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PROSPECTS FOR OIL DISCOVERIES IN ILLINOIS BEYOND PROVEN AREAS AND FROM DEEPER HORIZONS

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PROSPECTS FOR OIL DISCOVERIES IN ILLINOIS BEYOND PROVEN AREAS AND FROM DEEPER HORIZONS

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M. M. Leighton[2]

Introduction

In this discussion of prospects for oil discoveries beyond proven areas we have reference mainly to new pools that are five miles or more from previous productive areas. Therefore it omits a large area in the Illinois basin where oil pools are already closely spaced, except for considering the possibility of deeper production.

Based on developments in recent years, it is believed that the best possibilities for important new discoveries in Illinois are as follows:

(1) Silurian coral reef production, like that in the Marine pool in Madison County, in a belt extending northeastward from Marine to the LaSalle anticlinal belt in Champaign and Douglas counties.

(2) Rosiclare sandstone production on favorable structures in the general region around the newly discovered Assumption and Assumption North pools, Christian County. This includes Christian, Shelby, and parts of Moultrie, Macon, Sangamon, and Montgomery counties.

(3) Devonian limestone production on favorable structures in the northern part of the Illinois basin (encouraged by the recent discovery of Devonian production in Assumption and Assumption North pools, Christian County, Illinois, and the Wilfred pool, Sullivan County, and Springhill pool, Vigo County, in Indiana).

(4) Fault zone production, like that in the Slaughters pool, Kentucky, in an east-west belt along the Cottage Grove Shawneetown-Rough Creek fault system across parts of Gallatin, Saline, Williamson and Jackson counties.

(5) Stratigraphic traps on the west flank of the LaSalle anticlinal belt in Coles, Cumberland, Jasper, Crawford, and Lawrence counties.

(6) Pre-St. Peter formations in the basin. These are almost wholly untested and their possibilities are unknown. They will be more expensive to test but might contain large oil accumulations.

Historical

Illinois has had two noteworthy periods of oil development, the first, beginning in 1905, resulted in a production peak of 33,686,000 barrels in the year 1908. The second, beginning in 1937, resulted in a production peak of

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Urbana, Illinois

147,647,000 barrels in 1940 (see fig. 1). Since 1940, annual production has declined to 64,639,000 barrels in 1948 or approximately 45 percent of the 1940 rate. The present production rate may be maintained or raised by two means: (1) secondary recovery, and (2) new discoveries. It is with the second of these that this paper is concerned.

Except for methane gas produced from the Pleistocene glacial deposits, Illinois oil and gas comes from Paleozoic rocks. Of the six Paleozoic systems present in the area, one - the Mississippian - has produced about three fourths of the total oil. The Pennsylvanian system has produced about one-fifth of the total, and nearly all of this was from the old Southeastern Illinois field, mainly in Clark, Crawford, and Lawrence counties. The Devonian system has produced about five percent of the total, the Silurian 3/10 percent and the Orodvician 6/10 percent. Up to 1949, the Cambrian has produced no oil in Illinois.

A geologic column for the southern Illinois oil producing region is shown in figure 2, on which oil producing formations are shown by symbols.

A simplified geologic map of the Eastern Interior basin and surrounding region is shown in figure 3 which also shows the location of the Marine pool and major structural features.

Marine pool Madison County and its significance

The Marine pool, Madison County, Illinois, located on the west side of the basin about 25 miles northeast of St. Louis, was discovered in July 1943 following seismograph and gravity surveys. The oil reservoir is a Silurian coral reef and is the first one of its kind to produce oil in Illinois.

Figure 4 is a diagrammatic cross-section of the Marine pool reef. (3)

Up to the end of 1948, the Marine pool had produced 4,683,000 barrels of oil. During December 1948 it produced at the average daily rate of 2899 barrels from 142 wells, an average of ~~50~~ 20 barrels per well per day. Published reports describe the geology and development of the Marine pool.(3) (4)

In the earlier report (1946), Lowenstam and DuBois stated, "The discovery of a Niagaran reef at Marine, far removed from the reef belt which fringes the Michigan basin and the reef cluster in northwestern Illinois and Iowa, appears to be significant. The size of the Marine reef, at least as large as that of any other known Niagaran reef, suggests that the Niagaran deposits adjacent to the Ozark upland are potentially sites of other reefs, and as such have additional oil potentialities. It is not known at present whether the Marine reef is isolated or is part of a reef belt. It seems at least possible that it may be connected by a series of reefs to the known area of reef development in the north."

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(3) Lowenstam, H. A., and DuBois, E. P., Marine Pool, Madison County; Illinois Geol. Survey Rept. Inv. 114, fig. 10, p. 23, 1946.
(4) Lowenstam, H. A., Marine Pool, Madison County, Illinois, Silurian Reef Producer: Illinois Geol. Survey Rept. Inv. 131, 1948.

In the report published in 1948 Lowenstam said, "Niagaran reef rock has been cored near Arthur, Moultrie County, Illinois, and near Covington, Fountain County, Indiana. These previously unknown reef occurrences suggest a reef belt lying south of the Michigan basin belt or linking that belt to the Ozark border."

Since the publication of Report of Investigations 131, in 1948, a new oil producing Silurian coral reef has been discovered in the McKinley pool in Washington County, Illinois, which formerly produced only from the Benoist sandstone in the Chester series. There is also evidence that the Sandoval oil pool, Marion County, Illinois, overlies a Silurian coral reef which was responsible for the oil accumulation in the Devonian limestone and perhaps also in the Benoist sand through upward migration.

The area considered to have the best possibilities for oil in Niagaran reefs is shown in figure 5.

A regional study of the occurrence of Silurian coral reefs with special reference to oil prospecting has been made by Dr. Lowenstam and a report is being prepared for early publication.

