of 853,032 feet. In North Louisiana 798 wells were drilled with total footage of 2,355,514 feet. Of the total of 1,005 wells drilled in South Arkansas and North Louisiana, 564 were oil wells; 123 were gas and gas-distillate wells, 187 were dry holes in fields and 131 were wildcat dry holes.

In South Arkansas, during 1941 "Travis Peak" production was discovered in the Smart sand area of the Stephens field of Columbia County. Cotton Valley production was discovered in the East Schuler field in Union County, and Smackover lime gas-distillate production in the Macedonia field, in Columbia County. Smackover lime oil production was discovered in the Mt. Holly field, Union County and in the Patton field, Lafayette County.

In North Louisiana during 1941 six Eocene Wilcox sand oil fields were discovered in La Salle Parish and two in Catahoula Parish, with one gas-producing area in Caldwell Parish.

Lower Cretaceous Pettit limestone oil production was discovered in the Haynesville field, Claiborne Parish, during 1941. Other Claiborne Parish discoveries are the Athens and North Lisbon fields where gas-distillate production was found in the "Travis Peak." Smackover lime gas-distillate production also was developed in the North Lisbon field, the only Smackover production to date in North Louisiana.

15. LOUISE BARTON FREEMAN, Department of Mines and Minerals, Lexington, Kentucky

Silurian and Devonian Stratigraphy in the Area South and East of the Western Kentucky Coal Basin

The area under discussion is practically coincident with that underlain by Chester and Lower Mississippian south and east of the Western Kentucky coal basin, and includes Breckinridge, Meade, Hardin, Grayson, Larue, Hart, Warren, Barren, Allen, Logan, and Todd counties. Numerous wells have been drilled in these counties to test the so-called "Corniferous," or limestone beneath the Chattanooga shale.

The study of such samples as are available demonstrates the enormity of the erosional unconformity between the Beechwood (Hamilton) and the directly underlying formation, which may be Silver Creek (Hamilton), Jeffersonville (Onondaga), a member of the Silurian or Upper Ordovician. This thin limestone rests on older and older strata as the crest of the Cincinnati arch is approached on the east and has been entirely removed in many places close to the present outcrop.

The Jeffersonville with its basal sand also overlaps from Clear Creek onto the Louisville (Silurian) limestone. At the south end of the basin the pre-Jeffersonville unconformity is less striking than on the east, but the Chattanooga shale rests on strata ranging in age from Hamilton through Jeffersonville and Clear Creek to the Bailey (Helderberg), and in northern Tennessee the shale directly overlies the Upper Silurian.

16. E. E. REHN, The Ohio State University, Columbus, Ohio

Onondaga Group of Parts of West Virginia and Virginia

The Onondaga group discussed in this paper includes all rock units between the top of the Oriskany (Ridgeley) sandstone and the base of the Marcellus formation of the Hamilton group. It corresponds in part to the "Corniferous" of older reports and drillers' records. Within the area described it contains two separable lithologic members, an upper shale and a lower chert.

In southeastern West Virginia the group is represented mainly by the Huntersville chert, which crops out in a belt about 120 miles long in Pocahontas, Greenbrier, Monroe, and Mercer counties. In Pocahontas and Greenbrier counties it is exposed on both flanks of the Browns Mountain anticline which lies west of the Allegheny Front. In Virginia and elsewhere in West Virginia it is confined to the Valley and Ridge physiographic province, where it has been traced as far south as Saltville, Virginia. The formation contains impure chert, highly silicified shale, silicified mudrock, and, commonly, one or more prominent glauconitic sandstones. In general the Huntersville has few fossils, but at some localities there occur numerous species which the author has identified and recorded. The Huntersville chert occupies a stratigraphic position held in northeastern West Virginia and northwestern Virginia by a shale of Onondaga age which is believed to correspond with the Needmore shale of southern Pennsylvania. The chert appears to grade laterally into this shale, although where both units are represented, the shale invariably overlies the chert. Thus, the shale is partly younger than the chert. The upper Onondaga contact is apparently conformable, but an unconformity at the base reaches great magnitude at several localities in Virginia.

