozoic Correlations from Southern Rocky Mountain Front Range to Oklahoma-Texas Panhandles

By means of measured sections and well logs tentative correlations are made from Colorado Springs to the Amarillo Arch. While these correlations are not absolute they are presented in the hope that they may be of use to geologists working in the areas or with the formations involved. The "crinkly limestones" of the Front Range are believed to represent a zone, rather than definite beds which may be followed continuously. This zone is believed to correlate, at least in part, with the Blaine gypsum, and San Andres and Kaibab limestones. The Lyons sandstone, the age of which has been a serious problem because of lack of fossils, is provisionally correlated with the Glorietta of New Mexico and the Duncan sandstone of the Panhandles. By means of well logs and cuttings the Stone Corrall anhydrite and dolomite is carried from the Texas Panhandle into Baca and Las Animas counties in Colorado. Its probable equivalent is shown in well logs to extend into the area between Pueblo and Colorado Springs, where its identity is lost in the upper part of the Fountain arkose. According to this interpretation the Fountain formation would range in age from Cherokee, or perhaps even pre-Pottsville, to Permian. Evidence presented tends to indicate that the Amarillo Mountains may have been uplifted beginning in early Pennsylvanian time and continuing until late Pennsylvania time and that the Marmaton was a period during which great sheets of arkose were deposited in widely scattered areas in central Kansas, along the ancestral Rocky Mountains in Colorado and northeastern New Mexico, and along the flanks of the Amarillo Mountains in the Texas and Oklahoma Panhandles, their distribution being controlled by streams rather than offshore currents. The arkoses of the Oklahoma Panhandle may be the attenuate edges of the arkose sheets of the Texas Panhandle or they may have had a more proximate source.

40. W. A. WALDSCHMIDT, Colorado School of Mines, Golden, Colorado
Results of Petrographic Studies of Sandstone Cores from Rocky Mountain Structures

Detailed petrographic studies of sandstone cores from productive and non-productive structures in the Rocky Mountain region were made to determine not only the