

STATE OF ILLINOIS
HENRY HORNER, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
JOHN J. HALLIHAN, *Director*
DIVISION OF THE
STATE GEOLOGICAL SURVEY
M. M. LEIGHTON, *Chief, Urbana*

No. 34

ILLINOIS PETROLEUM

July 10, 1939

RECENT DEVELOPMENT IN ILLINOIS WITH
DISCUSSION OF PRODUCING FORMATIONS
BELOW McCLOSKEY "SAND"¹

ALFRED H. BELL AND GEORGE V. COHEE
Urbana, Illinois

ABSTRACT

The recent discovery of Devonian oil production in the old Sandoval field has focused attention on Devonian possibilities in the Illinois basin. As yet there has been relatively little testing of pre-Ste. Genevieve formations in the region. This paper reviews the known occurrences in Illinois of oil in the Mississippian below the Ste. Genevieve and in the Devonian, Silurian, and Ordovician systems.

A brief statement regarding developments in Illinois during 1938 and up to the early part of March, 1939, is included.

INTRODUCTION

During the 12-month period from March 1, 1938 to March 1, 1939, the rate of oil production in Illinois has mounted rapidly from a daily average of 43,000 barrels to one of 160,000 barrels—nearly a 4-fold increase. This increase has been due almost entirely to the development of fields on the western side of the Illinois basin, producing from sandstones in the lower part of the Chester (Upper Mississippian) series. The previous development during 1937 had been mainly in the central part of the basin where production to date is nearly all from the Ste. Genevieve oölitic limestone (McClosky "sand") in the upper part of the Iowa (Lower Mississippian) series.

A discovery which may have much significance in future development was made in December, 1938, when oil production was obtained in Devonian limestone in the old Sandoval field of Marion County, Illinois, which had been producing for 30 years from the Benoist sand of the Chester series. This article includes a discussion of developments during the 12-month period, and a review of the known occurrences of oil in Illinois in strata below the McClosky.

DEVELOPMENT IN 1938

An index map of new fields and extensions discovered during 1938 and the first 2 months of 1939 is shown in Figure 1.

In the last two years 23 new pools were discovered in Illinois, 8 in 1937 and 15 in 1938. Four new pools were discovered during the first two months of 1939. Following the presentation of the paper at the annual meeting of the Association three additional pools were discovered to April 4.

¹ Read before the Association at Oklahoma City, March 23, 1939. Manuscript received, April 15, 1939. Reprinted from Bull. Am. Assoc. Petr. Geol., Vol. 23, pp. 807-822, 1939.

With the new development in the state production has been obtained from three formations which were not productive in the old fields. A sandstone in the Paint Creek formation is productive in the Loudon (Beecher City) pool. It has locally been called the "Stray" sand. The Aux Vases sandstone, the basal formation of the Chester

