At the beginning of the Pennsylvanian, during Springer time, the sea was quite restricted and sediments of that age were deposited only in southern Oklahoma, in adjacent parts of Arkansas and North Texas, and in the Marathon region of West Texas. During Morrow time, the Pennsylvanian sea expanded somewhat and dark shales and limestones were deposited over a larger area. During Atoka time, conditions changed markedly in the Mid-Continent area, and the Wichita period of orogeny occurred. In addition to the continued uplifting of the Llanoria or Ouachita Mountain land mass to the southeast, three other different kinds of uplift occurred. One set of the new uplifts formed large anticlinal islands, such as the Wichita Mountains and Uncompahgre Uplift, trending northwest-southeast in the expanding Pennsylvanian sea. These large islands were eroded rapidly and clastics accumulated on their flanks. Some of the other uplifts were smaller and were rapidly buried by later sediments. The sea expanded to form new marine basins between uplifted land-masses.

During Des Moines-Strawn time, the Pennsylvanian sea probably extended to its maximum limit in this region. Thick sands which have produced much oil were deposited on the eastern side of the area and many limestones accumulated in the western area.

During Missouri-Canyon time, there was relatively little uplift or structural movement. Conditions in the seas were most favorable for reef building by calcareous organisms, particularly in West Texas.

During Virgil-Cisco time, another period of orogeny, the Arbuckle, occurred in southern Oklahoma and extended into the Panhandle of Texas. The Arbuckle and Wichita mountains were again uplifted and the thick series of Pennsylvanian shales and sandstones in the Ardmore and Anadarko basins were folded and faulted to form traps that produced many prolific oil fields.

ROBERT J. BEAMS, Sunbeam Oil Company, Ardmore, Oklahoma. Oil Development and Possibilities of Springer Sandstones.

The Springer sandstones of the Ardmore and Anadarko basins have attained in recent years a prominence previously held only by the Wilcox sands in the oil industry of Oklahoma. This paper is given in recognition of this current interest, and is intended as a progress report on those aspects of the Springer which are pertinent to oil exploration.

The Springer formation is composed of fine grained sandstones and dark gray to black fissile shales in the Morrowan series; overlain by the lower Dornick Hills formation and underlain by the Mississippian Caney formation.

The present subsurface distribution of the Springer was determined by erosion which took place during the Wichita orogeny and the Arbuckle orogeny. The truncated boundaries of the formation, as shown, represents the outcrop pattern of these strata previous to the deposition of younger Pennsylvanian, Permian, and Cretaceous beds. The Springer formation or its stratigraphic equivalent is present in the Ardmore, Anadarko, and McAlester basins and the Ouachita Mountains.

As shown by local conditions in typical fields, the Springer sandstones are oil productive from both anticlinal and stratigraphic traps and often associated with complex systems of faults and tightly folded beds.

A brief discussion of the reservoir characteristics including ultimate oil recoveries reveals the motivating force for the intensive search for Springer oil.

Geological comparison of oil producing fields with unexplored areas indicates that vast oil accumulations are undiscovered. These Springer sandstone potentialities are of a sufficient magnitude to insure Oklahoma of much additional exploration and production activities for many years.

T. E. WEIRICH, Phillips Petroleum Company, Bartlesville, Oklahoma. History and Petroleum Geology of the Early Pennsylvanian Rocks in Eastern Kansas and Eastern Oklahoma.

Early Pennsylvanian sediments exhibit the existence of a continental shelf in the sea progressively migrating northwestward in sympathy with subsidence of the Ouachita trough. This platform is defined on the northwest by an encroaching shoreline, on the southeast by a migrating flexure or hinge line. Littoral deposition, that is, barrier beaches, bars, lentils and general discontinuity prevailed in the sands over the shelf. Accumulation of commercial petroleum, whether in anticlinal or stratigraphic traps, is limited to the shelf. This condition is strong evidence of local origin, migration and accumulation of oil. The progressive migrating character of the shelf may be depicted by a series of isopach maps grouping the strata as follows: 1. Atoka and Hartshorne; 2. McAlester, Warner and Savannah ("Lower Cherokee"); 3. Boggy ("Middle Cherokee"); 4. Stuart, Thurman, Senora and Calvin ("Upper Cherokee").

HENRY J. MORGAN, JR., Atlantic Refining Company, Dallas, Texas. Paleozoic Beds South and East of the Ouachita Folded Belt.

