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ILLINOIS PETROLEUM

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RECENT PETROLEUM DEVELOPMENT IN ILLINOIS¹

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ABSTRACT

During the past year new drilling in Illinois, especially in the deeper part of the Illinois basin, has been providing a wealth of new information on the subsurface geology of the region. Oil has been discovered in numerous widely scattered localities in the basin, but as yet the boundaries of the productive areas are largely undefined. Since May, 1937, approximately 4 million barrels of oil has been produced from the new fields and present indications are that reserves in the new areas will exceed 100 million barrels. The producing strata and the structures controlling the accumulations are discussed.

INTRODUCTION

One year ago, the discovery of oil in three new areas in Illinois was reported to this Association. This discovery was preceded by extensive geological and geophysical investigations which resulted in the leasing of several million acres. The discovery wells were all of small capacity—not more than 100 barrels per day initial—and the question whether there were to be returns on the very considerable investment already made was still unanswered. Today the picture has changed. Initial daily flows varying from 1,000 to 2,600 barrels of oil have been obtained in 26 wells. Instead of three, there are a dozen new fields, with three hundred producing wells, yielding a daily production of 25,000 barrels of oil. This is more than double the total production of the old fields of Illinois for the same period, and thus the state's production has been trebled. The number and wide distribution of the new fields throughout the area of the Illinois basin give promise of many more discoveries to come and indicate not only increased drilling activity in the immediate future, but a period of orderly development which should last for many years. Since May, 1937, approximately 4 million barrels of oil have been produced from the new fields and present indications are that reserves in the new areas will exceed 100 million barrels.

DATA FROM NEW DRILLING

Previous to this new development few wells in this area had completely penetrated the Pennsylvanian strata, and because correlations

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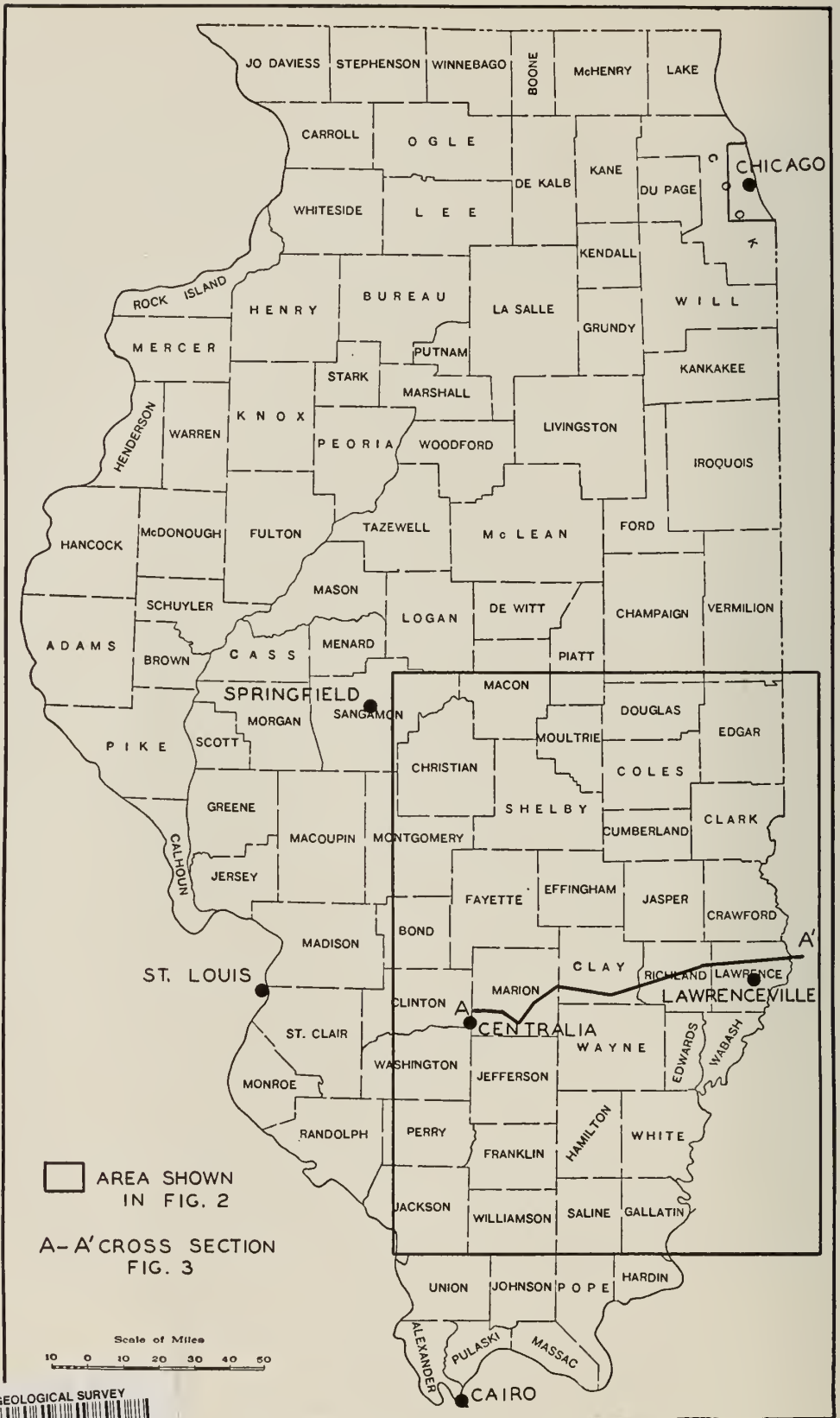


