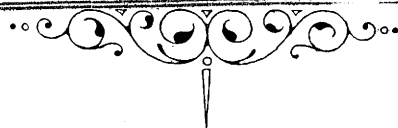
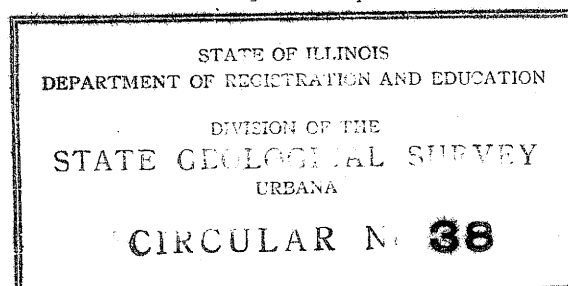


Possible Producing Strata Existing Below the McClosky in Illinois

By **ALFRED H. BELL**

Geologist and Head, Oil and Gas Division, Illinois State
Geological Survey



Reprinted from The Oil and Gas Journal, issue of June 16, 1938

Possible Below

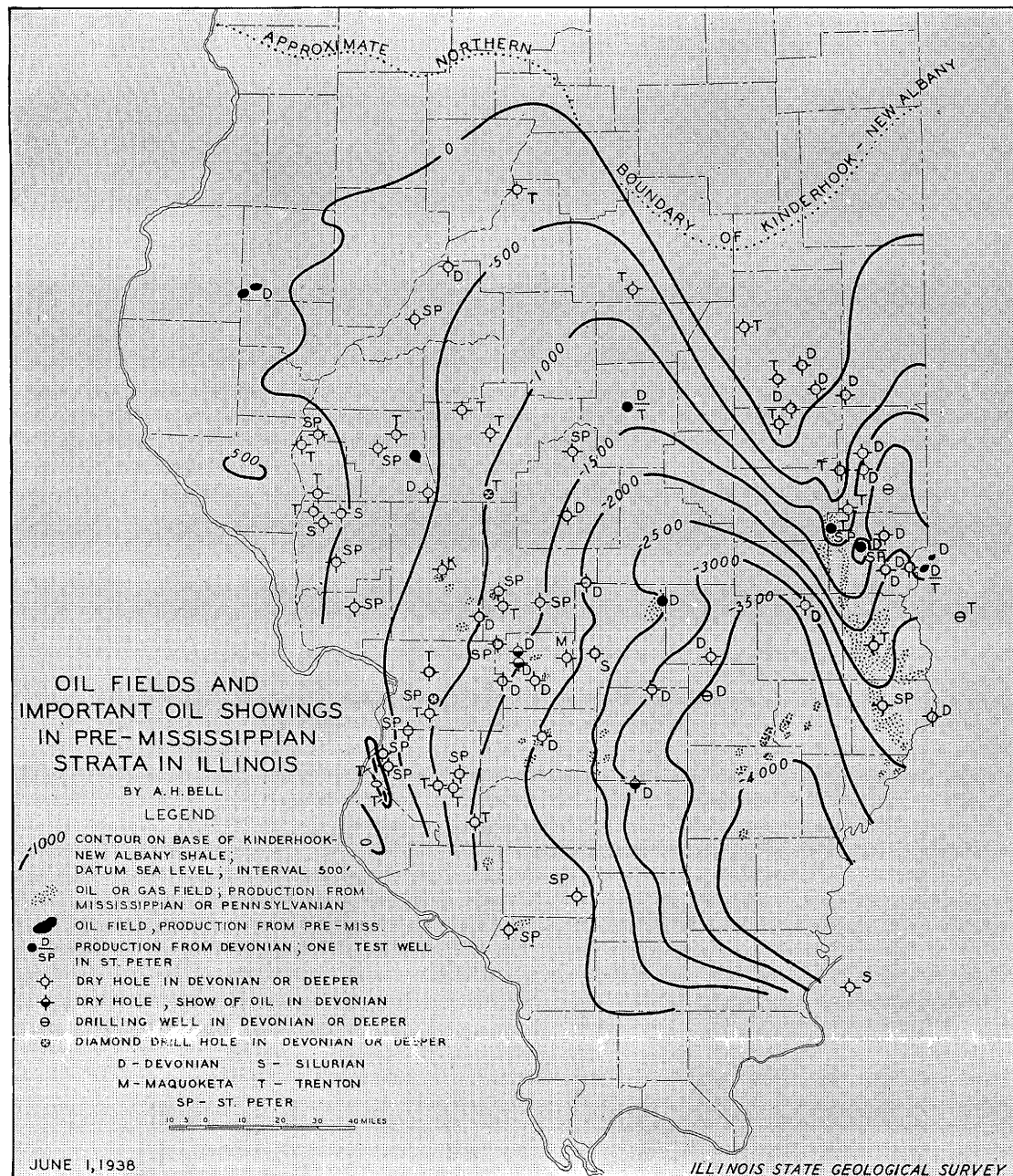


Fig. 1—Oil fields and most important discoveries in pre-Mississippian strata in Illinois

By ALFRED H. BELL

Geologist and Head, Oil and Gas Division, Illinois State Geological Survey*

Nearly all of the oil and gas so far produced in Illinois has come from strata in the uppermost one-third of the geologic column of sedimentary rocks present in the area. In the deepest part of the basin the sedimentary strata have a probable total thickness of 10,000 feet representing the Paleozoic systems from the Pennsylvanian down to the Cambrian. The lowest strata which have so far yielded large production of oil are the McClosky "sand," the Westfield "lime," and the Martinsville "lime," all of which are near the top of the Lower Mississippian or Iowa series. The McClosky has an approximate maximum depth of 3,500 feet in the Illinois Basin.

In view of the fact that important quantities of oil are obtained from pre-Mississippian strata in other states, for example the Devonian system in Michigan and the Ordovician system in the Mid-Continent area, the question of the oil possibilities of these systems in the Illinois Basin region is of interest to the oil industry.

The purpose of this article is to review the available data pertaining to oil possibilities in the two-thirds of the geologic column which lies below the

*Presented before Illinois-Indiana Petroleum Association Conference at Robinson, Ill.

McClosky. As yet, these strata have been relatively little explored in the Illinois Basin.

Evaluation of the oil possibilities of the unexplored portion of the geologic column in the Illinois Basin involves the consideration of several distinct but related types of data, as for example:

