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DEVELOPMENTS IN EASTERN INTERIOR BASIN,
1939 AND FIRST QUARTER OF 1940¹

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ABSTRACT

Although Mississippian rocks continue to contribute the major part of the oil produced in this region, the outstanding new feature is the discovery and development of Devonian limestone wells in five pools, Sandoval, Salem, Bartelso, Centralia, and Tonti (in order of discovery). The saturated zone in the Devonian consists of dolomitic limestone with solution cavities, and probably fissures and joints. In the pools listed the top of Devonian limestone lies from 1,100 to 1,400 feet below the McClosky oolitic limestone (the lowest large producing zone in the Mississippian), and this interval probably increases to more than 2,000 feet in the deepest part of the basin. Initial productions of the new Devonian wells are exceptionally high for the area, some exceeding 10,000 barrels per day, thus indicating a high degree of permeability of the oil-bearing rock.

Thus far all the new areas of Devonian production are on structural closures indicated in Mississippian or Pennsylvanian key beds (or both) and furthermore are in areas of previous production from shallower strata. Whether or not there are structures affecting Devonian but not younger strata and of sufficient size to cause oil accumulation is not yet known.

INTRODUCTION

The Eastern Interior basin comprises an area of approximately 49,000 square miles of which 37,400 square miles or 76 per cent is in Illinois, 6,600 square miles or 14 per cent is in southwestern Indiana and 5,000 square miles or 10 per cent is in western Kentucky. The geographic and geologic setting of the Eastern Interior basin is illustrated in Figure 1. Although the major part of the recent oil activity in the basin has been in southern Illinois, there has also been increased activity in the adjacent parts of Indiana and Kentucky.

In this article recent developments are discussed briefly, especially the new Devonian limestone production in western Illinois. For comprehensive statistics on developments during 1939, the reader is referred to the forthcoming annual *Transactions* of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers, to be reprinted as Illinois Petroleum No. 35.

ILLINOIS

PRODUCTION

The history of oil production and development in Illinois may be read briefly in the bar chart of annual and monthly production (Fig.

¹ Reprinted from *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 24, No. 6 (June, 1940).

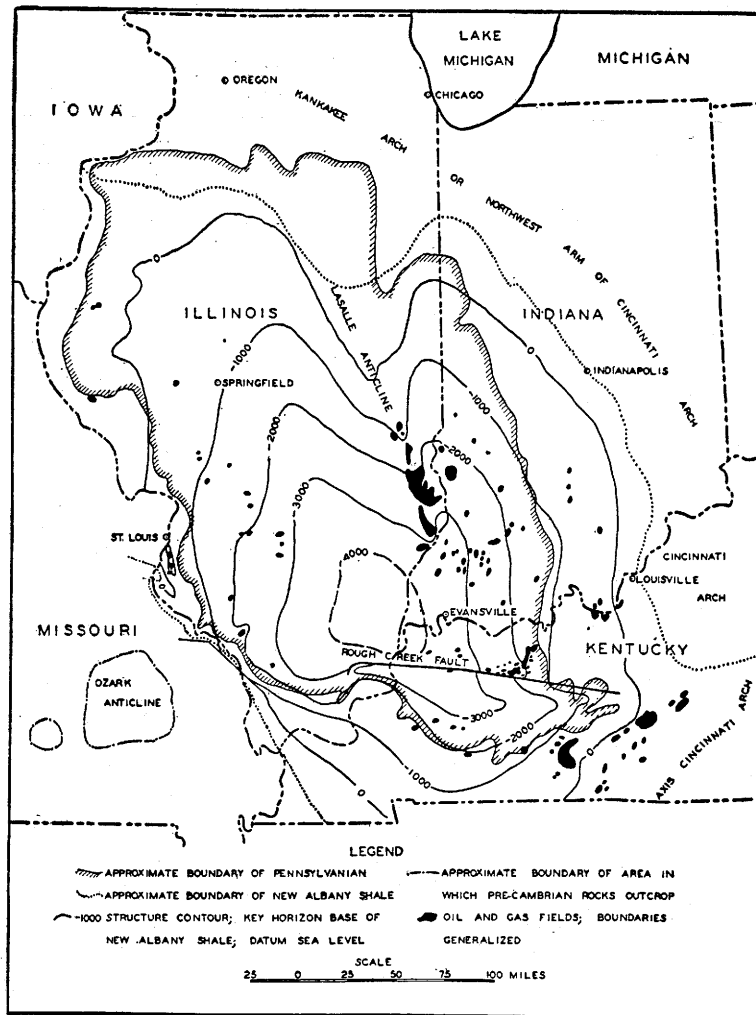


FIG. 1.—Map of Eastern Interior basin, showing principal tectonic features, oil and gas fields, and subsurface structure on base of New Albany shale. (From *Problems of Petroleum Geology*, Amer. Assoc. Petrol. Geol., 1934), p. 559.