FIG. 1.—Index map of Illinois.

of the few available logs were difficult, only very generalized subsurface contour maps or cross sections could be made.⁴

Data from the new drilling are furnishing a wealth of new knowledge of the subsurface stratigraphy and structure of Illinois, particularly for the central basin area. Most of the new wells are drilled into the Ste. Genevieve limestone of Lower Mississippian age and a few penetrate the Devonian or older systems. Studies of the new data are in progress, but are as yet far from complete. Only a brief mention can be made here of some of the more important findings.

STRUCTURAL AXES

The principal previously known structural axes are the LaSalle anticline—broken in the region of the Southeastern Illinois oil field by cross folds of which the most conspicuous is the Oakland anticline—the DuQuoin-Centralia monocline, the Shawneetown-Rough Creek fault, the faulted belt which borders the basin on the south and several axes trending east-west and in other directions in Bond, Clinton, and Perry counties. Studies of the stratigraphy and structure of outcropping Pennsylvanian beds in 1934-35 had revealed the presence of several anticlines in eastern Marion and western Clay counties, the axes of some of which are shown. A subsurface contour map of the base of the Pennsylvanian appeared to indicate two east-west anticlinal structures in this general area.

The drilling in the Clay City, Noble, and Cisne fields and surrounding territory has revealed the presence of anticlines arranged *en échelon* and trending slightly east of north. The eastern axis, that of the Noble structure, is in line with the axis of the Oakland anticline in the Westfield-Siggins area of Clark and Cumberland counties, one of the cross folds on the LaSalle anticline described by Mylius.⁵ According to Wasson⁶ seismograph findings indicate a structural disturbance extending across Wayne, Richland, and Jasper counties. This is of great interest from the point of view of further development. It is interesting to note that oil showings were found at Rose Hill (King well) almost along this axis and a new field has been discovered near Aden on the south line of Wayne County on what may be a southern extension of the same structural disturbance. This field is 16 miles from the nearest production.

The Aden field was brought in by The Texas Company's Silver-

⁴ *Illinois State Geol. Survey Rept. Investig. 40*, Figs. 2 and 3.

⁵ *Illinois State Geol. Survey Bull. 54*.

⁶ Theron Wasson, "Recent Oil Discoveries in Southeastern Illinois," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 22, No. 1 (January, 1938), p. 74.

man No. 1, SW. $\frac{1}{4}$, NW. $\frac{1}{4}$, Sec. 16, T. 3 S., R. 7 E. The well is producing from the "McClosky sand" at a depth of 3,276 feet. The initial production of the well was 385 barrels in 19 hours flowing. The Silverman No. 2 is being drilled.