1. The lithologic character and fossil content of the various strata composing the column, as revealed by their outcrops in areas marginal to the basin and by cuttings from scattered deep wells within the basin which have penetrated the particular strata under study.
2. Evidence for presence of porous horizons, especially porous horizons of wide lateral extent.
3. The fluid content of porous strata, previous production of oil or gas; showings of oil or gas; brine or fresh water; variations in the content of dissolved minerals; and the areal distribution of this variation for each porous horizon.
4. Unconformities, especially in relation to porous horizons.
5. Structures known from previous drilling or outcrop data which appear likely to continue downward into the deeper strata and structures revealed by geophysical surveys.

New Data From Deep Drilling

Within the last year several wells have been drilled into the Devonian limestone in the basin and two were drilled to the St. Peter in southwestern Illinois. Sample study logs of these wells

from the top of the Lower Mississippian down were used in constructing the cross sections which accompany this paper.

In the remainder of the paper the possibilities for production are discussed in descending order beginning with the Mississippian below the McClosky.

Possibilities in Mississippian Below McClosky

So far little oil has been produced in Mississippian strata older than the McClosky (St. Genevieve) except in the Westfield and Martinsville pools, Clark County, where the McClosky is absent. Here the principal production is from pay zones in the St. Louis and Salem limestones. In western Lawrence County on the crest of the anticline a few wells obtained small production from the St. Louis limestone.

The results of previous drilling suggest that production in the upper part of the Lower Mississippian may be related to an unconformity at the top of this series and that in any particular area it occurs in the uppermost formation. If so, there is small probability of finding important production in the St. Louis and Salem formations in areas where the McClosky is productive, as for example, in the new basin fields. This is merely a suggestion which can be proved or disproved only by the drill.