2). The production of the state rose rapidly from 1905, reaching a peak of 33.7 million in 1908 when it ranked third in the United States. From 1910 to 1936—a 26-year period—it declined steadily to a little more than 4 million barrels per year when Illinois ranked 14th. Then the tide turned; in 1937 production rose to 7.4 million barrels, in 1938 to 24 million barrels, in 1939 to 94 million barrels, the state's rank

rising to 11th in 1937, 8th in 1938, and 4th in 1939. The 1939 production was almost 3 times the peak in 1908.

During 1939 the monthly production rose from 4,446,000 barrels in January to 10,443,000 barrels in September after which it remained almost constant at a level between 10 and 10.5 million barrels for 4 months. Again in January, 1940, production began to rise rapidly,

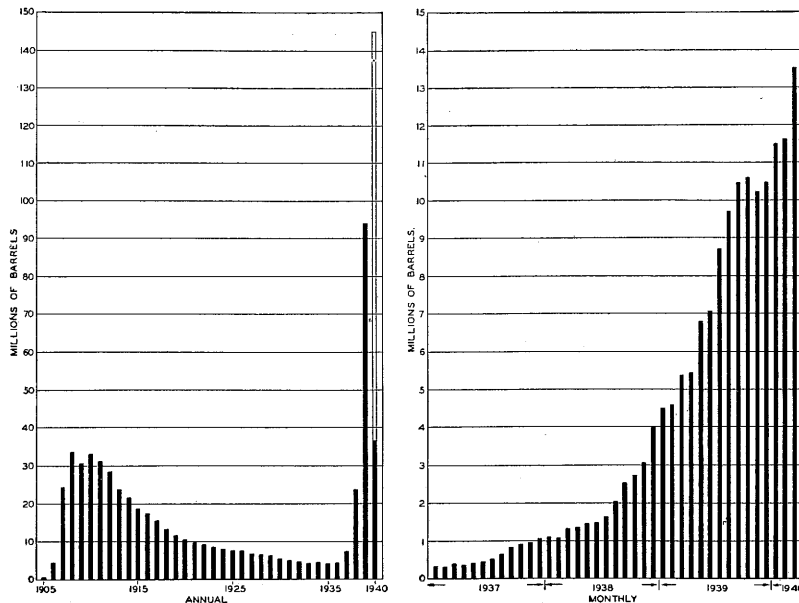


FIG. 2.—Crude-oil production in Illinois: annual, 1905-1940; and monthly, January, 1937-March, 1940.

reaching approximately 13.5 million barrels in March, 1940. The daily average during March was approximately 433,000 barrels. If production during the rest of the year continues at the average rate established in the first quarter, the 1940 production will be approximately 145 million barrels.

Oil and gas fields in Illinois as of January 1, 1940, are shown in Figure 3. Those discovered in 1939 are shown in solid black, those discovered in 1937 and 1938 are in outline, and those discovered prior to 1937 are in stippled pattern. Attention is called to the Salem pool (No. 24) which is responsible for more than half of the state's daily production, and to the Loudon pool (No. 11) which is the largest in

