years. Most of this storage is located in producing areas and additional storage is needed in market areas. Three basic requirements are needed for an effective underground salt-cavity storage project: (1) an adequate salt section; (2) fresh-water supply to wash out salt; and (3) disposal facilities for produced brine. The attached report briefly presents the availability and evaluation of each of these requirements as applied to the Stanolind Oil and Gas Company's underground storage project at the Stano Plant, Hugoton field, Kansas.

15. GEORGE ROBERTS, JR., Stanolind Oil and Gas Company, Tulsa, Oklahoma. A Review of Hydraulic Fracturing and Its Effects on Exploration

The process of hydraulically fracturing producing formations has developed into a major method for stimulating the productivity of oil and gas wells. The growth of formation fracturing is reviewed and the reservoir conditions and well conditions which have made it so successful are outlined.

The results of studies are presented which indicate that formation fracturing can be planned to overcome various types of unfavorable conditions. It is indicated that many oil-bearing strata previously considered to have inadequate permeability for commercial production might now be made commercial by creating deep penetrating fractures. The geologist should therefore become as familiar as possible with these possibilities in order to better plan exploration programs.

16. WARREN L. SALLEE and FRED E. RUGG, Dowell Incorporated, Tulsa, Oklahoma. Artificial Formation Fracturing in Southern Oklahoma and North-Central Texas

Artificial fracturing of formations to improve oil production has become a widely accepted procedure. In the few years since the process became commercial, more than 30,000 treatments have been made in the United States.

This paper is limited to a discussion of the fracturing results that have been obtained in southern Oklahoma and north-central Texas. The authors had more than 2,000 fracturing reports available for study. The majority of the work done in this area was in sands of Pennsylvanian age.

Production curves and tables are used by the writers to demonstrate the economic significance of the process. Of the results studied, more than 85 per cent are considered economically successful.

17. CLIFFORD W. MATTHEWS, Western Company, Midland, Texas. Hydraulic Fracture Completions in the Hugoton Gas Field

Formation fracturing by hydraulic process is becoming increasingly more popular as a technique to increase the rate of gas production in the Hugoton field. The productive formations, members of the Chase group, undergo a facies change from dolomites and limestones in the eastern and central part of the field to clastic equivalents updip along the western margin. In these areas, a new type acid-kerosene emulsion has been utilized as a fracturing medium. Results obtained from more than one hundred fracture-type treatments on wells situated in the marginal areas of the field have indicated a higher flow capacity than wells in the immediate locality completed by acidizing.

18. B. K. CRUMPLEY, Texas Company, Wichita, Kansas. Artificial Fracturing of Cherokee Sands in the Gibson Pool, Cowley County, Kansas

In order to present a background for the more specific data concerning the Gibson pool, some general information relative to the areal extent, stratigraphy, and history of oil and gas development of the Cherokee sands is necessary. The Cherokee sands of southeastern Kansas are confined to the Cherokee basin which is limited on the east by the Ozark uplift, on the west by the Nemaha arch, and defined on the north by the Bourbon arch. The basin is also considered to be a northern extension of Oklahoma's McAlester basin. The Cherokee sands, while widespread in this area, are not of the blanket type. In Cowley County, Kansas, which lies in the southwestern corner of the Cherokee basin, the sands are prevalent, but are concentrated in the western half of the county and on the eastern flank of the Nemaha ridge. An area in which they are particularly abundant centers near Arkansas City which lies approximately 3 miles east of the Gibson pool.

The Cherokee sediments which are lower Desmoinesian in age, while not the earliest Pennsylvanian rocks in Kansas, are the oldest represented in this area. Early Pennsylvanian seas were confined in southeastern Kansas by the Bourbon arch which isolated this area from the Forest City basin. The Cherokee section is made up predominantly of shales which, for the most part, are clayey or silty and micaceous. Fifteen coal beds and numerous sands have also been identified. The sands are lenticular and non-continuous, but because of their constant position in the Cherokee section, they lend themselves well to stratigraphic classification. Studies of the shales, coals, and sandstones indicate that they were deposited under cyclical conditions. There has been some controversy as to the true origin of the sand lenses and also a great deal of confusion about the correct correlation and nomenclature. The term "Bartlesville" has been somewhat loosely applied to any sand encountered in the lower part of the Cherokee section. This has been particularly true of the Cowley County area and there is considerable doubt that any sands of Bartlesville age are actually present in this part of southeastern Kansas.