Assumption and Assumption North pools, Christian County, and their significance

As one goes north from the deep basin area, the oil producing sands become fewer and thinner. Thus in the Mattoon pool in Coles County there are good pay sands in the Cypress (15 feet average thickness) and Rosiclare (10 feet average thickness), but 10 miles north in the Cooks Mills pool the sands have become thin and tight, and although some oil is present there is only small production. The discovery of excellent Rosiclare sandstone production in the Assumption North pool about 35 miles west of Cooks Mills makes the prospects for additional Rosiclare production on favorable structures in the general region seem much better than it did. There is also some production from the Bethel sandstone and Devonian limestone in the Assumption area.

The area considered to have good prospects for Rosiclare sandstone production on favorable structures is outlined in figure 6.

The discovery of oil production from Devonian limestone in the Assumption and Assumption North pools, Christian County, is a northward extension of the region in which Devonian limestone oil has been produced commercially in Illinois. Some oil was found in about 6 or 8 wells that were drilled between 1922 and 1924 just north of Decatur in Macon County, but it was not commercial. The recent discoveries suggest the possibility of other oil pools in the Devonian limestone in the vicinity (western stippled area in figure 7).

Two oil discoveries in Devonian limestone in western Indiana in 1948 - Springhill in Vigo County and Wilfred in Sullivan County - have revived interest in Devonian possibilities in an area extending into Illinois (eastern stippled area in figure 7).

Fault zone possibilities along Shawneetown and Cottage Grove faulted belt

A major fault zone called the Shawneetown-Rough Creek fault zone extends about 150 miles in an approximate east-west direction in the southern part of the Eastern Interior basin in southern Illinois and Kentucky. Westward from the end of the Shawneetown fault in Illinois, the Cottage Grove fault and related faults constitute a fault zone which approximately lines up with the Shawneetown-Rough Creek fault zone and extends west as far as Duquoin. The northern edge of the highly faulted zone has in the past been considered the approximate southern boundary of the area of best oil possibilities in Illinois, and up to date all of the oil pools in Illinois are north of it.

The discovery in 1947 of the Slaughters oil pool in Webster County, Kentucky, located just south of the Shawneetown-Rough Creek fault zone and about 30 miles from the Illinois-Kentucky boundary, suggests that oil pools similarly located with respect to structure should be sought in Illinois. The territory considered to have possibilities for this type of oil occurrence is shown in figure 8.

West flank of LaSalle anticlinal belt

On the steeply dipping west flank of the LaSalle anticlinal belt in a strip about five miles wide and 100 miles long (see figure 9), there are possibilities for oil production from porous lenses of sandstone or limestone wedging out eastward against the anticline. Some small areas of production from Ste. Genevieve limestone in Lawrence County, for example, the Ruark and Sumner pools are of this type. Some exploratory drilling has been done but much more will be necessary to determine whether or not such stratigraphic traps are present.

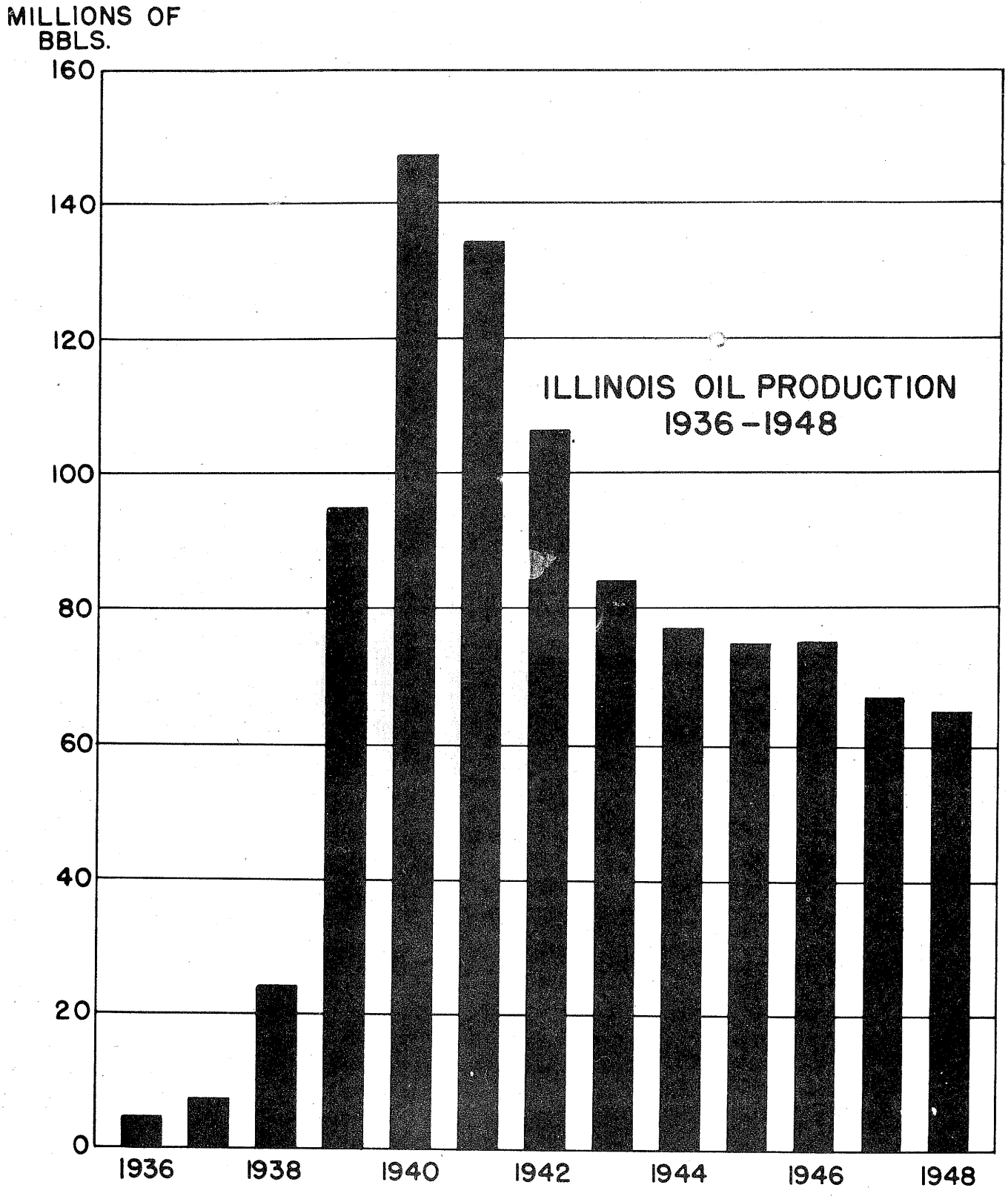
Oil possibilities of strata below St. Peter sandstone