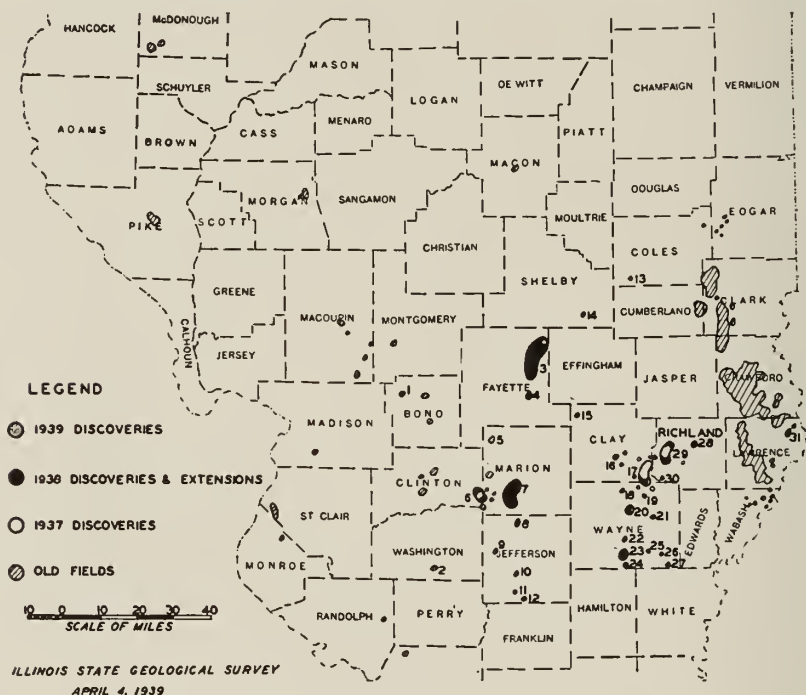
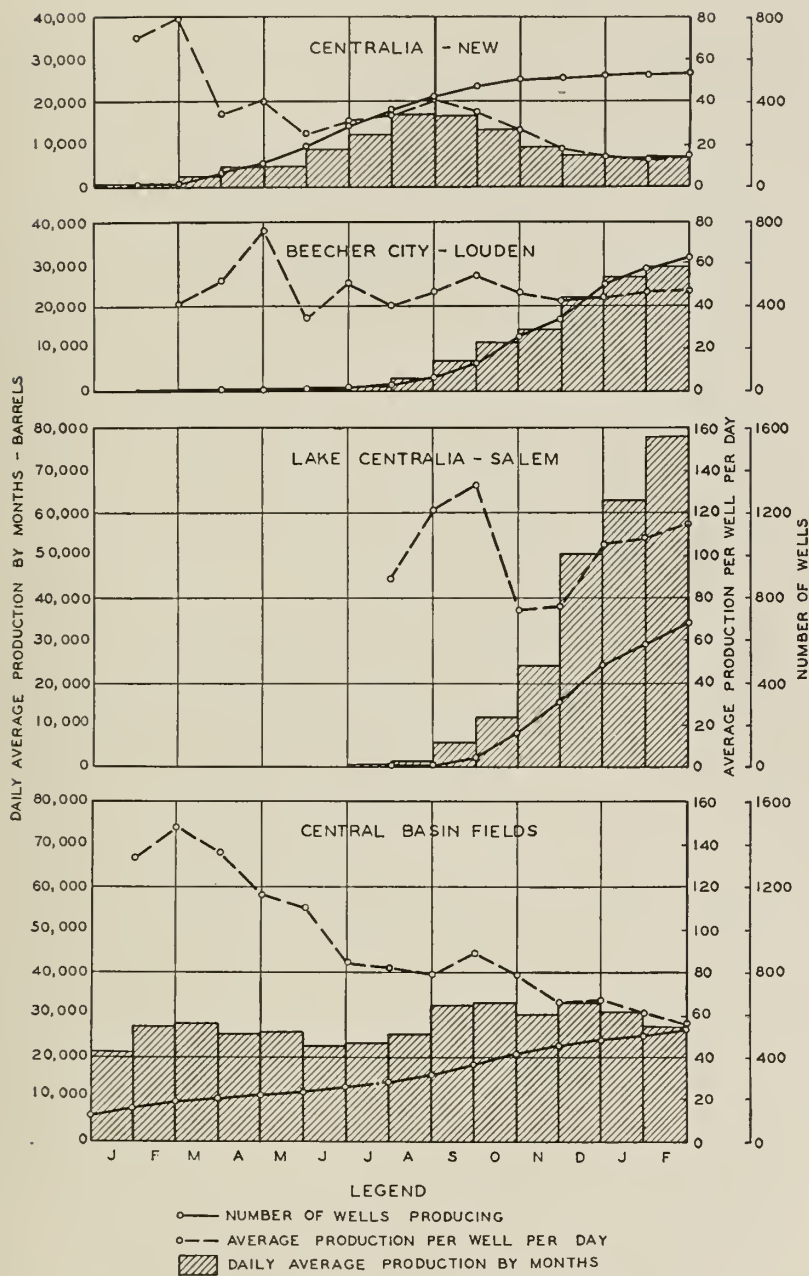


