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L. F. Laporte, Brown University, Providence, R. I.
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A. R. Campbell, Shell Development Co., Houston, Tex.
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M. N. Bramlette, Scripps Institution of Oceanography, La Jolla, Calif.

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T. W. Smoot, Illinois State Geological Survey, Urbana, Ill.
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Keith A. W. Crook, University of Alberta, Edmonton, Alberta, Canada.
DISTINCTION OF SHORELINE ENVIRONMENTS IN NEW JERSEY
E. W. Biederman, Jr., Cities Service Research and Development Co., Tulsa, Okla.

MID-CONTINENT REGIONAL MEETING, WICHITA, KANSAS, OCTOBER 28–30, 1959

ABSTRACTS

EDWARD J. ASSITER, International Business Machines Corporation, Houston, Texas

Electronic Computers Aid in Exploration Decisions and Interpretations

Electronic computers are at present being used to solve or aid in the solution of the two categories of problems which exist in exploration.

Where, when, and how much exploration is needed? Which exploration tools are desirable and in what proportion? These questions demand logical decisions based on voluminous data. Here the role of the computer is to summarize and generalize these data to permit more rigorous decisions by management. In many cases this decision may be compared with others to determine optimum selection.

Computers as interpretational aids are more wisely employed than in the first category. The reason for this is the facility with which interpretational procedures may be expressed in mathematical form. Examples of procedures already being performed on computers are: electric-log analysis, log and core correlations, seismogram synthesis, seismic velocity determination, migration charts, accurate fault location, geological and geophysical maps plotted, cross sections, bore-hole deviation calculation, regression analysis for geological parameters, gravity and magnetic interpretations, etc.

In addition to the mentioned categories many other company problems are solved which are of interest to exploration. Of these, property evaluation and inventory control of exploration tools are of importance insofar as they reduce exploration costs and therefore improve arguments for more exploration projects.

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Isopachous and Paleogeologic Studies in Eastern Oklahoma North of Choctaw Fault

General southward thickening of pre-Desmoinesian stratigraphic units in eastern Oklahoma suggests the existence of a geosyncline on the south during the Paleozoic era until middle Pennsylvanian time.

The Arbuckle group thickens from 500 feet in northeastern Oklahoma to a postulated 5,000 feet in the McAlester basin. The overlying Simpson group is 700 feet thick in the basin, thins northward, and is absent north of Washington, Rogers, Mayes, and Delaware counties. The Viola-Fernvale limestone, Sylvan shale, and Hunton group in the McAlester basin have respective maximum thicknesses of 200, 70, and 255 feet. Northward truncation of Hunton and older units and overlap by the Chattanooga formation suggest strong post-Hunton southward tilting and warping. The Chattanooga averages 55 feet thick over most of the area and thickens toward the south. Post-Chattanooga Mississippian units are widespread in the area and vary locally from zero to 550 feet. The "Springer formation" occurs in a narrow belt in the McAlester basin and is estimated to be 1,600 feet thick. The Morrowan series overlaps the "Springer" and attains a postulated thickness of 2,000 feet in the basin. Post-Morrowan uplift in the Ozark area and accompanying downwarp on the south are shown by a northward truncation of the Morrowan series. The overlapping Atoka formation thins from 6,500 feet in the McAlester basin to its northern limit in Tulsa, Rogers, Mayes, and Craig counties. Post-Atokan recurrence of strong southward tilting is indicated by northward truncation of the Atokan and overlap by Desmoinesian beds.

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Present and Future Oil and Gas Possibilities in Pennsylvanian and Permian Rocks of Southeastern Colorado

Cambro-Ordovician, Ordovician, Mississippian, Pennsylvanian, Permian, Triassic, Jurassic, Cretaceous, Tertiary, and Quaternary sedimentary units are present in the Colorado part of the Anadarko basin. All rocks below the Atokan-Desmoinesian series of the Pennsylvanian system appear to have been deposited in broad, shallow epicontinental seas. Strong epeirogenic unwarp of the Sierra Grande-Apishapa uplift beginning in Atokan-Desmoinesian time and persisting with decreasing intensity through Virgil time resulted in the removal from most of this uplifted area of all sediments down to the granite basement. Concurrently, a band of coarse, arkosic, clastic material was contributed to the Atokan-Desmoinesian, Missourian, and Virgilian sediments fringing the uplift areas. Beyond the perimeter of this coarse clastic material Pennsylvanian and lower Permian deposition was normal shallow marine. Definition of the Las Animas arch throughout Permian and Pennsylvanian time was slight, and this feature did not achieve regional prominence until Cretaceous time.

By middle Permian time the Sierra Grande-Apishapa uplift had been completely inundated by Permian seas. Deposition from middle Permian to the close of Permian time was evidently in a restricted basin environment as upper Permian sediments are increasingly evaporitic.