The Beecher City field was discovered by the Carter Oil Company. Its Mary Miller well No. 1, located in Sec. 12, T. 8 N., R. 3 E., Fayette County, with a total depth of 3,100 feet, was completed on December 20, 1937. An initial production of 57 barrels of oil was obtained in 17 hours from the Devonian limestone. Production of this well dwindled to about 5 barrels per day after which it was plugged back to the Cypress sand. A second well in the field is the same company's Clow No. 1 which is producing about 40 barrels per day from the Benoist sand at a total depth of 1,503 feet. A third well, the Farrelly *et al.* Lilley No. 1 is reported to be showing oil and may be a producer in the same sand.

Since January 1, 1938, the Dix field in the northern part of Jefferson County was brought in by the Carter Oil Company's Tate well No. 1, in the center, W. $\frac{1}{2}$, NW. $\frac{1}{4}$, NE. $\frac{1}{4}$, Sec. 10, T. 1 S., R. 2 E. The well is producing from the Benoist sand at a depth of 1,982 feet and had an initial production of 58 barrels in 18 hours on the pump. Another well was drilled in the field by the Carter Oil Company on the Douthit farm in the center, E. $\frac{1}{2}$, NE. $\frac{1}{4}$, SE. $\frac{1}{4}$, Sec. 9, T. 1 S., R. 2 E. The initial production was 147 barrels of oil and 12 barrels of salt water per day.

At present one of the most active areas in the state is the New Centralia field, which was discovered in December, 1937. This field now (March 12, 1938) has 12 producing wells, 7 drilling wells, 6 rigs standing, 16 wells rigging up, and 3 locations. Production is from the Benoist sand at an average depth of approximately 1,350 feet. The productive area has been extended into the western part of the city of Centralia. Initial production of more than 300 barrels is reported for some of the wells, whereas the average initial production for wells west of the city is between 150 and 200 barrels.

Showings of oil in scattered wildcats have been found near Ina, Jefferson County, near Whittington (Mitchell well), Franklin County, near Farina, Marion County (Nichols well), and east of Harrisburg in Saline County (Beagle well, NW. $\frac{1}{4}$, NE. $\frac{1}{4}$, Sec. 13, T. 9 S., R. 7 E.). The last is of special interest because of its location near the Cottage Grove and Shawneetown faults. The oil showing was in the Tar Springs sandstone from 1,780 to 1,824 feet. The well was shot with 160 quarts of nitroglycerine on February 15 and has been shut down since that date.