FIG. 1.—Index map showing old and new oil and gas fields in Illinois. The new fields are as follows: (1) Sorento; (2) Cordes; (3) Loudon (Beecher City); (4) St. James; (5) Patoka; (6) Centralia; (7) Salem (Lake Centralia); (8) Dix; (9) Roaches; (10) Marcoe; (11) Elk Prairie; (12) Ina; (13) Mattoon; (14) Stewardson; (15) Iola; (16) Flora; (17) Clay City; (18) Rinard; (19) Enterprise; (20) Cisne; (21) Mt. Erie; (22) Boyleston; (23) North Aden; (24) Aden; (25) Barnhill; (26) Golden Gate; (27) Leech Township; (28) Olney; (29) Noble; (30) Schnell; (31) Russellville gas. Numbers 16 to 30 inclusive are referred to collectively as the Central Basin fields.

series, is productive in the Salem (Lake Centralia) and Cisne pools and in the recently discovered Iola pool. The Rosiclare sandstone member of the Ste. Genevieve formation is productive in the Roaches pool in west-central Jefferson County. Tables I and II list the producing strata in the state and the approximate depths to the producing formations in the new fields.

The course of development in this 14-month period in four producing areas, which include about 97 per cent of the production from



ILLINOIS STATE GEOLOGICAL SURVEY

FIG. 2.—Oil production and number of producing wells in four new producing areas of Illinois, January, 1938–February, 1939.

the new fields, is shown by Figure 2. For each of the four areas three sets of data are shown graphically: (1) the number of producing wells at the end of each month; (2) the daily average production by the month; and (3) the daily average production per well each month.

The data for this last curve were calculated by dividing the daily average production for each month and for each field by the number of producing wells in the field at the end of the month. This involves an error which is small in comparison with the figure obtained but the results are useful as an indication of the trend in average production per well in each area.

There is an upward trend in the total production rate of the new fields during the 14-month period, an increase each month in the number of producing wells, and a generally downward trend in the average production per well.

The upper three graphs are of fields producing almost entirely from sandstone, and the lowermost graph is a composite of fields producing almost entirely from limestone.

The central basin fields, producing from limestone, had their initial development in the spring of 1937, previous to the period of the graph, and their daily production had already reached 21,000 barrels, from 126 wells. During most of the period of the graph the flush production of the new wells was hardly more than sufficient to offset the decline of the previous wells. This was interrupted in August, September, and October, 1938, when the North Aden field, Wayne County, was being developed. The trend of the average production per well has been downward during most of the period from a high of 148 barrels to a low of 52 barrels. There was very little artificial restriction of production in this area during the period of the graph.

Of the three areas producing from sandstone for which graphs are shown, the earliest to be developed was the Centralia (New). Pipeline proration was introduced in this pool in April, 1938, and has been in force in varying degree ever since. Because this field is located partly within the city limits of Centralia, there was very rapid drilling development, and a peak of production was reached in August, 1938. The rate of production declined for the following 6 months. The close spacing of the wells in part of the area within the city limits is already leading to early abandonment of some of them.

The Loudon (Beecher City) field, Fayette County, had a rather slow development up to August, 1938, after which the rate of drilling and the daily production increased rapidly. The rate of drilling was retarded somewhat in January and February, but the production

continued to increase, and the average production per well rose slightly. Because pipe-line proration has been in effect in this field from the beginning the curve of the average production per well can not be regarded as representing natural conditions.

The Salem (Lake Centralia) field is outstanding among the new fields of Illinois. At the end of the period of the graph (February 28, 1939) it was producing more than half of the total oil of the state. When it is remembered that the discovery well of the field was completed July 6, 1938, the exceptionally rapid development is apparent. The curve representing number of wells by months is seen to be the steepest of the four areas represented. At the end of February, 1939, there were 676 wells producing a daily average for February of approximately 78,000 barrels, or an average of 115 barrels per well per day. The curve representing daily average production per well does not show an overall downward trend; on the contrary it shows a rise during the last 5 months represented in the graph. Pipe-line proration in varying amounts has been in effect almost from the beginning.