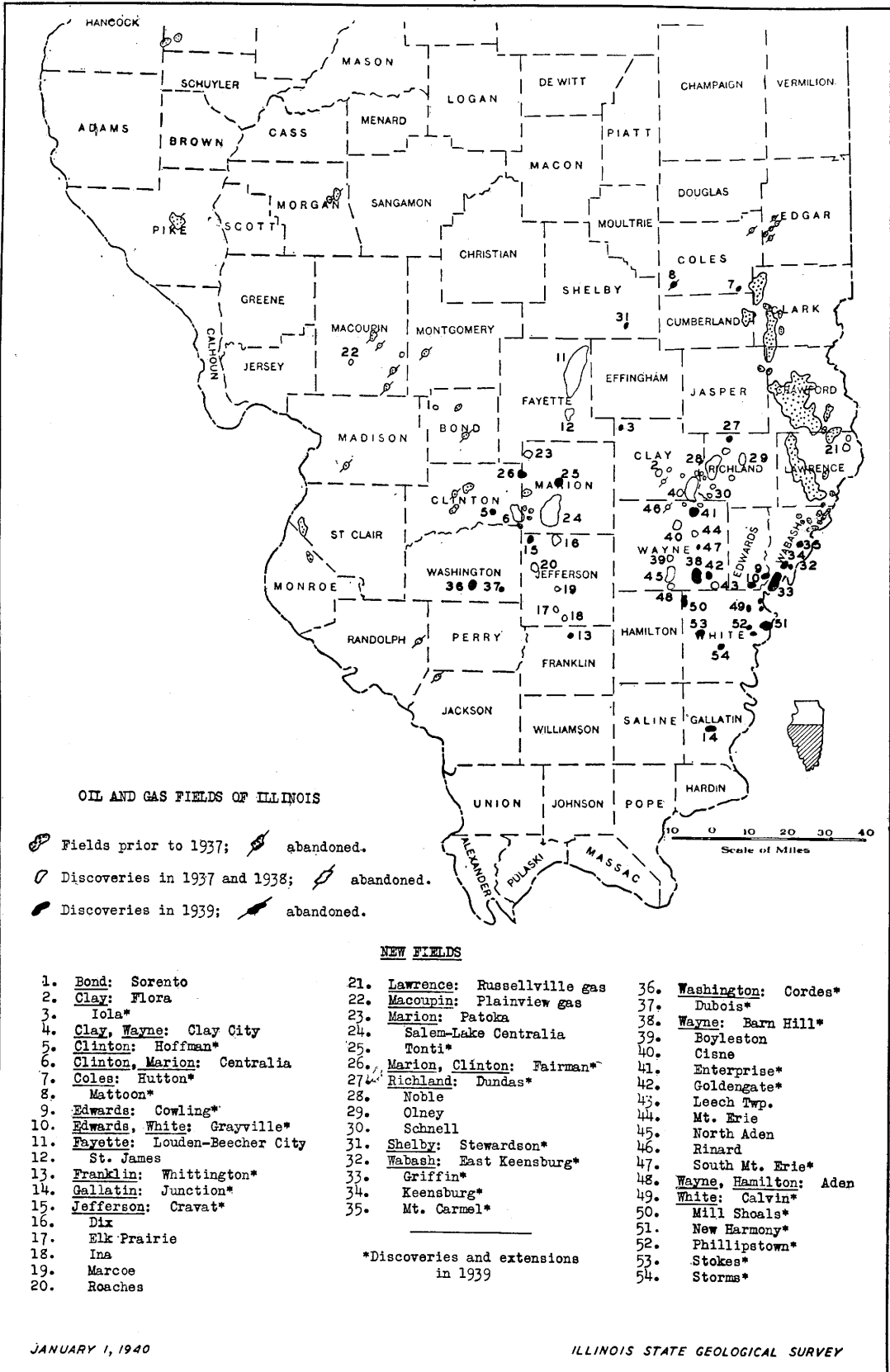


FIG. 3.—Oil and gas fields of Illinois. January 1, 1940.