In western Illinois there are porous, water-bearing horizons in the Keokuk-Burlington limestones of the Osage series. However, few shows of oil have been reported from this part of the section in scattered wells in the basin.

Production is obtained in the Martinsville field, Clark County, from the Carper sand, a standstone in the Kinderhook, above the Kinderhook-New Albany black shale. The Carper sand appears to be of somewhat local occurrence as it is absent in most wells in the basin which have been drilled through its horizon.

Devonian-Silurian Possibilities

Immediately below the Kinderhook-New Albany black shale is a body of limestone several hundred feet thick of Devonian and Silurian age. In most of Illinois both systems are present but the available data do not indicate with certainty how much should be assigned to each system. Accordingly, this series of strata is referred to collectively as the Devonian-Silurian limestone. It is known to the drillers as the "Niagaran" or "Corniferous." In some areas, notably in the vicinity of the Dupo and Waterloo fields, St. Claire County and the Pittsfield-Hadley gas field, the Devonian is absent, so that the Silurian directly underlies the Kinderhook-New Albany shale. In a small part of southwestern Illinois in the vicinity of Valmeyer, both Devonian and Silurian are absent, and the Kinderhook shale lies on Ordovician strata. In an area surrounding the Colmar-Plymouth field, McDonough County, the Silurian is absent and only the upper Devonian intervenes between the Mississippian and Ordovician.

Oil has been produced from the Devonian in

Producing Strata Existing the McClosky in Illinois

the following areas in Illinois and adjacent parts of Indiana, which are listed in approximate order of total production to date:

Area—	County—
Colmar-Plymouth pool	Hancock and McDonough
Siosi pool	Vigo and Sullivan, Indiana
Martinsville pool	Clark County, Illinois
Prairie Creek pool	Vigo County, Indiana
Decatur pool	Macon County, Illinois
Beecher City pool	Fayette County, Illinois

Shows of free oil in amounts bordering on commercial production have been reported from Devonian limestone in the Carter-Tate well, the discovery well of the Dix pool in Jefferson County (which produces from the Benoist sand), the Producers Oil Co., Sam Brown No. 1 and 2 wells, near Old Ripley, Bond County, and in the Barron well about 4 miles north of Old Ripley, in Bond County.

Numerous wildcat test wells have been drilled in search of production in the Devonian, or "Niagaran," particularly in Clark County and the surrounding area. One to three water horizons are reported in the upper hundred feet of the limestone and most well records end with the notation "much water." Oil shows are reported at various depth below the top of the "Niagaran," above the horizon of abundant water.

A number of analyses have been made of Devonian brines, from east-central Illinois and the adjacent part of Indiana. They indicate a wide variation in dissolved mineral content from approximately 13 to 135 parts per thousand. There appears to be little relation between the dissolved mineral content of the water, and the known geological conditions. Moulton has suggested that a low mineral content indicates effective water circulation and hence a high permeability of the containing rock and that conversely a high mineral content is associated with low permeability. He states "A sodium chloride content in this general territory of from 20,000 to 30,000 parts per million is believed to indicate favorable conditions of permeability . . ." (Illinois Petroleum 14, pp. 11.) This seems to the writer to be a favorable working hypothesis but more evidence is needed to establish it on a firm basis. Further analyses