Principal development to date in the Salem field has been in the Benoist sand (Chester series). However, two other formations, the Aux Vases in the Chester and the McClosky, are yielding some production and may be productive over most if not all of the area of Benoist production. The possibilities of production below the McClosky in this area remain to be explored.

PRE-MCCLOSKEY PRODUCTION

With the widespread development in Illinois attention has been focused upon the potential oil strata below the McClosky "sand." To date the development in Illinois has been largely limited to the McClosky and higher formations because of the cost of deeper exploration and the small amount of structural information regarding the lower formations. Production has been obtained from strata below the McClosky in various areas in Illinois. A discussion of these areas follows.

A well, recently drilled to the Devonian in the Sandoval field, Marion County, created much interest in Devonian-Silurian possibilities in other areas in the state. The well was drilled on the crest of the dome and reached the Devonian limestone at a depth of 2,876 feet, producing from 2,920 to 2,926 feet. A second well, a dry hole, was drilled to the Devonian at the northeastern edge of the old productive area and found the top of the Devonian 125 feet lower than in the discovery well one-half mile southwest. A third well which was

TABLE I
OIL AND GAS PRODUCING STRATA IN ILLINOIS

System or Series	Formation and Lithology*	Local Name and Area Productive
Pleistocene		Gas from glacial drift
Pennsylvanian	McLeansboro - sh., ss., thin ls., and coal	Upper Siggins, "Gas" - Clark County fields
	Carbondale - sh., ls., ss., coal	Casey, Claypool, Upper Partlow, Lower Siggins, "Bellair 500" - Clark County Dykstra, Wilson - Marion County
	Pottsville - ss., sh., and thin coal	Lower Partlow - Clark County Robinson - Crawford County Bridgeport - Lawrence County Buchanan - Lawrence County Biehl & Jordan - Wabash County Petro - Marion County
Chester (Upper Mississippian) Series	Kinkaid - ls., sh. Degonia - ss. Clore - ls., sh. Palestine - ss. Menard - ls., sh. Waltersburg - ss. Vienna - ls., sh. Tar Springs - ss. Glen Dean - ls., sh. Hardinsburg - ss. Golconda - ls., sh. Cypress - ss. Paint Creek - ls., sh. Bethel - ss. Renault - ls., sh., ss. Aux Vases - ss.	Carlyle - Clinton County Kirkwood - Lawrence County Upper Lindley - Bond County Weiler - Richland and Fayette Counties Stray - Fayette County Tracey - Lawrence County Benoist - Clinton, Fayette, Jefferson and Marion Counties Aux Vases - Marion County Bradley - Wayne County
Iowa (Lower Mississippian) Series	Ste. Genevieve - ls. St. Louis - ls. Salem - ls. Warsaw - ls. Keokuk - ls. Burlington - ls. Fern Glen - ls. Kinderhook - sh., ls., ss.	Levias - ls. Rosiclare - ss. Fredonia - ls. Osage group Rosiclare - Jefferson County McClosky "sand" - Illinois basin and southeastern fields Westfield lime - Clark County "Mississippi Lime" Carper sand - Clark County
Mississippian and Devonian	Chattanooga - New Albany sh.	
Devonian	Limestone	"Niagaran" Martinsville pool - Clark County "Hoig sand" Colmar-Plymouth field - McDonough County (Hunton limestone of Oklahoma)
Silurian	Dolomite	
Ordovician	Maquoketa - sh. Kimmewick - ls. Plattin - ls. Joachim - ls. St. Peter - ss.	"Trenton" Westfield pool - Clark County Dupo field - St. Clair County (Viola limestone of Oklahoma) (Wilcox sand of Oklahoma)