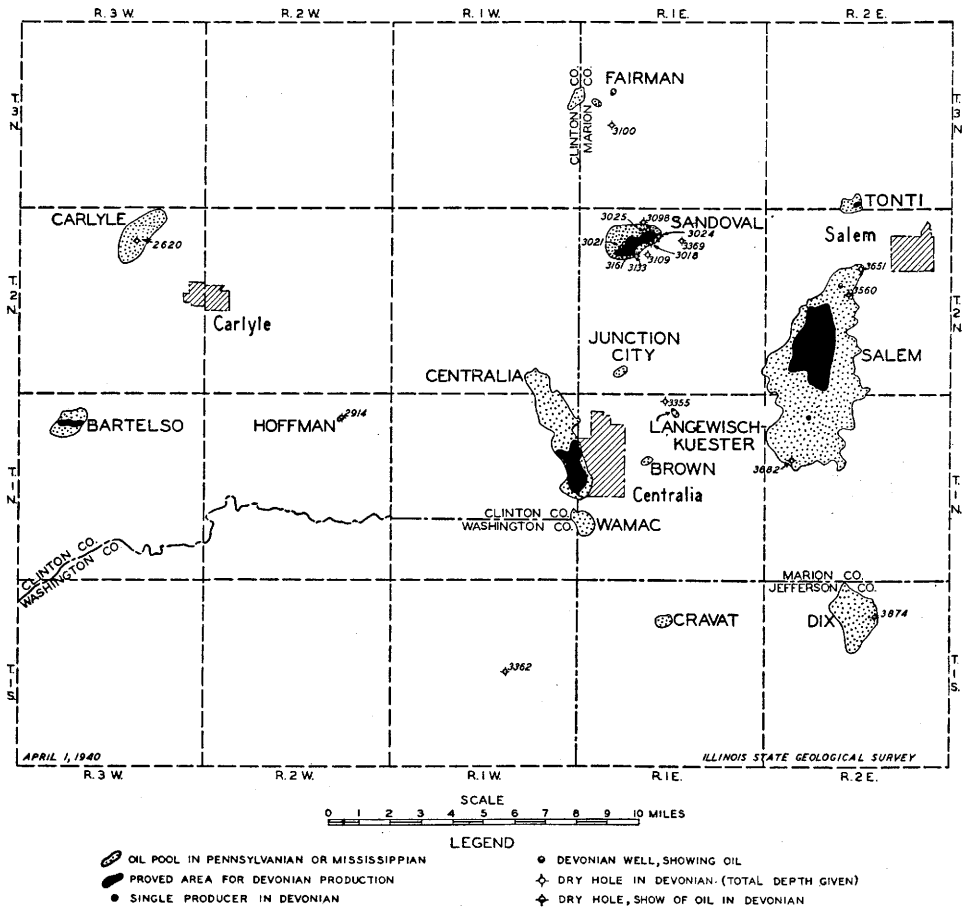


FIG. 5.—Map of new Devonian oil pools in Illinois.

area of the new pools. Among 1939 discoveries the following yielded the most oil to the end of the year.

Tonti (No. 25)	900,000 barrels
Keensburg (No. 34)	780,000 barrels
Barn Hill (No. 38)	600,000 barrels
Cordes (No. 36)	470,000 barrels

STRUCTURE

The subsurface features of the Illinois part of the Eastern Interior basin are shown in somewhat greater detail in Figure 4 than in Figure 1. The contoured horizon is the same, the base of the Kinderhook-New Albany shale, but the scale is larger and the contour interval is 500 feet instead of 1,000 feet. The predominant structural features are the LaSalle anticline which is shown extending more than 150 miles through the eastern part of the mapped area, and the Shawneetown-Rough Creek fault in the southeast corner, with the associated Eagle Valley syncline and Hicks dome south of it. Elsewhere, three structural closures may be noted, a minus 3,000-foot contour around the Salem anticline, Marion County, a zero (sea-level) contour around the Waterloo-Dupo anticline, St. Clair and Monroe counties, and a plus 500-foot contour around the Pittsfield-Hadley anticline in Pike County.

Where datum points are closely spaced there are many bends in the contours representing minor flexures. When more data become available from wells drilled to the Devonian, the presence of additional minor flexures will doubtless be revealed and revisions will be necessary. This is believed to be especially true of the southern part of the deep-basin area where many pools now producing from Mississippian strata are likely to be tested to the Devonian or deeper.

DEVONIAN PRODUCTION

The location of five new Devonian oil pools in the western part of the Illinois basin is shown in Figure 5. It will be noted that the areas of proved Devonian production are all more restricted than the areas of Mississippian production in which they occur. Data on these pools are tabulated here.