CROSS-SECTION A-A' ACROSS THE ILLINOIS BASIN

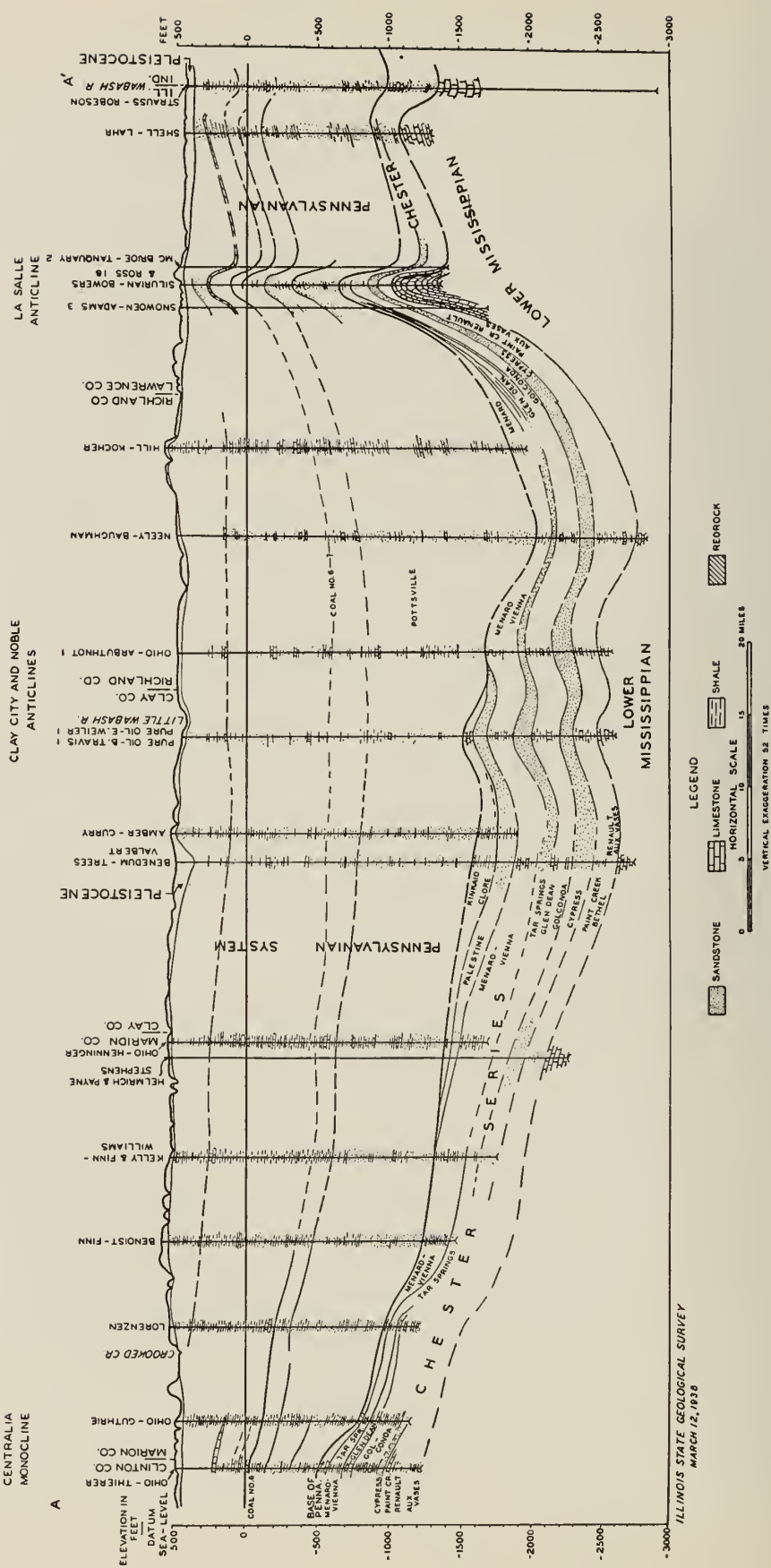


FIG. 3.—West-east section, A-A', across Illinois basin. Location shown in Figure 1.

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CROSS SECTION

A graphic picture of some recent additions to knowledge of the subsurface structure is seen in the cross section (Fig. 3). This has been amplified after Figure 3 in *Illinois State Geological Survey Report of Investigations No. 40*. Formerly no well had been drilled into the lower part of the Chester series in this part of the basin. The base of the Pennsylvanian in this area was shown in the earlier cross section by a smooth dashed line. Since then numerous wells have penetrated the Ste. Genevieve formation in the Lower Mississippian of which the following wells were added to the cross section: Benedum-Trees' Valbert; Pure Oil Company's Travis and Weiler; Ohio Oil Company's Arbuthnot, Neely-Baughman, Strauss-Robeson; and Helmerich and Payne's Stephens. Two well defined anticlines are shown in the Clay City-Noble area. There is also evidence of structural disturbance in the vicinity of the Lorenzen well in Marion County.

The correlations of Pennsylvanian beds as shown on the cross section by dash lines must be regarded as merely tentative. In some wells these beds are logged less carefully than are beds in the Mississippian which include the pay zones. Because the Pennsylvanian beds vary laterally to a considerable degree, most of the wells are spaced too far apart along this cross section to admit of certainty of accurate correlations. Studies of surface geology indicate that the outcropping strata in western Lawrence County and across most of Richland County belong to the same two cyclothem⁷ (Cohn and Bogota). From the crest of the LaSalle anticline in Lawrence County at the Silurian Oil Company's Bowers and Ross well No. 18, westward to the Neely-Baughman well No. 1 in the basin, a distance of 16 miles, the base of the Pennsylvanian drops 1,370 feet, and the top of the Lower Mississippian 1,700 feet. The tentative correlations indicate that the greater part of this thickening from the LaSalle anticline westward takes place in the Pottsville and a lesser amount in the beds above Coal No. 6. Assuming these tentative correlations to be correct, a large amount of downwarping of the basin and of deformation of the Clay City and Noble anticlines took place during Pottsville time and a smaller amount later.