Recent discoveries in the Morrowan series and the Atokan Desmoinesian series on the southern end of the Las Animas arch and in an area from the Freezeout Creek fault zone to the Kansas and Oklahoma state lines give southeastern Colorado increasing stature as an oil and gas province. Lenticular bodies of the Morrowan "McClave" sand and fingers of arkosic sandstone in the Atokan-Desmoinesian on the southern end of the Las Animas arch offer attractive stratigraphic trap prospects of sizeable proportions. Thick lower Morrowan "Keyes" sand intervals and numerous Atokan-Desmoinesian arkosic sands present interesting structural trap possibilities in the area between the Freezeout Creek fault zone and the Oklahoma and Kansas state lines. North and east of the perimeter of arkosic material derived from the Apishapa-Sierra Grande uplift structural and possibly stratigraphic entrapment of hydrocarbons in carbonate rocks of Missourian, Virgilian, and lower Leonardian age offer a relatively unexplored potential.

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Prospecting for Stratigraphic Traps

Stratigraphic traps are directly related to their respective environments of deposition. An understanding of the depositional environment is essential to successful prospecting for oil or gas from this type of reservoir. Isopach studies of shale units directly above, or both above and below a lenticular reservoir sandstone, are of considerable value in reconstructing depositional environments. Such shale intervals, either directly above a reservoir sandstone, or embracing it, are genetic units, and variations in thickness are completely independent of present-day structural configuration. Isopach maps of such genetic units serve as realistic indicators of where certain lenticular sands were deposited. Depositional trends of beach sands, offshore bars, and strike valley sands are readily determined from such studies. Structural maps, constructed on a reliable time marker within the genetic interval, serve as a means of localizing oil or gas accumulation within any of these reservoir types. In all such studies electrical log data are essential, since arbitrarily selected genetic units are seldom named formational units. The thinner the genetic interval, the greater the necessity for accurate "picks" from electrical log data.

Deltaic reservoirs are poorly understood and only rarely recognized by the geologist. This type of reservoir is, nevertheless, abundantly preserved in the sedimentary section. Regional isopach studies of depositional environment are prerequisite for the construction of meaningful exploration maps of this type of reservoir. An understanding of the trends of distributary fingers and the influence of differential compaction in producing drape structures, likewise, is important.

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Geology of Natural Gas in Arkansas Valley, Arkansas

The Arkansas Valley is an east-west trending synclinorium bounded on the north by the Ozark uplift and on the south by the Ouachita Mountain anticlinorium. The Valley is an eastward extension of the McAlester basin of southeastern Oklahoma.

Pennsylvanian Atoka sediments form the principal outcrops in the Arkansas Valley. The Atoka measures 20,000 feet or more near the Ouachita front. Post-Atoka Pennsylvanian sediments (Hartshorne through Boggy) aggregate 3,000 feet in the western part of the Valley. Cambrian through Pennsylvanian Morrow sediments thicken southward from 5,000 feet or less in the Ozarks to an estimated 25,000 feet of correlatives in the Ouachitas. Little is known of the pre-Pennsylvanian section in the Arkansas Valley because of inadequate drilling densities.

Morrow shales, sandstones, and subordinate limestones were deposited mainly under shallow-water marine conditions. Morrow facies changes occur southeastward in the subsurface and eastward on the outcrop. Meagerly fossiliferous dark shales and lenticular sandstones constitute the Atoka in the Valley. Regional Atoka facies changes have not been observed.

Numerous east-west trending anticlines and synclines have surface expression in the Arkansas Valley. Many are faulted parallel with their axes. Steeply dipping flanks of the folds are indicated on the surface mostly by sharp ridges, and open synclines are expressed by flat-topped mountains. Folds in the southern part of the Arkansas Valley are tight and asymmetrical, with steeper north flanks. Dips of 50° or more are common. Progressively northward, the structures are less tightly folded and more nearly symmetrical. The folding was initiated during the Ouachita orogeny as early as Middle Pennsylvanian time and terminated after Boggy time.

A major fault system marks the structural boundary between the Valley and the Ozarks. These faults are normal and predominantly downthrown toward the south with displacements up to 3,000 feet. The structural boundary between the Arkansas Valley and the Ouachitas is more difficult to define. Faults near the Ouachita front are predominantly downthrown toward the north. High-angle reverse faults and low-angle thrusts are the common types in that region. Major faulting in the Arkansas Valley was not initiated until Atoka time or later.

Only dry gas is produced in the Arkansas Valley, chiefly from the Atoka but increasingly from the Morrow. The gas is sweet, generally high in methane and low in nitrogen. Currently there are 41 designated gas fields in the Arkansas Valley. Daily production averages 50 million cubic feet. Cumulative production since the first commercial well in 1902 totals 300 billion cubic feet. Reserves are in excess of 800 billion cubic feet.

Pennsylvanian production is expected to be expanded both eastward and southward in the Arkansas Valley. Pre-Pennsylvanian sediments, especially the Mississip-