*ls. - limestone; ss. - sandstone; sh. - shale

TABLE II
APPROXIMATE DEPTHS TO PRINCIPAL PRODUCING HORIZONS IN ILLINOIS OIL FIELDS*

Geologic system or formation	Colmar- Plymouth	Dupo	Carlyle- Bartleso	Centralia	Lake Centralia - Salem	Dix	Patoka	St. James	Beecher City - Loudon	Central Basin Area	Southeastern Illinois
PENNSYLVANIAN	Pottsville										Robinson and Bridge- port sands 1000' Buchanan - 1250'
	Cypress		Carlyle sand 1000'	Cypress 1200'				Weiler 1600'	Weiler sand 1510'	Weiler sand 2600'	Kirkwood sand 1500'
	Bethel			Benoist 1350'	Benoist 1770'	Benoist 1950'	Benoist 1420'		Benoist 1540'		Tracey sand 1600'
MISSISSIPPIAN	Aux Vasee				Aux Vases 1800'					Bradley sand 2990'	
	Fredonia				McClosky "sand" 2000'					Clay City 2980' Noble 2960' Olney 3050' Schneil 3010' Flora 2970' Cisne 3120' Aden 3290' N. Aden 3310' Leech Twp. 3450'	McClosky "sand" 1700'
DEVONIAN	Holing sand 450'										Martinsville pool "Niagaran" 1550'
		"Trenton" 500'									Westfield pool "Trenton" 2260'
ORDOVICIAN											

* Several fields, having only one to four wells each, are not included.

also dry was drilled $\frac{1}{4}$ mile west of the first well and the top of the Devonian limestone was found to be 75 feet lower.

Evidently, there was little or no shifting of the structure with depth. Also, the structure becomes sharper with depth and has a

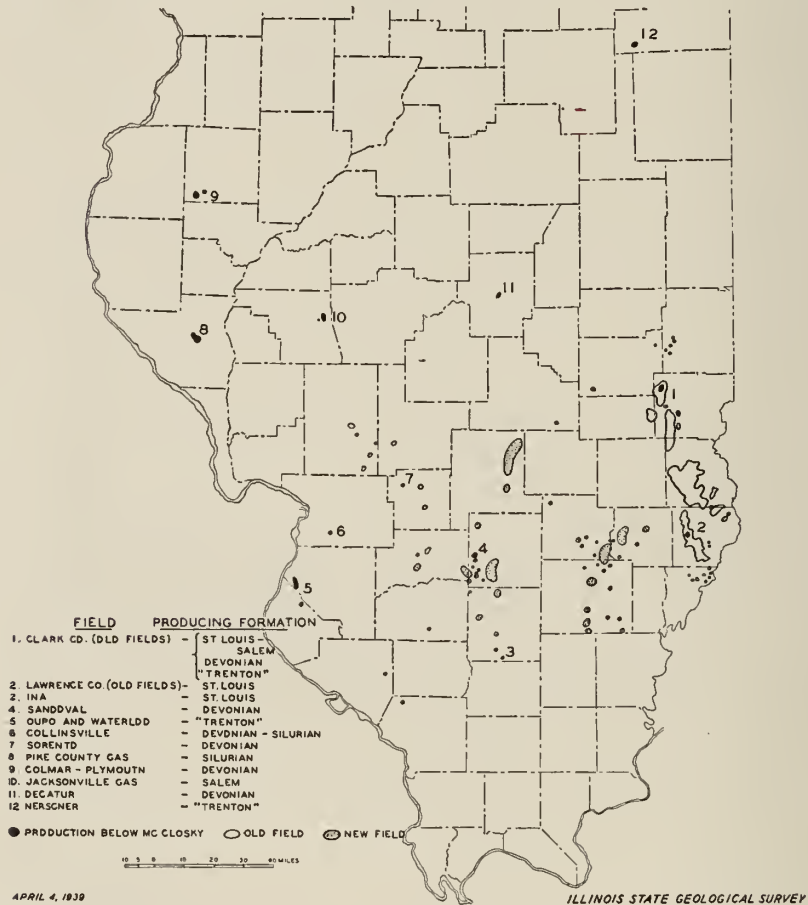


FIG. 3.—Index map of areas of production from formations below McClosky (Ste. Genevieve formation, Lower Mississippian).

smaller area of production than the overlying Bethel sandstone. It is believed that similar structural conditions will be found on other structures in the Illinois basin.