The sedimentary strata from the St. Peter sandstone down to the pre-Cambrian, which are estimated to have a maximum thickness of 4000 to 5000 feet, have not yet been tested in the greater part of the Illinois basin. A line on the map in figure 10 divides Illinois into two parts; in the northern part pre-St. Peter oil prospects are considered improbable, the southern part they are considered possible. In northeastern Illinois hundreds of wells - mostly water wells but also some oil tests - have been drilled into the Lower Ordovician and Cambrian strata without finding oil except for rare oil shows reported by drillers. Many porous strata in this area contain fresh or slightly brackish waters. Although fewer wells have been drilled in northwestern and west central Illinois the same results have been obtained.

In the southern area only about 25 wells have been drilled as deep as the St. Peter sandstone, and only 16 go below the St. Peter. The fact that oil is produced from strata of equivalent age both to the west (Arbuckle limestone production in Oklahoma) and to the east (Knox dolomite production in Kentucky) suggests that the pre-St. Peter strata have oil possibilities in Illinois. However the greater expense of drilling to test the whole of the

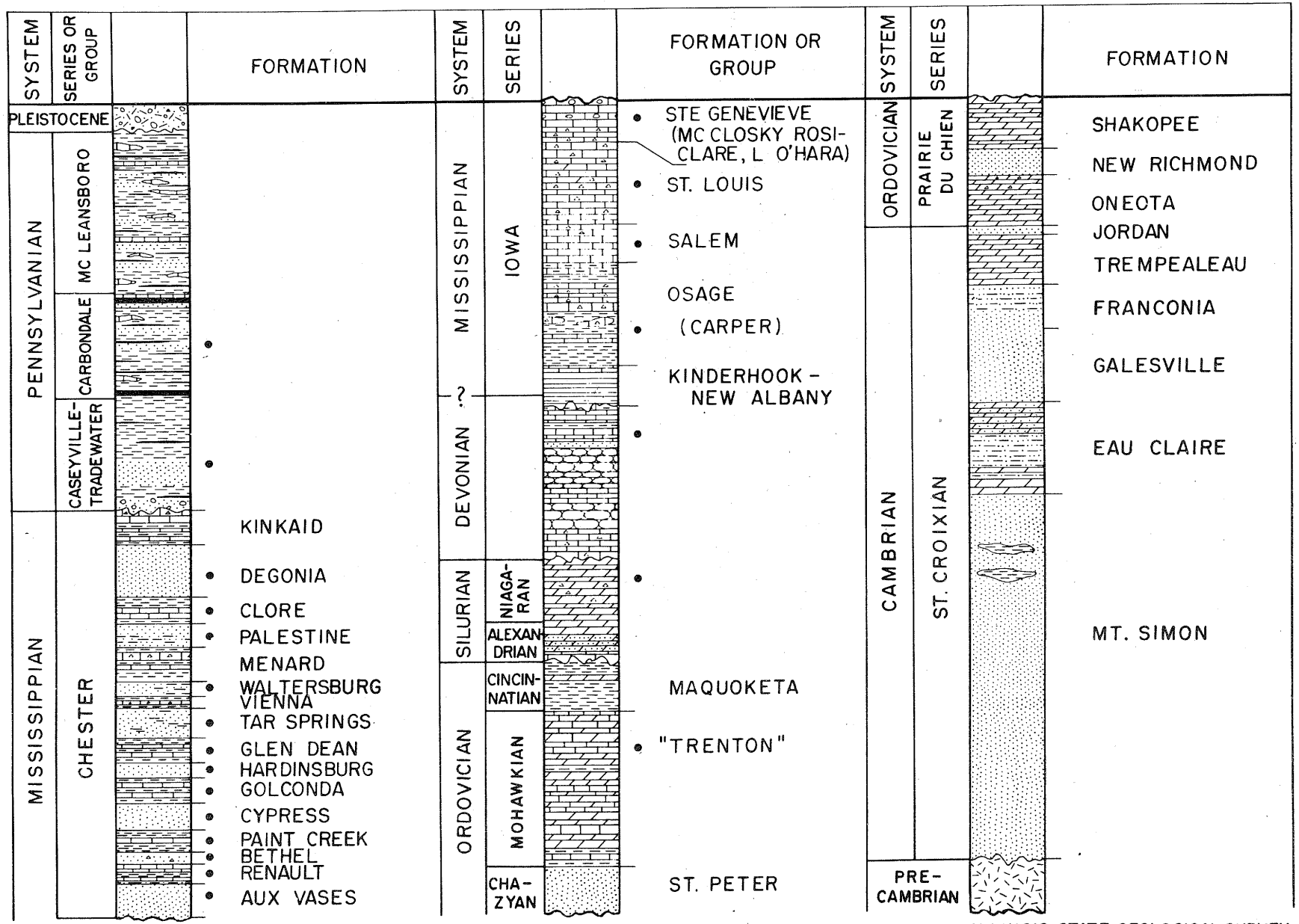
sedimentary series in the Illinois basin, resulting from depths of as much as 11,000 or 12,000 feet, has deterred such prospecting up to date, especially while new discoveries continue to be made at depths of less than 4000 feet.