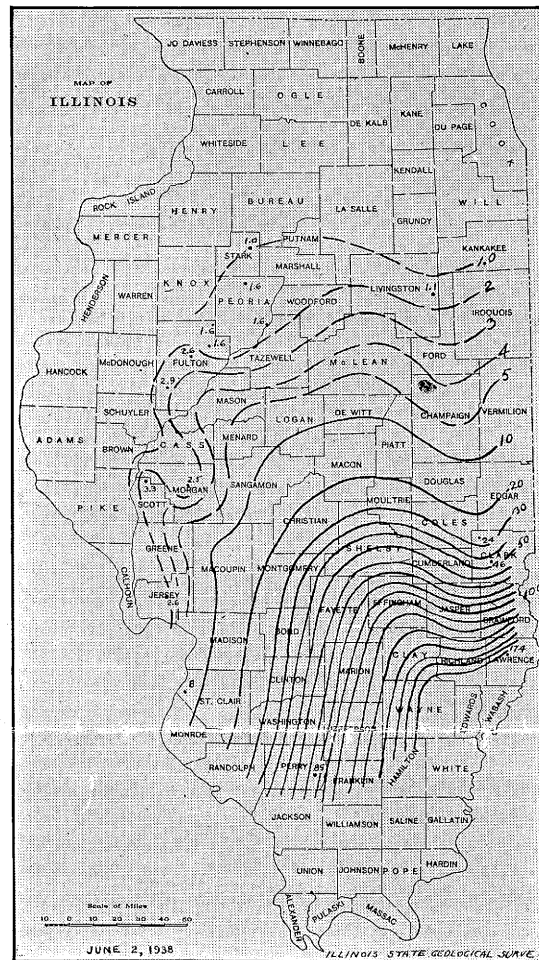


Fig. 3—Contour map of total dissolved mineral matter in water from the St. Peter sandstone. Contours show parts per thousand by weight. Interval varies from 1 to 10 thousand.

should be made of the Devonian brines and determinations of permeability and porosity should be made on representative cores of the rock.

In view of (1) the known presence of oil in

the Devonian-Silurian (Niagaran) limestone in the above mentioned areas scattered through central and southern Illinois, (2) the presence of a fairly consistent porous zone in the upper hundred feet of the section the chances appear favorable for obtaining commercial oil production from this zone on structures in the Illinois Basin. The new fields in the basin indicate the presence of favorable structures caused by "folding" of the rocks, which was particularly strong in the vicinity of the Beecher City, Centralia, Noble, and Clay City fields.

Trenton Possibilities

The "Trenton" limestone of Illinois consists of the Kimmswick, Platin and Joachim formations in southern Illinois and the Galena-Platteville in northern Illinois. The Kimmswick formation in which oil production has been obtained in a few localities in southern Illinois is a light gray, crystalline limestone, nearly pure calcium carbonate.

Little oil production has been obtained to date from the Trenton in Illinois. About 12 wells produced from this formation in the Westfield pool and one in the Martinsville pool, Clark County. The production was small because the lime is "tight." In the Dupo field, St. Clair County, which has produced nearly 1,000,000 bbls. of oil since 1928, the Trenton lime is much more permeable and it resembles the Viola of the Mid-Continent. As yet the eastward extent of the Viola type Trenton in Illinois is not known due to lack of drilling.

St. Peter Possibilities

The St. Peter sandstone lies below the Trenton. Its approximate correlation with the highly productive Wilcox sand of Oklahoma and Kansas has led many to believe that it has very favorable prospects for oil production in Illinois and other states east of the Mississippi River. No well authenticated shows of oil, however, have been reported thus far from the St. Peter in Illinois.

The St. Peter sandstone formation is well known from its outcrops in the Ottawa-La Salle area,

