westward nearly to Colorado. Regional paleotectonic studies indicate that the line of outcrop runs almost from shore to shore diagonally across an elongate seaway extending from northeastern Wyoming southeastward to northeastern Oklahoma. Thirteen distinct facies of the Beattie are recognized, based on mineralogic, paleontologic, petrographic, and field data. Two facies provinces with a boundary in central Greenwood County, Kansas, are clearly indicated. Basin topography is demonstrated to be the prime controlling influence on the distribution and nature of the facies. Simple transgression-regression explanations are not adequate to explain observed facies patterns in the Beattie limestone.

LOUISE JORDAN, Oklahoma Geological Survey, Norman, Oklahoma, and T. L. Rowland, Oklahoma City, Oklahoma

Mississippian Rocks in Northern Oklahoma

Mississippian rocks divided into series by lithologic criteria and by electric-log character underlie Early or Middle Pennsylvanian rocks in the central part of northern Oklahoma. Osagean rocks, or locally, rocks older than Mississippian, underlie Middle Pennsylvanian strata along the north-trending Central Oklahoma arch which includes the Nemaha ridge on the west, the Oklahoma City uplift at the south, and the Cushing anticline on the east. The arch narrows southward as a result of greater uplift and steeper dip, so that on its west flank, the boundaries of Chesterian and Meramecian units which are beveled by Early and Middle Pennsylvanian erosion trend east and then south toward the Oklahoma City uplift. From the east the boundaries trend southwest and then south on the east side of the uplift.

Chesterian strata thicken toward the Anadarko and McAlester basins. Meramecian rocks rest with angular unconformity on the Osagean unit and both series thicken northward on the east side of the arch.

ROBERT C. LANG, Consulting Geologist and President, Compadre Oil Corporation, Ardmore, Oklahoma

Western Limits of Oil Creek Sand in Southern Oklahoma and Northern Texas

The Ordovician Oil Creek sand is found over most of central and southern Oklahoma and parts of Cooke and Grayson counties, Texas. It is one of the best oil- and gas-producing formations in this area.

Subsurface and surface control now available places the western limit of the sand along a line which extends from Stephens County, Oklahoma, to Grayson County, Texas. Generally, in Oklahoma, the limit of the sand is the result of a facies change; in Texas, it is the result of truncation.

Isopachous interpretations in southern Oklahoma show a rapid thickening of the sand away from the strand line. The sand is generally thin in northern Texas.

There have been several recent deep gas-distillate discoveries in Love County, Oklahoma, and Grayson County, Texas, in the Oil Creek sand. Most of these fields seem to be associated with structural traps. There are, however, truncation traps in Grayson County containing oil.

Large accumulations of oil or gas which have used the wedge-out nature of the sand as a trapping agent have not been found so far; however, there are several areas which seem prospective for a trap of this type in the Oil Creek sand.

A. I. LEVORSEN, Consulting Geologist, Tulsa, Oklahoma

Preservation of Early Paleozoic Oil and Gas

One episode in the geologic history of much of the United States and part of Canada consisted of three parts: (1) the formation of several great upfolds or arches at the end of Mississippian time, (2) the erosion of the elevated rocks until Precambrian rocks were exposed along the crests of these uplifts, and (3) the deposition of Pennsylvanian sediments across the eroded and peneplaned surface. A paleogeologic map of this surface of unconformity shows the geology of the eroded surface at the time it was overlapped.

A question that may have significance in exploration is how and where was the oil preserved in the pre-Pennsylvanian rocks during this episode? Obviously all of the "loose" or "free" oil and gas would be expected to have moved into the anticlines and arches and have been eroded or have escaped by seepages along the outcrops of that time. Yet a great amount of petroleum was preserved in the early Paleozoic rocks as evidenced by the oil and gas production in rocks of these ages today. How? and Where?

Some of the possible solutions include such phenomena as oil fields protected because erosion did not extend deep enough, buried wedge belts of permeability, favorable hydrodynamic gradients, late generation of petroleum, late transformation of organic matter to petroleum, late accumulation of petroleum into phase continuity, and post-unconformity (Pennsylvanian) source of the petroleum. Any one, or combinations of several, may explain where and how the oil and gas now found in early Paleozoic rocks were preserved during such an episode. If the regions favorable for the preservation of oil and gas can be located, then these would be areas in which to concentrate detailed structural and stratigraphic work in order to locate specific traps. The same type of reasoning would apply to each surface of unconformity in the geologic section.

RAYMOND C. MOORE, University of Kansas, Lawrence, Kansas

Stratigraphic Frontiers in Petroleum Geology

Like other frontiers that change in location or nature, stratigraphy at beginning of the 1960s appropriately is subjected to reappraisal as an indispensable component of petroleum geology, not to say the most important single subscience applied to oil and gas exploration. Such recognition in no way belittles investigations in the fields of geophysics, geochemistry, sedimentation, petrology, paleontology, structural geology, and the like, because all of these are more or less closely linked with stratigraphical studies. The present paper is introduced by a brief analysis of the stratigraphic content of contributions published during the last two decades in two international journals devoted to petroleum geology and geophysics. This is followed by discussion of the current outlook relating to rock stratigraphy, time-rock stratigraphy, biostratigraphy, Pleistocene stratigraphy, and Precambrian stratigraphy, only the last of which has little importance for the petroleum geologist. Finally, functions of the American Commission on Stratigraphy are stated and purposes of Stratigraphic Codes (a considerably revised North American Code now made ready for publication) are pointed out.