List of Illustrations


MILLIONS OF BBLS.
160
140
120
100
80
60
40
20
0
ILLINOIS OIL PRODUCTION
1936 - 1948
1936
1938
1940
1942
1944
1946
1948

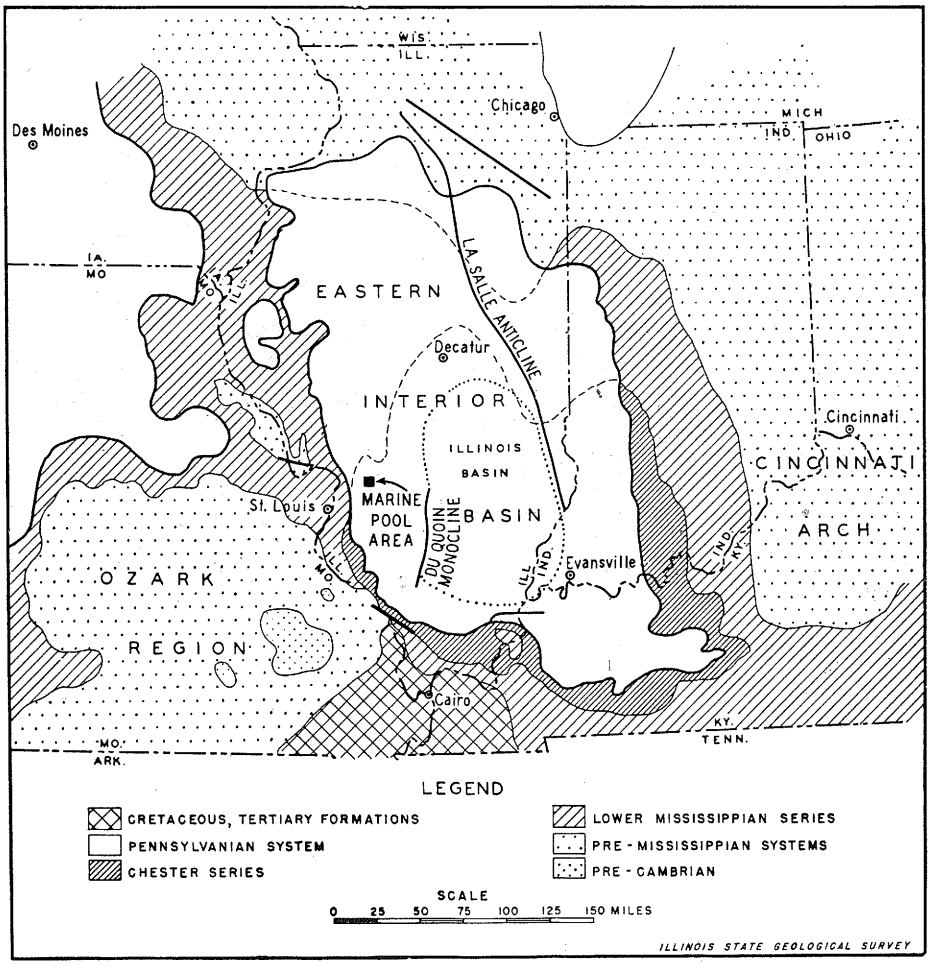
FIGURE—1

GEOLOGIC COLUMN FOR SOUTHERN ILLINOIS
SHOWING OIL PRODUCING STRATA(•)