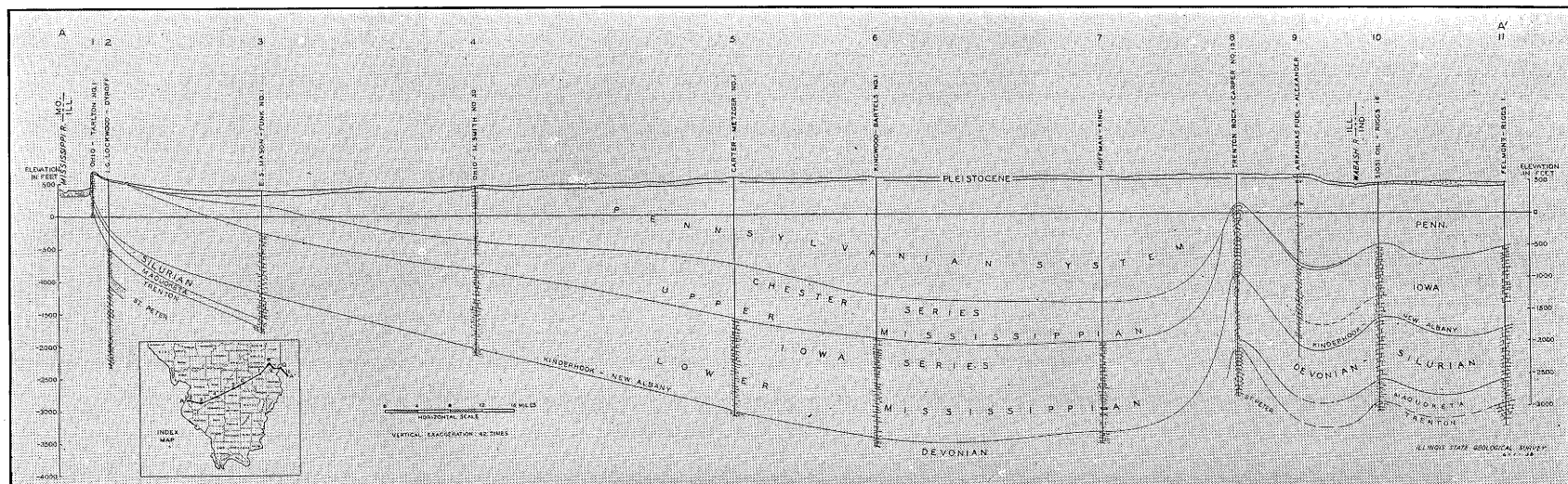


Fig. 2—Cross section of Illinois Basin subsurface taken as indicated in small map at lower left

where on the La Salle anticline it forms the famous Starved Rock, and from numerous wells in the northern part of Illinois, where it is an important source of fresh water. It is a nearly pure silica sand, consisting of rounded, frosted grains, many of which are of nearly uniform size, rather poorly cemented together, so that it disintegrates rapidly upon weathering. It has high porosity and permeability and if it should be saturated with oil anywhere, it would be an excellent reservoir rock.

The St. Peter has not yet been tested in the deeper parts of the basin area. The location of St. Peter tests to date in the southeastern Illinois oil field and in western Illinois are shown in Figure 1. All three of the St. Peter tests in the southeastern field were located on large closed structures in areas of production from shallower horizons, but the St. Peter contained abundant salt water. Two of the three tests were located on the crest of structures, the Westfield and Martinsville domes, the third was located fairly low on the east flank of the western Lawrence County anticline. This is the Ohio Oil Co. No. 23 Middaugh. It is located 2½ miles southeast of the crest of the anticline and 90 feet structurally below the crest as mapped on the Kirkwood sand.

It is of interest to note the variations in dissolved mineral content of the St. Peter water (Figure 3). In northern and western Illinois the St. Peter contains fresh water, the total dissolved minerals being from 1 to 3 parts per thousand by weight. In the three St. Peter test wells in the

southeastern Illinois oil field the total dissolved minerals were 24, 46 and 174 parts per thousand, from north to south. In the Forester well on the Du-Quoin anticline in Perry County the St. Peter water contains 85 parts per thousand by weight of dissolved mineral matter. It thus seems fairly safe to assume that throughout the deep basin area, the water in the St. Peter has a high mineral content. As far as the character of the water is concerned there seems to be no reason why the St. Peter could not carry oil somewhere in the basin.

Figure 4 is a cross section showing three St. Peter test wells. Variations in thickness of the formations above the St. Peter between these wells are shown by the correlation lines. In spite of large variations in thickness of some of the series and formations between wells 2 and 3, the St. Peter is very nearly the same elevation in these two wells. However, the basin intervenes between them and in it the St. Peter may lie at depth as great as 7,000 feet or more.