In recent years five wells have been drilled in the rearward areas of the Ouachita Folded Belt. These wells, under the old conception, should have either encountered pre-Cambrian rocks or the usual sequence of dark, steeply dipping, varyingly metamorphosed beds characterizing the Ouachita Folded Belt.

Instead, these wells, under the normal thickness and facies of Mesozoic formations, found Paleozoic beds that showed no evidence of metamorphism, and that exhibited flat dips in cores.

It is proposed to describe these occurrences in some detail and to assess the effect they have on presently held theories concerning Llanoria and the Ouachita Folded Belt.

BEVERLY MCMAHON, Shell Oil Company, Wichita Falls, Texas. Atoka Series in North Central Texas.

During the Mississippian and Pennsylvanian periods in North Texas, the area of thickest accumulation shifted westward and the tectonic activity, as shown by the character of the sediments and their rate of thickening, decreased. In the sequence of gradually changing depositional environments from linear geosynclinal type to continental basin type, the Atoka and Des Moines epochs are transitional. The depositional pattern of Atoka sedimentation suggests a modified geosynclinal environment.

Sediments of early Atoka time indicate that the Atoka basin formed under conditions of considerable crustal mobility. Thousands of feet of interspersed shale and "dirty" sandstones attest the rapid burial of the geosynclinal sediments. The Atoka series thins rapidly across a hinge area, where the sediments are predominantly shales with some interbedded sandstones, to the shelf area, where limestones and dark shale were deposited. The different sedimentary types, controlled by environment, were deposited contemporaneously. The marked divergence of time and lithologic units makes it advisable to apply terminology only to facies types.

The Marble Falls formation in North Central Texas, as generally considered, includes the Pennsylvanian-Mississippian unconformity.

Although the Muenster Arch was not uplifted until post-Atoka-pre-Des Moines time, conditions existed in the general area which inhibited the rate of downwarping relative to the surrounding area. The thinner Atoka sediments, which were deposited over the Arch, were later removed by erosion.

HERBERT D. HADLEY, Billings Geological Service, Billings, Montana. Development in the Williston Basin.

Modern exploration for oil and gas possibilities in the Williston Basin began with the drilling of the California Kamp No. 1 well during 1937–38. Some attempt to further evaluate this huge area was made in 1940, '41 and '42.

The present activity was initiated by discovery of oil in the C. Iverson well on Nesson anticline by the Amerada Petroleum Corporation in 1951. This was followed by the Shell-Richey discovery in Dawson County, Montana. At least seven new fields have been discovered to date, and it is becoming increasingly apparent that the Cedar Creek and Nesson anticlines may be the location for very large oil reserves.

Commercial oil has been found in rock of at least four different ages with several potential horizons believed present in the Mississippian, Devonian and Ordovician. While the Paleozoic rocks, to date, have proved the most fruitful, there is much yet to be learned concerning the age of portions of the thick Paleozoic section.

Cost of wildcat drilling varies from $50,000.00 to as much as $750,000.00 per well.

Estimates of the number of wildcat tests to be drilled during 1952 run as high as 250.

The discoveries to date have been located where structural closure is thought to exist, but as additional information is secured many tests will be drilled to evaluate stratigraphic variations.

HARRY L. THOMSEN, Shell Oil Company, Tulsa, Oklahoma. Oil and Gas Development in the Denver-Julesburg Basin.

Close to 50 new producing areas have been discovered on the east flank of the Denver-Julesburg Basin since the discovery of oil in Cheyenne County, Nebraska, by the Ohio Oil Company in June, 1949. All of these fields produce from Dakota group sandstones of Cretaceous age, at depths ranging from 3,300 feet to 7,350 feet. Deeper objectives appear to be present but as yet are relatively untested in the central part of the basin.

Most of the new fields have been found by use of the seismic method. They appear to be located on structural anomalies of minor relief, but it is apparent from subsurface information that stratigraphic changes within the Dakota group often aid in controlling accumulation.

More than half of the undeveloped acreage in the basin is now under lease. Exploration and development work is proceeding at a high level particularly in the area outlined by recent discoveries, which covers over one-tenth of the total basin area.

P. R. SCHULTZ, Stanolind Oil and Gas Company, Tulsa, Oklahoma. Oil Discovery—Past, Present, and Future.

Current alarm concerning the ability of the petroleum industry to satisfy the liquid fuel requirements of the United States is unwarranted. Unfortunately, information released by the industry in the past has been misinterpreted so as to indicate that the potentiality of the nation is reaching a criti-