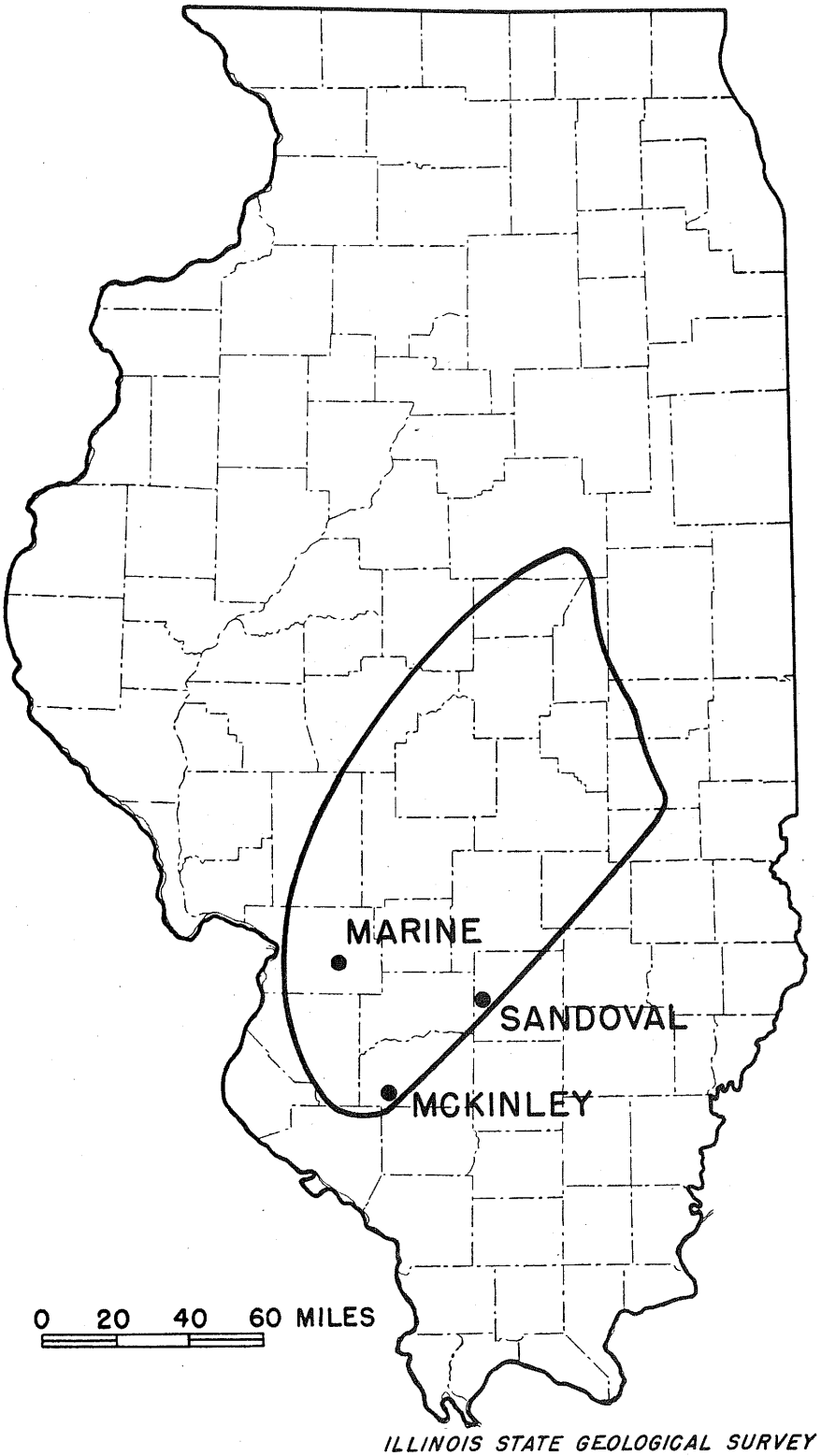


FIGURE—2

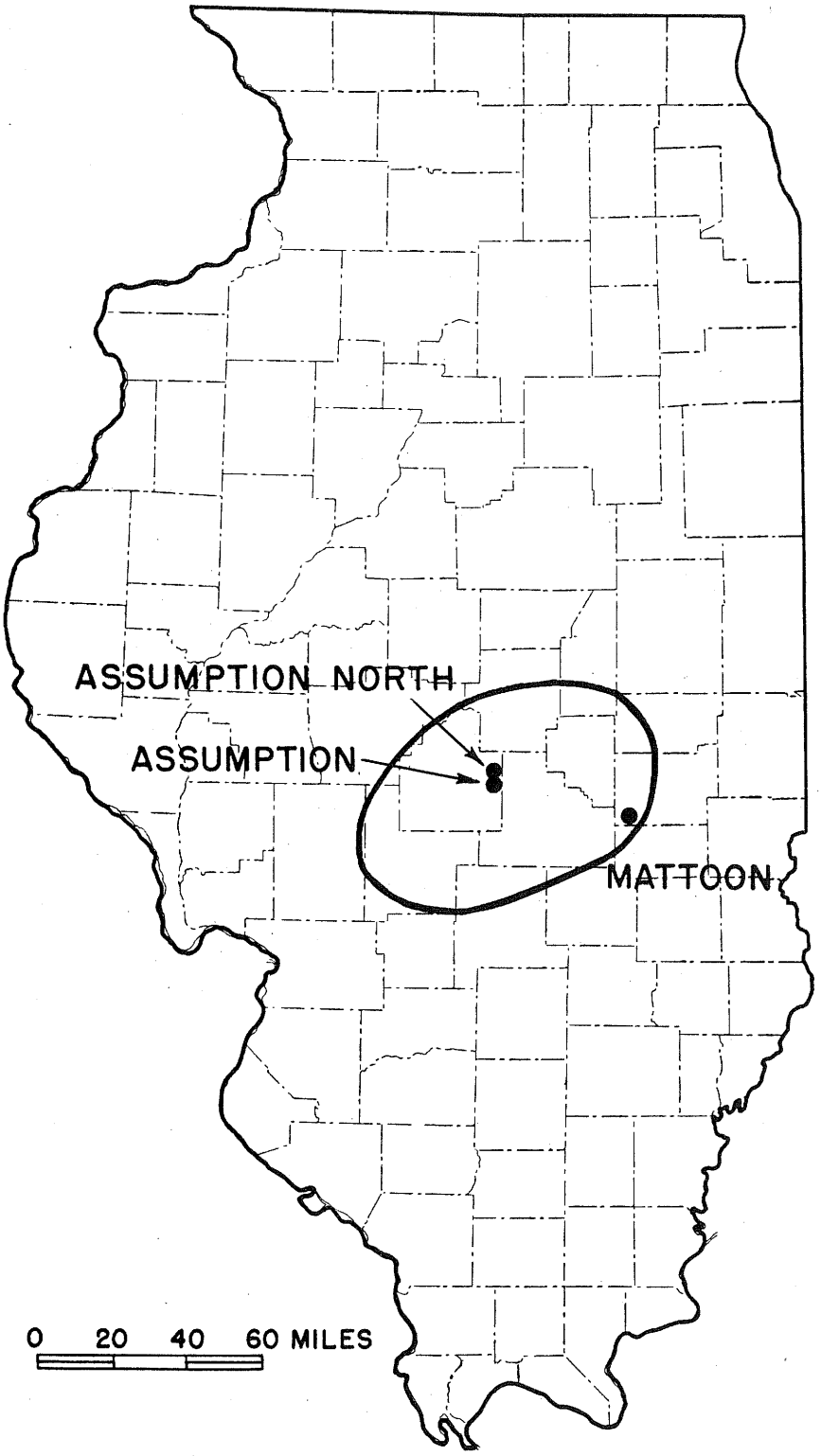
ILLINOIS STATE GEOLOGICAL SURVEY


WIS.
ILL.
Chicago
MICH
IND.
OHIO
Des Moines
IA.
MO
EASTERN
LA SALLE ANTICLINE
Decatur
INTERIOR
ILLINOIS
BASIN
Cincinnati
CINCINNATI
ARCH
MARINE
POOL
AREA
DU QUOIN
MONOCLINE
BASIN
St. Louis
OZARK
REGION
Evansville
ILL.
IND.
IND.
KY.
Cairo
MO.
ARK.
KY.
TENN.
LEGEND
CRETACEOUS, TERTIARY FORMATIONS
PENNSYLVANIAN SYSTEM
CHESTER SERIES
LOWER MISSISSIPPIAN SERIES
PRE-MISSISSIPPIAN SYSTEMS
PRE-CAMBRIAN
SCALE
0 25 50 75 100 125 150 MILES
ILLINOIS STATE GEOLOGICAL SURVEY