Wells pentrating deep horizons in West Virginia, western Pennsylvania, and eastern Ohio encounter a limestone and chert unit at the general Onondaga level. This unit is the eastern subsurface extension of the Columbus limestone of Ohio and, probably, the analogue of the Onondaga limestone of New York. It is also the precise equivalent of the Huntersville chert. Commercial gas was discovered in it (1936) along the Chestnut Ridge anticline of southwestern Pennsylvania, and a recent Oriskany test well on the same structure encountered rock pressure of 3,275 pounds in the Huntersville. Most likely the chert is a reservoir only because of brecciation. The extreme brittleness of the Huntersville is attested on the outcrop by strong fragmentation wherever it is folded. This fact suggests its potential value as a gas and, possibly, an oil reservoir wherever deformation has caused brecciation at depth.

17. F. A. NICKELL, U. S. Bureau of Reclamation, Denver, Colorado
Geology Applied to Engineering

Engineering geology from an obscure beginning achieved most of its growth in the period of unprecedented construction chiefly during the past 15 years. The responsibility and points of interest of the engineering geologist are distinct in some respects from those in the better known fields of applied geology. However, basic considerations and methods of interpretation differ only in adaptation and emphasis. A few major projects of national importance illustrate typical problems.

18. CARL A. HEILAND, Colorado School of Mines, Golden, Colorado
Applications of Geophysics in War

War-time applications of geophysics come under the heading of military operations and location of essential minerals. In the combat zone, sound ranging helps to locate hostile guns and to adjust friendly artillery. Listening devices determine the approach of submarines or airplanes. Buried munition dumps, shells, and bombs can be located by radio detection devices. Vessels at sea may establish their position by radio-acoustic ranging. Planning of fortifications and harbors and location of construction materials will be aided by seismic refraction, electrical resistivity, and dynamic ground testing. The same methods are applicable to problems involving the construction of railroads, highways, bridges, tunnels, and munitions plants. For the last, added protection is possible by static-ground-resistance investigations. Salvage operations, location of shipwrecks and practice weapons, are aided by echo-sounding and radio methods.

In the second group, geophysics is concerned with the location of water, fuels, and strategic minerals. Water may be found under favorable conditions by electrical and seismic methods, and water wells may be tested by electrical logging. Geophysical foundation investigations are applicable in irrigation, flood-control, and power projects. Magnetic, gravimetric, seismic-reflection, and electrical well-logging methods occupy a prominent place in oil exploration. Coal and lignite deposits may be mapped by geophysical methods. Magnetic, electrical, gravimetric, and seismic exploration methods are now used in a systematic government-sponsored exploration program to uncover vitally needed deposits of bauxite, chromite, manganese, mercury, nickel, tin, and tungsten.

19. HERBERT HOOVER, JR., United Geophysical Company, Pasadena, California
Contribution of Geophysics to the National Effort

20. K. C. HEALD, Gulf Oil Corporation, Pittsburgh, Pennsylvania
Origin of Oil

21. L. L. NETTLETON, Gulf Research and Development Company, Pittsburgh, Pennsylvania
Geophysical Evidence on the Mechanics of Salt Domes

In 1934 the author presented a theory of salt-dome formation and illustrated it with a model which indicated: (1) that the motive force causing salt uplift is essentially the gravitational force resulting from the fact that the density of the salt is less than that of the surrounding sediments and (2) that both salt and sediments behave essentially as highly viscous fluids. The present paper considers the experimental and theoretical work, largely by others, carried out since that time which has a bearing on this fluid-mechanical theory.

Hubbert in 1937 derived, from dimensional considerations, the numerical relations between the physical constants of a model and its prototype in nature which should be fulfilled to give true dynamic similarity. Dobrin in 1941 determined physical constants of a fluid salt-dome model, applied Hubbert's analysis, and established that the model