The discovery well of the Loudon (Beecher City) field, the Carter Oil Company's Mary Miller No. 1, Sec. 12, T. 8 N., R. 3 E., first produced oil from the Devonian, but since the production was very

small, it was plugged back to the Cypress sandstone from which it is now producing. The well is located at the northeastern edge of the structure and is within the area of production of the overlying Chester formation.

Another well to the Devonian was drilled about the same time as the Sandoval discovery. The DeMayo *et al.* Dressor No. 1, Sec. 21, T. 6 N., R. 4 W., Bond County, drilled on the flank of the Sorento dome, made a small producer in the upper part of the Devonian from 1,800 to 1,830 feet. The well was drilled higher on structure and about $\frac{1}{4}$ mile north of an old well which had a good showing of oil in the same zone. Owing to unfavorable weather and road conditions there has been no further development in this area. It is expected that this discovery will stimulate interest in western Illinois.

Production in the Lower Mississippian below the McClosky is practically limited to areas in which there is a marked erosional unconformity at the top of the Lower Mississippian. However, there are a few exceptions and more may be found. Zones of dolomite and dolomitic limestone are very common in the Ste. Genevieve, St. Louis, and Salem limestones. These zones are very persistent and can be traced in wells throughout the Illinois basin. The porous zones may carry salt water and may also have small oil showings. The Leach Brothers' Albert Lee No. 1, Sec. 11, T. 1 S., R. 10 E., Edwards County, had a showing of oil in one of these porous dolomitic zones in the Salem limestone. In Lawrence County high on structure two or three wells on the Bowers and Ross lease, Sec. 29, T. 4 N., R. 12 W., obtained production from a dolomite zone at the top of the St. Louis limestone, and 200 feet below the top of the Ste. Genevieve.

Another area of St. Louis production of considerable interest is the Nolle Oil and Gas Company's Kelley No. 1, Sec. 25, T. 4 S., R. 2 E., Jefferson County, which obtained production at a depth of 3,002 feet, 100 feet below the top of the St. Louis limestone. Production is in a porous zone in the fossiliferous limestone which is of very local occurrence. Wells drilled north and south of the discovery well were dry.

SOUTHEASTERN ILLINOIS FIELD

To date production below the McClosky sand in the southeastern Illinois oil field is practically limited to the northern part in Clark County. The Westfield limestone, which is the main producing formation of the Westfield pool, underlies the Pennsylvanian at a depth of 400 feet and includes the St. Louis and Salem limestones of the Lower Mississippian series. A well drilled in Sec. 17, T. 11 N., R. 14

W., logged 75 feet of St. Louis limestone overlying the Salem limestone. It is estimated that approximately 50 feet of St. Louis is present on top of the dome. Most of the production is obtained from the upper 50 feet of the limestone whereas on the sides of the dome it may be as much as 100 feet below the top. Very little production has been obtained at greater depths in the limestone. There are from one to three pays in dolomitized, slightly oölitic, pure or impure limestone zones. The range in porosity is very wide owing to the varying degree of dolomitization and oölitic content. Very porous streaks are usually less than 10 feet thick and vary from 10 to 100 feet apart.

The "Trenton" (Kimmswick-Plattin) limestone which is geologically the oldest producing formation in Illinois, is productive in 11 wells near the top of the Westfield dome. The limestone is reached at a depth of about 2,270 feet and the pay was found in the upper 150 feet of the limestone. The oil occurs in pure crystalline limestone which is more porous in the lower part. The wells had a flush production of approximately 100 barrels after shooting, but within two or three months dropped to 10 or 12 barrels a day on pump.

The St. Peter sandstone was tested on structure in the Tidewater Associated Oil Company's Spellbring No. 34, Sec. 8, T. 11 N., R. 14 W. The top of the sand was reached at 2,984 feet; the well was drilled to 3,009 feet.