If the surface beds have not been deformed at all, there is of course no use in attempting to map surface structure as a guide to exploratory drilling. However, previous work indicates that some surface structures in the Pennsylvanian continue downward, for example, the

⁷ William Newton and J. M. Weller, "Stratigraphic Studies of Pennsylvanian Outcrops in Part of Southeastern Illinois," *Illinois State Geol. Survey Rept. Investig. 45*.

Martinsville dome.⁸ It is reported that seismograph findings have confirmed the presence at depth of some of the structures mapped from outcrops in eastern Marion and western Clay counties.⁹

Careful study and correlation of Pennsylvanian strata from the surface down are necessary to work out the geologic history of the Illinois basin. The Pennsylvanian has been very productive in the southeastern field, but not in the new fields. It may well prove productive in some unexplored areas, but even if it should not be, the value of detailed studies of Pennsylvanian stratigraphy has been amply demonstrated, and justifies careful sampling of Pennsylvanian strata in wildcat wells. The lack of oil production or even oil showings in the Pennsylvanian in wells so far drilled in the central basin area presents an interesting theoretical problem.

PRE-PENNSYLVANIAN UNCONFORMITY

The unconformity at the base of the Pennsylvanian is conspicuous in the cross section. The uppermost Chester formation varies from the lower part of the Golconda (at the Lahr well, Lawrence County) up to the Kinkaid in Benedum-Trees' Valbert well in the basin. The Kinkaid, Clore, and Palestine wedge out eastward and westward. Important deformation took place after deposition of the latest Chester in this area and before the earliest Pennsylvanian deposition. This is the earliest definitely known diastrophism in the central basin area. The record of possible earlier diastrophism must await further data from deeper drilling.

MCCLOSKY LIMESTONE

Nearly all of the oil in the new fields is produced from the McClosky "sand" or McClosky "lime." The term "McClosky" is applied to any porous zone in the Fredonia member of the Ste. Genevieve limestone formation usually occurring within 25 feet of the top. Wherever it has been seen (in well cuttings, cores, and in outcrops), the Fredonia is composed largely of oölites (Fig. 4). The size and character of the oölites and the amount of cement between them vary greatly. In the best producing wells of the new oil fields, the oölites are fairly uniform in size and are very slightly cemented. The amount of cementation varies considerably from well to well both on and off structure. In areas of tight, well cemented oölites, dry holes

⁸ For areal geology of the Martinsville dome in Clark County, see the following Illinois State Geological Survey publications: *Report of Investigations 45*, Fig. 2, page 7; for the subsurface geology, see *Bulletin 54*, plate 22B, and *Illinois Petroleum 14*, Fig. 3, pp. 6 and 7.

⁹ *Illinois State Geol. Survey Rept. Investig. 40*.

