Zenith pool, production is obtained from Misener sand, Maquoketa dolomite, and cherty dolomite of the Viola. In the Peace Creek pool, oil is produced from the cherty Viola dolomites. Production in the Stafford pool is from the Viola, and one well is producing from the Arbuckle.

Where present, the top of the Fernvale in this area is considered the top of the Viola. Fernvale limestone is present over most of the producing areas under consideration. Two pronounced unconformities are present: one between the Pennsylvanian and Mississippian, and the other between the Mississippian and Ordovician. Post-Fernvale –pre-Kinderhook erosion is shown by the absence of Maquoketa and Fernvale over considerable areas adjacent to the pools.

In the Peace Creek and Zenith pools, accumulation is thought to be controlled by stratigraphic trap conditions, while in the Stafford pool accumulation is controlled by structure on the Viola.

49. CHARLES B. READ, U. S. Geological Survey, Washington, D. C.
LLOYD G. HENBEST, U. S. Geological Survey, Washington, D. C.
Pennsylvanian and Permian Stratigraphy of Northern New Mexico

This paper deals with the Pennsylvanian and Permian rocks exposed in the northern half of New Mexico. The Pennsylvanian consists of marine arkoses, shales, and limestones with interbedded continental clastics, including some coal. The Permian consists mainly of redbeds, arkoses, evaporites, and thick, light-colored, cross-bedded sandstones with local marine clastics and limestones in the lower part. A profound unconformity separates these rocks from the underlying granites and metamorphics of supposed pre-Cambrian age. Lithologic variations reflect the pre-Pennsylvanian physiography and the changing distribution of land and sea during the periods of deposition. All of the main units, except a basal limestone, contain fossil plants, fusulinids, and metazoans that provide evidence for detailed correlations. The earliest sedimentary formation in the areas of outcrop is a local massive limestone whose age is uncertain because it is barren of fossils excepting very rare, small crinoid columnals. It seems to be nearly conformable with the early Pennsylvanian rocks and is tentatively included as a formation with them, though it may be Mississippian or even earlier in age. Above this are rocks of Morrow, Des Moines, and upper Pennsylvanian age, though a complete succession is not present everywhere. The Morrow and lower Des Moines rocks commonly consist mainly of clastics and include some coal. The remainder of the Des Moines is dominantly calcareous and contains many horizons of *Wedekindellina* and *Fusulina*. The upper Pennsylvanian is represented by both marine and continental rocks and locally contains abundant *Triticites*.

The Wolfcamp equivalent is composed of marine and continental rocks, the latter continuing upward into possible Leonard equivalents. Above these are light-colored, tangentially cross-bedded sandstones, thin limestones, and evaporate-bearing redbeds of possible Leonard and Whitehorse age. Upper Triassic sandstones commonly overlie the last named.

Work in eastern Arizona has indicated a need for revision of the Arizona-New Mexico Permian correlations. The top of the Permian in the Colorado Plateau, the Kaibab limestone, is apparently the equivalent of the San Andres formation. Careful tracing eastward from the DeChelly upwarp indicates a continuation of the DeChelly sandstone or an upper tongue of the Coconino sandstone into the Glorieta sandstone and the Yeso formation of New Mexico. The Abo sandstone of some parts of New Mexico may be correlated with the lower Coconino as well as with the Hermit shale and Supai formation.

50. LAURENCE L. SLOSS, Montana School of Mines, Butte, Montana
EUGENE S. PERRY, Montana School of Mines, Butte, Montana
The Big Snowy Group: Subsurface Extent and Character in the Northwest Great Plains

The Big Snowy group, as defined by Scott, consists of an upper and middle Mississippian series of shales, limestones, and sandstones with some evaporites. Recently drilled deep wells and new interpretations of older wells in eastern Montana and the Dakotas yield information which makes possible further considerations on the eastward extension of Big Snowy sediments.

An isopach map of the group indicates that an east-west depositional basin in Montana fingered over the northern portion of a widespread area of lower Mississippian (Madison) deposition. South of a narrow peninsula which occupied the approximate

position of the Montana-Wyoming state line, a more restricted basin was the site of nearly simultaneous deposition of the Sacajawea formation of Wyoming.

Sediments of the Big Snowy group in eastern Montana differ from those of the type (surface) section in the diminution of coarse sandstone and green shale and the notable increase in red shale and anhydrite. The ease of divisibility of the Big Snowy group into its component formations rapidly decreases eastward, and, moreover, there appears to be a gradational transition from Madison into Big Snowy deposition in contrast to the presence of a hiatus between the two groups in central Montana.

51. W. NORVAL BALLARD, Consulting Geologist, Oklahoma City, Oklahoma
Notes on the Structural History and Oil Possibilities of the Dakota Basin

This article contains a structure map contoured on the top of the Dakota sandstone. The periods of tilting and folding are discussed along with the evidence for these structural deformations. Three cross sections are included to explain the structure and geologic history. Paleogeologic maps for the pre-Cretaceous and pre-Pennsylvanian surfaces are shown. The possible oil- and gas-producing zones of the Dakotas are discussed and compared with sands that are producing oil or gas in the surrounding states.

52. PAUL H. PRICE, West Virginia Geological Survey, Morgantown, West Virginia
A. J. W. HEADLEE, West Virginia Geological Survey, Morgantown, West Virginia
Natural Coal Gas in West Virginia

A quantity of methane approximately equal to the state's production of natural gas escapes to the air from West Virginia coal mines. It is very important that a technology of production of this gas be developed.

Natural coal gas occurs sorbed in the coal except where there are feeders, squeezes and drainage belts due to mining operations. The gas consists of 90 per cent methane, most of the remainder being nitrogen and carbon dioxide.

Methane was produced by biochemical processes during coal formation. In some instances, a considerable quantity of methane is now being formed by bacterial action in mine waters.

53. ROBERT C. LAFFERTY, The Owens, Libbey-Owens Gas Department, Charleston, West Virginia
RALPH N. THOMAS, Inland Gas Corporation, Ashland, Kentucky
"Corniferous" in Eastern Kentucky and Western West Virginia

In this paper the limestones of Devonian and Silurian ages, occupying a stratigraphic position between the Devonian Shales above and the Silurian Shales below, are considered the "Corniferous." Three more or less persistent zones of porosity are recognized in these rocks.

With the increasing demand for natural gas in the eastern industrial area and the rapid drilling of the shale-gas territory, interest in the producing possibilities of the "Corniferous" has once more been revived.

Localized thinning over known fields in the regionally converging "Corniferous" suggests that production is controlled by porous zones of shoreline deposition, and unconformities, that are the result of movements and oscillation of shallow seas on the epi-continental shelf during deposition of the sediments.

54. F. B. PLUMMER, University of Texas, Austin, Texas
Contributions of Petroleum Engineering Research to the Problem of the Migration and Accumulation of Oil

The anticlincal theory of the origin of oil pools has dominated petroleum geology since first mentioned by T. Sterry Hunt in 1860. In spite of the importance and wide acceptance of this theory, the exact mode of oil migration and its accumulation to produce an oil pool is still a controversial problem and one concerning which quite divergent views are held by geologists at present. Recent investigations by chemical and petroleum engineers on the flow of fluids, fluid mixtures, and gas through sands have contributed some data toward the solution of this important. In this paper some of the results of recent work is reviewed briefly, and their application to the explanation of the migration of hydrocarbons through water-bearing sands is pointed out.

55. URBAN B. HUGHES, Consulting Geologist, Jackson, Mississippi
Developments in Southeastern United States in 1941

Outstanding development trends in the Southeastern United States during 1941 were the following.