JAMES L. PORTER, Consulting Geologist, Wichita, Kansas

Relating Seismic Time to Geological Datum

Seismic time must be related to a common datum in each shot point, in order that the measured travel time to the reflecting horizon may be compared with all other shot points. The reflection seismograph method was first used in the Gulf Coast province, where the present method of correcting seismic time to a horizontal datum was developed. The special geological conditions of the Gulf Coast allow the correcting of seismic time to a horizontal datum to be usable and accurate. However, when this method of correcting seismic time is applied under other geological conditions, serious errors are introduced.

Three types of errors are inherent in correcting seismic time to a horizontal datum. These are: (1) if velocity is inaccurate, each change in elevation of the shot causes a change in the amount of error introduced; (2) constant velocity is used to correct to the horizontal datum, through different formations in each shot point; (3) formations cross the horizontal datum. When beneath the horizontal datum, these are calculated as having the average velocity to the reflecting horizon. When above the datum, the same travel time is calculated at a much lower velocity. The effect is that all near-surface structure cut by the horizontal datum is exaggerated two to three times.

Seismic time can be corrected to a geological datum if each shot hole is logged. By plotting uphole times on the log, seismic time can be corrected to a geological marker without actually placing a shot opposite the bed. By noting seismic travel time between different beds, seismic time in a whole shooting program may be corrected to a particular geological datum, by using the same methods as have been applied in surface and core-drill mapping.

Seismic time corrected to a geological datum has several advantages over time corrected to a horizontal datum. The seismograph is directly applied to local geology and seismic time is measured through the same near-surface geological section in each shot point. Variations in the seismic time between shot points are related to the deeper geological conditions and therefore more directly related to the purpose of seismic exploration.

Bailey Rascoe, Jr., Phillips Petroleum Company, Wichita, Kansas

Pennsylvanian and Permian Regional Stratigraphy of Western Mid-Continent

Pre-Des Moines (pre- "Thirteen-Finger" limestone), Des Moines, Missouri, and Douglas sediments were deposited by a transgressive Pennsylvanian sea which originated in the Ouachita geosyncline and invaded the western Mid-Continent through the Ardmore and Anadarko basins. Successively younger Pennsylvanian beds overlapped older from the Anadarko basin onto the Central Kansas uplift, and unconformably onlapped pre-Pennsylvanian Paleozoic rocks. During this transgressive phase the Anadarko basin expanded areally as shown by the shelfward migration of (1) the hinge lines and (2) the shelf-carbonate to basin-shale facies changes. When the Anadarko basin expanded to merge with the McAlester basin on the east, blanket sandstones in the latter moved progressively westward into the Anadarko basin.

During Shawnee, Wabaunsee, Council Grove-Admire, and Chase deposition the sea began to withdraw from the western Mid-Continent and move toward the West Texas region through the Dalhart and Palo Duro basins. The Anadarko basin diminished in areal extent as hinge lines moved basinward, and became an embayment off the thicker deposits on the southwest. Shelf-carbonate to basin-shale facies changes moved progressively basinward, and blanket sandstones became successively smaller in areal extent. Permian red shales and sandstones shed by the Apishapa and Front Range uplifts were deposited in the western Mid-Continent in the wake of the retreating sea.

H. W. Stevens, Texaco, Inc., Wichita, Kansas

Stratigraphic Oil Production in Wil Pool Area, Edwards County, Kansas

The Wil pool, located in southeastern Edwards County, Kansas, was discovered in October, 1958, and since has been extended to overlap into Stafford County. Production is from the formations at, or adjacent to, the post-Mississippian unconformity, namely, the Basal Pennsylvanian sands (Conglomerate or Cherokee?), Mississippian, and Kinderhook sand. Although a common source of supply is indicated, there are examples of a separation of reservoirs. Truncation of the various horizons plus impermeable seals are presumed to be the causes of accumulation. In most wells, fracturing is a necessity due to the low permeabilities of the formations and inactive water drives.

The pool has produced more than 158,000 barrels of oil to January, 1959, an average of more than 7,200 barrels per well in one year. Recoveries are not expected to be high, but the 40-acre spacing should make the pool profitable. The reservoir in the Wil pool has been extended to cover parts of 13 sections. Abrupt variations in permeabilities and (or) paleogeologic boundaries will possibly be the main factor in finding local areas unproductive. The total areal extent of the Wil pool has yet to be defined.

Victor J. Veroda, Republic Natural Gas Company, Hugoton, Kansas

Mississippian Production in Southwest Kansas

Southwest Kansas is situated between two regional structural features. They are the Sierra Grande uplift-Buried Amarillo Mountain trend on the southwest and the Central Kansas uplift on the northeast. Mississippian rocks are absent on both features. The Mississippian thickens to 1,800 feet between these features in what is called the Anadarko basin.

The Mississippian system consists of four series. All four produce gas and (or) oil somewhere in southwest Kansas. There are seven major Mississippian pools in the area. They range in size from 18 to 56 gas wells and 41 to 239 oil wells. There are many other commercial pools.

The Mississippian produces from both stratigraphic and structural traps. Developmental drilling has revealed 220 feet of structural relief between 40-acre locations, which is the first indication of faulting in the area. Pool studies reveal an erratic occurrence of sands in the basal Chester, a new objective.

The Mississippian is still in the pioneer stage of exploration. More major pools will be discovered.

Lewis G. Weeks, President, American Association of Petroleum Geologists

Energy in 2059

Population increase and an acceleration in per capita demand for energy will produce a total demand for energy in the year 2059 of 40 to 50 times that of 1959. Thus, demand for energy will a little more than double every 20 years. Much of this energy in 2059 will be