Since December, 1938, when oil production from Devonian limestone was discovered in the old Sandoval pool in Marion County, approximately 12,600,000 barrels of oil have been produced from about 276 wells in the 5 pools. Of this, approximately 11,800,000 barrels, or about 95 per cent of the total, was produced during 4 months (December 1, 1939, to March 31, 1940). Slightly more than 1 million barrels was produced from 23 Devonian wells in the Sandoval

DATA ON FIVE NEW DEVONIAN OIL POOLS IN WESTERN PART OF ILLINOIS
BASIN—APRIL 2, 1940

<i>Field</i>	<i>County</i>	<i>Date Discovered</i>	<i>Age in Months (Approx.)</i>	<i>Producing Wells</i>	<i>Dry Holes*</i>	<i>Drilling Wells</i>
Sandoval	Marion	12-20-38	15	23	8	4
Salem	Marion	11-21-39	4	182	3	86
Bartelso	Clinton	12- 5-39	4	3	0	5
Centralia	Clinton and Marion	12-31-39	3	66	0	86
Tonti	Marion	1-23-40	2	2	0	0
				276	11	181

* Within 1 mile of production.

pool in 15 months, a little more than 11 million barrels was produced from 182 wells in the Salem pool in 4 months, and approximately 425,000 barrels from 66 wells in the Centralia pool in 3 months.

All of the new Devonian oil pools are in areas of structural closure as shown on either Pennsylvanian or Mississippian key beds or both, and furthermore, they are in areas of previous production from shallower sands. Although boundaries of the Devonian production are not yet well defined (except in part of the Sandoval pool), present indications are that the productive areas are smaller than those in Mississippian sands and that they are confined to the upper parts of the structures. In this respect the new Devonian pools resemble the old Martinsville pool in Clark County where the Devonian limestone is productive, and the Westfield pool where the "Trenton" limestone is productive high on the crests of large domes.

Subsurface contour maps of the Salem field on the top of the Bethel (Benoist sand) and on the top of the Devonian limestone are shown in Figure 6. The position of the anticlinal axis, where known, appears to be almost exactly the same for the two horizons although they are separated by an interval of about 1,650 feet. The rate of dip seems to be nearly the same for the two horizons where they can be compared on the east limb of the anticline, the dip of the Devonian being only slightly greater. Drilling data are not yet available which would permit a comparison of the dips for the two horizons on the west limb of the anticline.

The presence of two Devonian dry holes within the limits of Mississippian production and a third well which is a small producer and is making some water give some indication of the more restricted boundary for the Devonian production. The latter well, near the center of Section 16, is at a point about $\frac{1}{2}$ mile west of the eastern bound-

ary of Mississippian production. Here the top of the Devonian limestone has an approximate elevation of -2,934 feet. If we assume that the boundary of the Devonian production follows the contours, the total productive area for Devonian would be approximately 5,000 acres. This compares with approximately 8,870 acres for the Benoist and McClosky.

Although the data are not at hand for the construction of production decline curves for Devonian wells in the Salem pool, indications

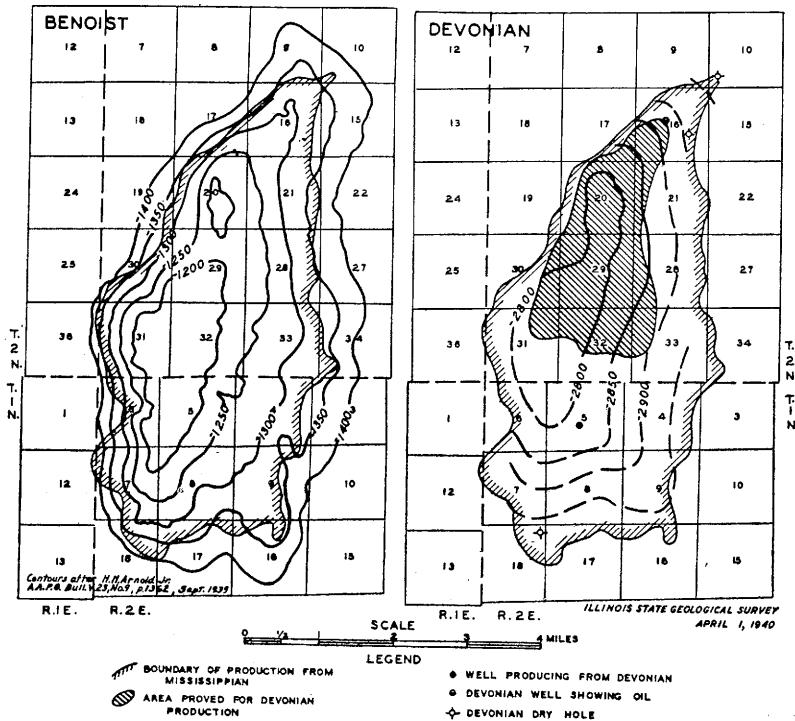


FIG. 6.—Subsurface contour maps of Salem field on Bethel formation (Benoist sand) and on Devonian limestone.

are that early declines are rapid. The high initial productions for some of the wells indicate a high degree of permeability in the reservoir rock. For the week ending April 2, average initial production for 12 wells was 1,775 barrels as compared with approximately 3,200 barrels for the first 14 wells in the pool (to January 16, 1940). This decline in initial productions of new wells in the short period of 3 months suggests that the reservoir energy is being rapidly depleted.