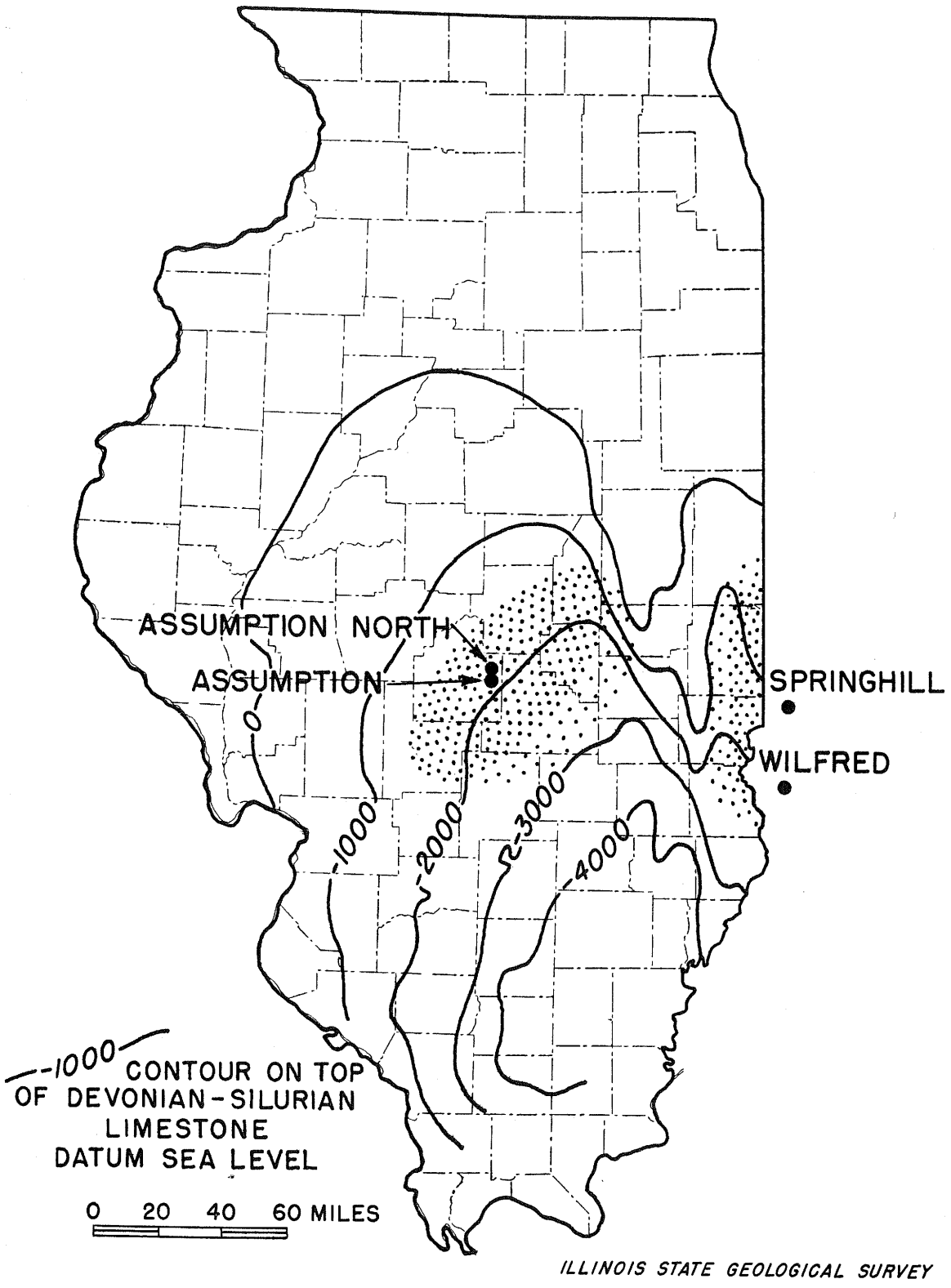
FIGURE—3


MARINE
SANDOVAL
McKINLEY
0 20 40 60 MILES
ILLINOIS STATE GEOLOGICAL SURVEY

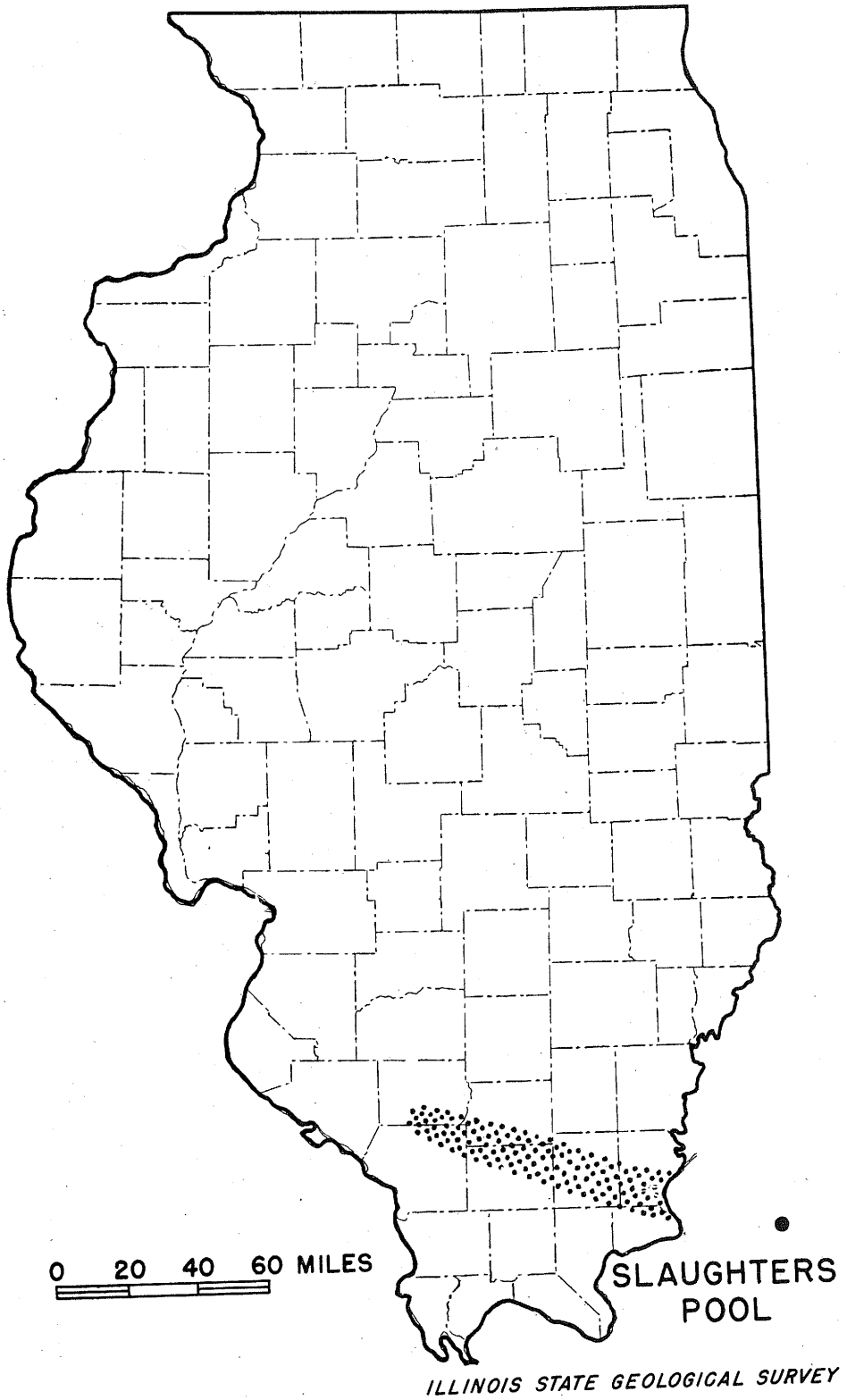
FIGURE—5


ASSUMPTION NORTH
ASSUMPTION
MATTOON
0 20 40 60 MILES
ILLINOIS STATE GEOLOGICAL SURVEY

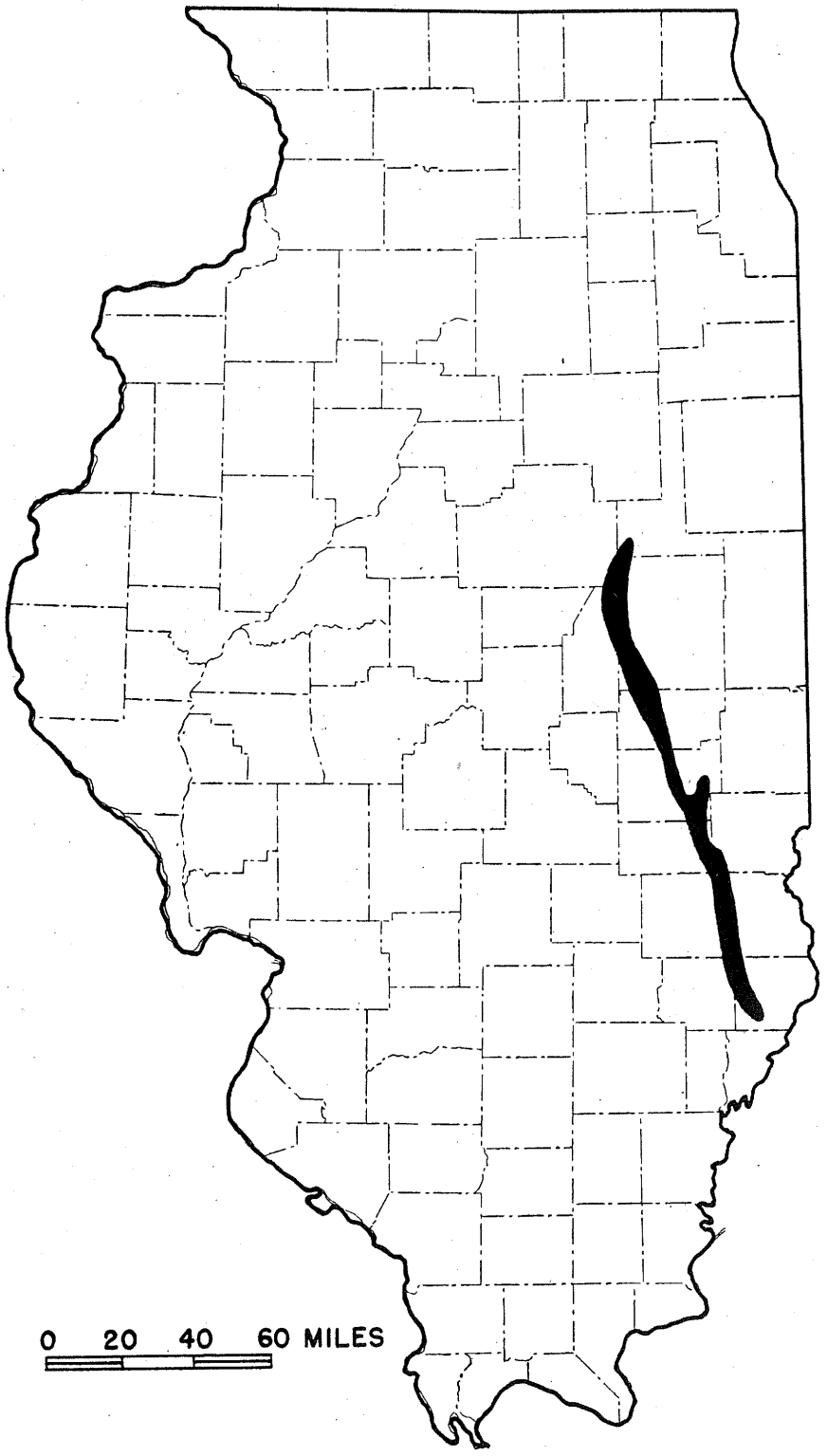
FIGURE—6