The development of oil and gas reservoirs of the Cherokee sands in southeastern Kansas may be defined into two major periods. One may be considered that period of development prior to the utilization of hydraulic fracturing treatments, while the other represents that period influenced by artificial fracturing. The first period may also be subdivided into several phases. The first commercial well drilled in Kansas was in 1860 near Paola. The outbreak of the Civil War discouraged any further venture such as this, but drilling was resumed following the war and exploration spread all up and down the Verdigris and Neosho Valleys. A major impetus to the development of oil and gas in Kansas was provided by the discovery of the El Dorado pool in 1915 and the Augusta pool in 1916. A generally normal period of development followed with a slight decrease in activity to 1949. In the fall of 1950, the first artificial fracturing treatment was applied to the Cherokee sands in southeastern Kansas with excellent results. This started another near-boom and for the past 2 years the drilling activity has increased many-fold, resulting in many discoveries.

One area in which the hydraulic fracturing of reservoir rocks has produced excellent results is in the Gibson pool, T. 34 S., R. 3 E., Cowley County, Kansas. The name "Bartlesville" has been utilized to identify the producing beds in the Gibson pool to conform to common usage in this area. However, it is believed the sand should be considered Red Fork or Burbank in age and that no true Bartlesville sand is present in this part of Kansas. The discovery well of the Gibson pool is Texas Company's Bryant 1 "A," SE., SE., NW., Sec. 32, T. 34 S., R. 3 E. This well encountered a saturated sand superjacent to the Mississippian, but drill-stem testing of this zone recovered only a minor quantity of mud which was very slightly oil-cut. However, after pipe was set and the formation fractured, the Bryant 1 "A" was completed as a flowing well with a potential of 80 barrels of oil per day on March 3, 1952. Twenty-six new wells have been drilled within the new pool area and in many places the reservoir sand was found to be tight with low permeability and porosity conditions indicated by core analyses and drill-stem testing. However, fracturing treatment, both in the open hole and through casing, has resulted in obtaining some excellent wells, three of which have been given a maximum production rating.

ROCKY MOUNTAIN SECTION ANNUAL MEETING, CASPER, WYOMING, APRIL 23–24, 1953

ABSTRACTS

1. PAUL UMBACH, consulting geologist, Albuquerque and Denver, "Tectonics and Its Relation to Oil and Gas Production in the Four Corners Area of New Mexico, Colorado, Arizona, and Utah."

The type of sediments deposited as a result of geo-anticlines, geo-synclines, local embayments' and uplifts are of major importance.

Sediments indicate the intensity of the uplifts, some of which have been active since at least the Devonian period. Uplifts and embayments have caused varied sediments, ranging from coarse arkose near the uplifts to sandstones, shales, evaporites, and limestones. The mapping of the changes of sediments by isofacies and isopach maps is considered of utmost importance.

The large number of successful wildcat wells drilled for stratigraphic traps as a result of detailed study of the sediments, compared with the success of wildcat wells drilled on anticlinal structures without regard to the types of sediments in the Four Corners area, indicates that a study of the changes in the type of sediments is more important than the mapping of local anticlinal structures.

A study of the type of sediments and the location of anticlinal structures with the seismograph within the areas having sediments favorable for oil and gas reservoirs will be the key to future success in the drilling of wildcat prospects in the Four Corners area.

2. FOUR CORNERS GEOLOGICAL SOCIETY (Presented by SHERMAN A. WENGERD, University of New Mexico, Albuquerque), "Pre-Triassic Stratigraphy of the Four Corners Region."

The pre-Triassic strata of the Four Corners region are a hemi-cyclic complex of marine and non-marine facies resulting from complicated inter-reactions of broad uplifts from both outside and inside the region, localized uplifts and subsidences within the region, and major shifts of eugeosynclinal deposition within the Paleozoic Cordilleran geosyncline on the west.

The major stratigraphic divisions of the Four Corners region are thus four-fold as a direct result of a complex interplay of epeirogenic and orogenic activities within and surrounding the region. An outline summary of these divisions follows.

1. Widespread erosion of the pre-Cambrian complex during the Lipalian interval over the broad San Luis platform of which the San Loid, Defiance, Kaibab, Navajo, and Apache positive areas were only shelf components of the Cordilleran eugeosyncline. The San Luis platform is thus considered to be a broad region separating the Ouachita geosyncline on the east, the Sonoran geosyncline