INDIANA

The following information regarding oil and gas developments in southwestern Indiana was provided by Ralph Esarey, State geologist, and G. F. Fix, State gas supervisor, Indianapolis, Indiana.

During 1939 Indiana experienced a great increase in prospecting and drilling for oil and gas. Major activity, as during the preceding year, was in the southwestern part of the state, the Indiana portion of the Eastern Interior Coal basin. An increasing interest was evident during the year, however, in the entire state, chiefly in northern Indiana, on the south flanks of the Michigan basin, and in the old Trenton field of east-central Indiana. In the latter area several tests to deeper parts of the Trenton and to the underlying St. Peter sandstone were completed. Results have been discouraging, however.

There were 377 wells completed in Indiana during 1939 and 77 others were in various stages of drilling at the close of the year. Of the 377 completed, 255 were classed as field locations and 122 as wildcats or semi-wildcats. The field wells were divided as follows: 156 oil wells, 39 gas wells, and 60 dry holes. Wildcats: 98 dry holes, 19 oil wells, and 5 gas wells (wildcat oil and gas wells include deeper production in oil fields and field extensions as well as new field discoveries). During 1939, 218 more wells were completed than during 1938.

Outstanding developments for 1939 include the discovery of several new oil and gas fields. In the Griffin field, discovered during the closing days of 1938, 83 wells were drilled of which 80 were productive. The Superior Oil Company (California) opened the New Harmony pool on Ribeyre Island, western Posey County, with their New Harmony Realty Company well No. 1, and 17 other oil wells and 1 dry hole were drilled on the Indiana side of this field during the year. Damron Brothers discovered the new Rockport gas field in Spencer County. Production is from the Palestine sandstone (upper Chester) at depths of 890-900 feet. The initial production of wells varies from 2.5 million to 21 million cubic feet per day. Deeper production or field extensions added new production to several other fields during the year. In addition, several "singles" were scattered over the southwestern counties—areas in which only one productive well had been completed at the close of the year, so that it was not possible to determine whether or not a new field of any proportions had been discovered.

Pipeline proration, limiting wells to $\frac{2}{3}$ their potential, continued in the older fields in the state. Many of these older fields failed to produce even their last year's allowable. Total oil production was 1,729,564

barrels; total gas production was 871,586 million cubic feet. The only new gas production of any consequence (Rockport, potential between 75 million and 100 million cubic feet per day) had no pipeline connections until after the end of the year. Consequently, no gas was sold from this field during 1939.

Leasing activity has declined considerably in southwestern Indiana, since most of the desirable acreage is now under lease. Many operators are now interested in other parts of the state and are leasing accordingly. It is probable that activity during 1940 will be as great as, or greater than, during 1939, since many operators, both independent and major companies, hold large blocks of leases which have not been tested.

KENTUCKY

The following information regarding oil and gas developments in western Kentucky was provided by D. J. Jones, State geologist, Lexington, Kentucky.

There have been 495 tests drilled in western Kentucky during the year of 1939 and the first quarter of 1940. Of these tests, 215 were oil wells, 264 were dry holes, and 16 were gas wells; 136 were wildcat tests 20 of which were productive.

Oil is being produced from sandstones and limestones ranging from the basal Pottsville to the McClosky sand of the Ste. Genevieve limestone.

Production is commonly found on domes and plunging anticlines. In many places it is governed by the lenticularity of the producing formation, as well as by the variable conditions of porosity.

Wells in various parts of the productive area range in depth from 150 to approximately 2,500 feet. Initial production in western Kentucky ranges up to 1,500 barrels per day. Total production for 1939 and the first quarter of 1940 for this area was 3,692,516 barrels. A large percentage of this oil was produced from Daviess, Hancock, Henderson, and McLean counties.

Total accumulated production for western Kentucky on April 1, 1940, is 39,634,367 barrels as compared with approximately 175 million barrels for the entire state.