ASSUMPTION NORTH
ASSUMPTION
SPRINGHILL
WILFRED
0
-1000
-2000
-3000
-4000
-1000 CONTOUR ON TOP OF DEVONIAN-SILURIAN LIMESTONE DATUM SEA LEVEL
0 20 40 60 MILES
ILLINOIS STATE GEOLOGICAL SURVEY

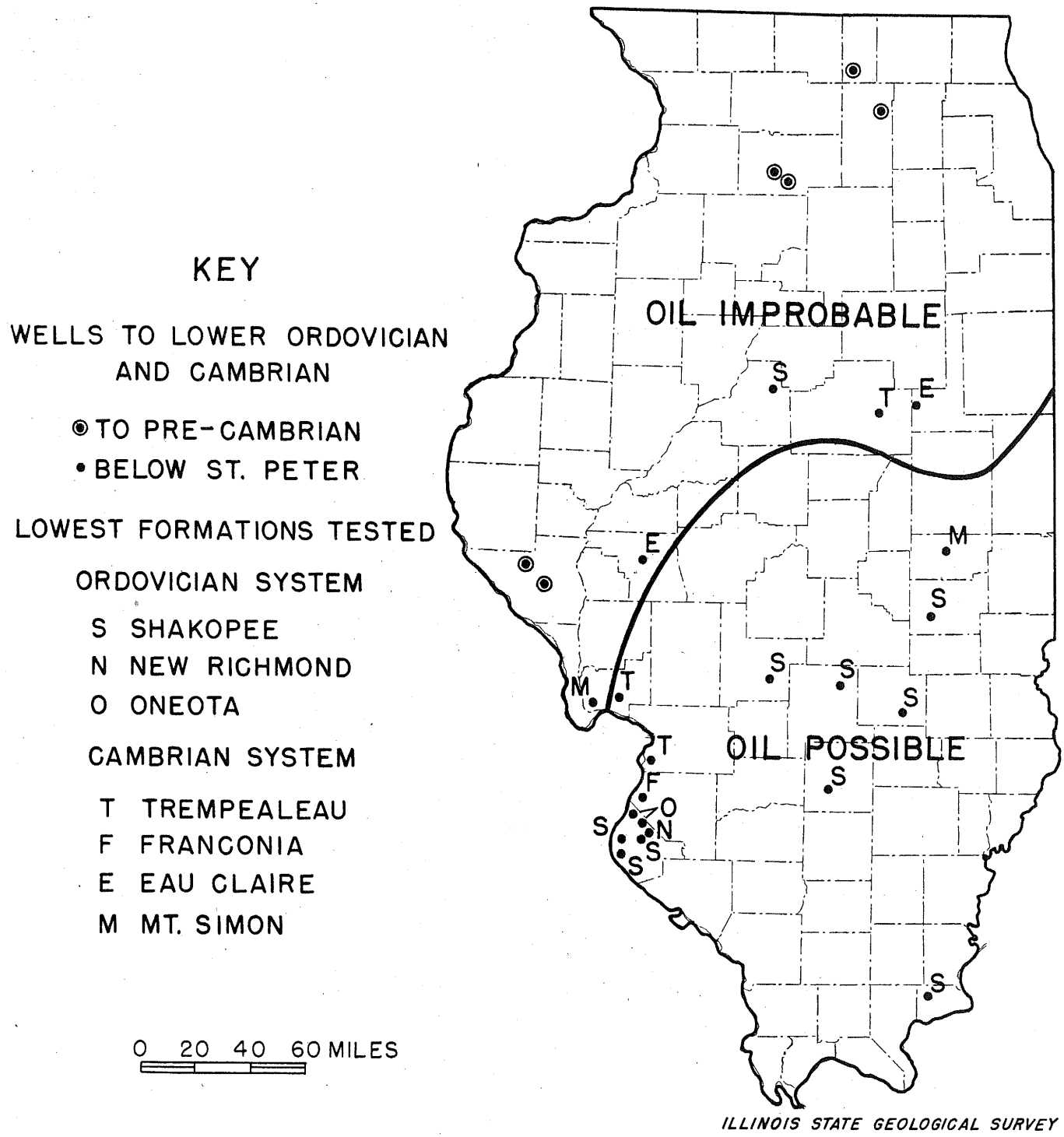
FIGURE—7


0 20 40 60 MILES
SLAUGHTERS POOL
ILLINOIS STATE GEOLOGICAL SURVEY

FIGURE—8



FIGURE—9


KEY
WELLS TO LOWER ORDOVICIAN AND CAMBRIAN
◉ TO PRE-CAMBRIAN
• BELOW ST. PETER
LOWEST FORMATIONS TESTED
ORDOVICIAN SYSTEM
S SHAKOPEE
N NEW RICHMOND
O ONEOTA
CAMBRIAN SYSTEM
T TREMPEALEAU
F FRANCONIA
E EAU CLAIRE
M MT. SIMON
0 20 40 60 MILES
OIL IMPROBABLE
OIL POSSIBLE
ILLINOIS STATE GEOLOGICAL SURVEY

FIGURE—10