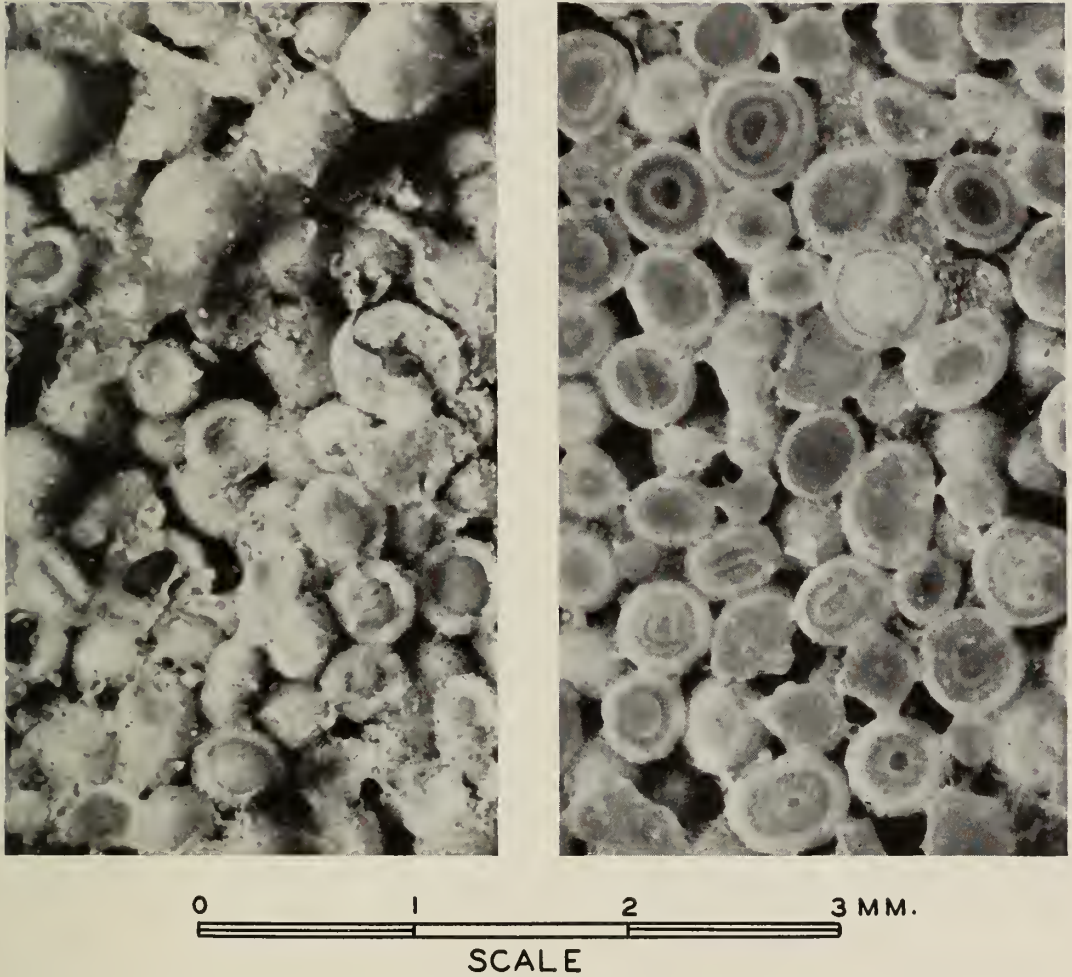


FIG. 4.—Ste. Genevieve limestone (McClosky "sand"), W., SW., NE., Sec. 8, T. 3 N., R. 9 E., Noble field, Richland County, Illinois. Left, broken surface; right, smooth surface, acid rinsed.

have been drilled in the midst of producing wells in both the Clay City and Noble fields. In some wells low on structure, where the oölitic zone is very porous, the fluid contained in the pore space is wholly or in part salt water. Among the wells located low in structure, Myers and Fitzpatrick's Shannon, SW. $\frac{1}{4}$, SW. $\frac{1}{4}$, SE. $\frac{1}{4}$, Sec. 26, T. 2 N., R. 8 E., Wayne County, and Benedum-Trees' Knapp, SE. $\frac{1}{4}$, NW. $\frac{1}{4}$, SW. $\frac{1}{4}$, Sec. 33, T. 2 N., R. 7 E., Wayne County, are producing water with the oil. The Liebke well, SE. $\frac{1}{4}$, SE. $\frac{1}{4}$, SW. $\frac{1}{4}$, Sec. 17, T. 3 N., R. 7 E., Clay County, had an encouraging showing of oil, but the amount of water obtained was too great to permit commercial production.

The available data appear to indicate that porosity trends are largely independent of the structural trends in the new fields. In this respect the new fields are similar to the old. The porosity of the oölitic zones seems to be original and the cementation of the tight oölitic zones seems to be secondary. The problem of the conditions which controlled the varying amounts of cementation is of scientific interest and its solution would have practical value as an aid in future oil development.