Below the St. Peter formations is a succession of some 3,000 feet of strata consisting largely of dolomite and sandstone of Ordovician and Cambrian age. Up to date no oil or gas has been produced from these rocks in eastern United States. However, occasional shows of oil have been reported in them, as for example in well No. 2 in the cross section, Figure 2. There is very little shale in this stratigraphic interval and there is considerable question whether there was adequate source material for oil. They cannot be ruled out entirely

in considering possibilities, but the development of production from them in the Illinois Basin appears remote at this time.

In prospecting for oil in the Devonian or deeper strata it cannot be assumed that their structure is necessarily parallel to that of overlying Pennsylvanian or Mississippian. It is likely that future deeper drilling will reveal increasingly complex structure downwards in the geologic column through the Devonian, Silurian and Ordovician systems. Before sufficient deep drilling is done in the basin area, however, the only available clues to the structure of the deeper strata are (1) knowledge of the structure of shallower key beds and (2) the results of geophysical surveys. Recently acquired data are revealing important differences between the structure of the Chester series (Upper Mississippian) and the Pennsylvanian, thus emphasizing the importance of the pre-Pennsylvanian unconformity.

In planning a program of exploration of the deeper strata in the Illinois Basin, it seems desirable at this time to give first consideration to the Devonian limestone, second to the Trenton and third to the St. Peter. Before these strata are tested in the deep basin area, they should be tested on known favorable structures in the marginal areas where they lie at shallower depths, as for example, Centralia, Sandoval, Patoka, Beecher City. If production or encouraging oil or gas shows are found in these structures, deep exploration should be carried progressively into the central basin area.

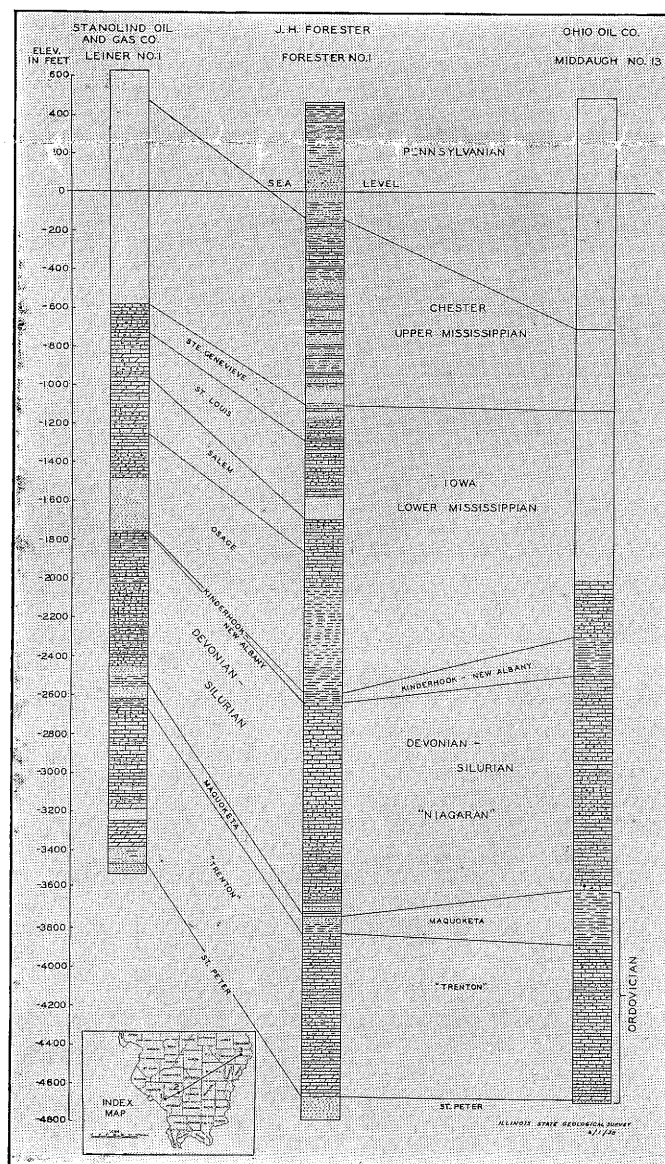


Fig. 4—Cross section of three St. Peter test wells in Illinois