

## THE RELATION OF GEOLOGY TO THE DEVELOPMENT OF THE PETROLEUM INDUSTRY IN ILLINOIS\*

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The position of Illinois as an oil-producing state is illustrated by the fact that it has produced up to date more than 390,000,000 barrels of oil, or about 3.2 per cent of the total so far produced in the whole United States. Our state's rank among oil-producing states has dropped from third in 1908, the time of the highest production, to eleventh in 1928, and because no major oil fields have been discovered in Illinois in the past twenty years the belief has gained ground that possibilities for the discovery of important new productive areas are exhausted. A study of the facts, however, indicates that such a belief is not well founded. The recent discovery of oil pools on local anticlinal structures in the deeper parts of major structural basins in Michigan and in west Texas has an important bearing on the oil prospects of parts of Illinois. It is conceded that much of the success of the operators in the southwest in discovering new fields is due to the work of their geologic staffs. We believe that the discovery of new production in Illinois in the future will depend more and more on geological work.

### DEVELOPMENT OF PETROLEUM GEOLOGY

The application of geology to the problems of petroleum exploration and production began in the Appalachian field through the work of government surveys and universities, but geology was practically unused by the operators of that field at the time of maximum development.

Petroleum geology first came into general use in the southwestern states where the absence of glacial drift and the presence of numerous outcropping key beds facilitated the mapping of structure from surface observations. Many tests of favorable structures have been made in the past thirty years, so that now untested favorable structures discoverable by surface observations are on the whole scarce. But there are large areas where the surface features give little or no indication of the structure of the deeper strata and where conditions are known to be locally favorable for oil accumulation, and therefore petroleum geologists are now concerned mainly with subsurface studies.

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Valuable aids to the study of subsurface geology have come into use in the past few years in the southwestern states, namely, (1) intensive study of drill cuttings from complete sets of samples, (2) micropaleontology used with sample studies in correlation, (3) core-drilling to shallow key-horizons to determine structure before undertaking deep drilling, (4) geophysical methods, the more important of which are gravitational, seismic, and magnetic. Notable success in the discovery of new oil pools has resulted from the use of all of these methods in the mid-continent and gulf coast areas.

#### EARLY DEVELOPMENT

The business of petroleum production began as did other mineral industries through the efforts of practical men, and the early exploration for petroleum was carried on with little or no scientific guidance, largely by "rule-of-thumb" methods. The first successful oil well in America was drilled in 1859 near Titusville, Pennsylvania—the famous Colonel Drake well. Drilling in the Appalachian field proceeded rapidly during the next few years. The time of greatest drilling activity for the eastern states is approximately indicated by the time of maximum annual production as shown in the following table:

New York .....	1882
Pennsylvania .....	1891
Ohio .....	1896
West Virginia .....	1900
Indiana .....	1904
Illinois .....	1908

#### DEVELOPMENT OF THE ILLINOIS FIELD

The majority of the producing wells in Illinois were drilled between 1905 and 1911. The time of greatest drilling activity was therefore somewhat later than it was in the states of the Appalachian region. The present State Geological Survey was organized just at the time that this intensive drilling campaign was beginning and from the first has pursued a policy of cooperation with the petroleum industry. That this policy was a vigorous one is illustrated by the fact that in 1906, only one year after the organization of the Survey, a comprehensive bulletin on the industry was published, namely, Bulletin 2, "The Petroleum Industry of Southeastern Illinois," by W. S. Blatchley. Numerous bulletins have been published from time to time, describing structure, recommending areas favorable for testing, and reporting on previous development.

In spite of the efforts of the State Geological Survey the full importance of geology in the business of petroleum development was not realized by the operators. Consequently a great many wells were drilled without adequate logs being kept, and the saving of complete sets of samples was practically unheard of. For the great majority of the wells in the southeastern Illinois field the operators were content with "skeleton" logs which recorded only the depths to the top and bottom of the oil sand or sands and possibly one or more coal beds. As a result much less is known about the structure and stratigraphy of Illinois than would be if accurate and full well logs had been kept.

As a matter of fact, the old-style petroleum geology, which was first widely applied in the mid-continent field, and which was mainly concerned with the study of surface features, was not suited to Illinois because so much of the state's area is covered by glacial drift. The newer methods mentioned above which have been widely and successfully used in the southwest, namely micropaleontology, core-drilling, and geophysics, have not yet been tried out in Illinois on any extensive scale.

#### OIL POSSIBILITIES

There still remains a large area in Illinois in which the oil possibilities of the deeper strata have not been tested. An area 70 miles wide from east to west and 100 miles long from north to south, lying between the Centralia field on the west and the La Salle anticline on the east, is practically untested. This area includes the deepest part of the Illinois structural basin, and in it the base of the Pennsylvanian strata lies at depths of as much as 2,400 feet. Very few wells have penetrated the Chester series and none have gone deep enough to test the basal Chester sands which have given some of the best production in Lawrence County to the east and in the Sandoval and Carlyle fields to the west. The strata which underlie the Chester are, of course, also untested in this area. The fact that an important oil field is located on a local anticline near the deepest part of the Michigan structural basin, namely, the Mount Pleasant field, suggests that production similarly located with respect to structure should be looked for in Illinois.

Prospecting for oil in the deeper parts of the Illinois basin will, no doubt, be expensive and difficult, as it is in Michigan and elsewhere. The presence of glacial drift and the great depth of drilling necessary to test all possible producing formations make for high costs. Ultimate costs incurred in the production of any oil which may exist in the territory will be kept to a minimum if full use is made of scientific aid.

The best combination of methods for studying subsurface conditions in the Illinois structural basin to guide test-drilling will have to be found by experience. Such a study should begin with the construction of the best possible subsurface structure maps that can be made from the available data. Core-drilling to shallow key-beds is recommended as the most precise method for determining the structure of the Pennsylvanian strata. Although a major unconformity exists at the base of the Pennsylvanian system it is likely that important folds in the pre-Pennsylvanian beds are reflected in the Pennsylvanian strata. The relation between structures in Pennsylvania and older strata is incompletely known, and for this reason it is especially desirable that complete sample sets should be preserved for all deep wells drilled. The samples should be studied by a geologist familiar with the area and by a micropaleontologist. Micropaleontology will possibly be useful in correlating, particularly the Pennsylvanian and Mississippian strata, and accordingly may assist in determining structure. The extent to which geophysical methods may be useful in oil prospecting in Illinois is not yet known.

A small amount of wildcat drilling is in constant progress in Illinois, and present indications are that wildcat activity will increase. Most of the operators are now cooperating with the State Geological Survey in providing samples and well logs, and there is every reason to believe that the newly acquired geologic data will help to find new production.