In the Westfield pool the structure is a broad, well defined dome with about 180 feet of closure on the eroded top of the Lower Mississippian limestone and about 300 feet of closure on the top of the "Trenton." The top of the "Trenton" structure appears to be about $\frac{1}{4}$ mile west of the top of the structure on the Mississippian limestone.

In the Martinsville pool the St. Louis limestone which immediately underlies the Pennsylvanian is productive. Locally the pay stratum has been called the Martinsville "sand." It is in the porous, somewhat altered zone in the limestone usually from 5 to 10 feet below the top and averages 20 feet in thickness.

The Carper sand, consisting of one to four sandstone lenses, each 10 to 30 feet thick, is in the lower Osage group. The sandstones are fine-grained and occur in lenticular beds of variable thickness and considerable areal extent. Each bed is separated by 10 to 15 feet of shale. The top sand is usually barren of oil and the second sand is the principal producer. Much gas was produced with the oil near the crest of the structure.

Mylius (1)³ considered the Carper sand upper Kinderhook in age and Moulton (2) placed the sand "in the black shale underlying the

³ For references, see end of article.

Mississippian limestone." Later studies in the Martinsville field by L. E. Workman and J. N. Payne⁴ show that the Carper sand is basal Osage. All of the sandstones that have been called the Carper sand occur above the Rockford limestone which is near the top of the Kinderhook in this part of Clark County. A sandstone may be present in certain areas beneath the Rockford limestone, but it is of local occurrence and very thin.

The Devonian-Silurian limestone which has been called "Niagaran" and "Corniferous" is productive in the Martinsville pool. Production is from the weathered zone in the upper part of the limestone and the best production is found 10 to 30 feet from the top. Much water has been produced with the oil from this zone.

The "Trenton" has been tested in two wells, both on the west slope of the structure, one of which was dry. The other produced a small amount of oil from a coarsely crystalline limestone, somewhat sandy toward the base. The producing well on the McFarland farm, Sec. 19, T. 10 N., R. 13 W., was drilled 125 feet into the "Trenton" limestone, reached at a depth of 2,708 feet. The Lowe dry hole was drilled in Sec. 25, T. 10 N., R. 14 W. The top of the "Trenton" was reached in this well at a depth of 2,709 feet.

The structure in the area is an elongate dome on the side of and somewhat parallel with the major fold of the LaSalle anticline. There is a closure of 20 feet on top of the eroded St. Louis limestone and less than 100 feet on the top of the Devonian. The Trenton Rock Oil Company's Carper No. 13, Sec. 30, T. 10 N., R. 13 W., total depth 3,411 feet, was drilled to the St. Peter sandstone, the top of which was reached at a depth of 3,400 feet.

In northern Crawford County the Salvage Oil and Fuel Company's W. S. McGrillis No. 6, Sec. 25, T. 8 N., R. 13 W., had a good showing of oil and gas in the Devonian limestone topped at a depth of 2,775 feet, total depth 2,785 feet. This well has created considerable interest in the possibilities of deeper production in Crawford County where the principal producing horizon is the Robinson sand of Pennsylvanian age. Small production has been obtained locally near Oblong, Illinois, in a deeper sand which has been correlated as the McClosky sand.

The Hastings *et al.* Athey No. 1, Sec. 18, T. 8 N., R. 12 W., a few miles northeast of the McGrillis well, tested the Devonian and had a fair showing of oil. Southeast of Stoy, Illinois, and within the producing area of the Robinson sand, the Zanhizer *et al.* Jones well tested the "Trenton" limestone in Sec. 12, T. 6 N., R. 13 W. The top of the

⁴ Personal communication.

Devonian was reached at the depth of 2,896 feet, the "Trenton" at 4,243 feet, and the total depth of the well was 4,620 feet. Showings of oil were reported in the Devonian at 2,900 feet and 3,130 feet. It is expected that several tests will be drilled to the Devonian in the near future. To date these three wells are all that have been drilled to the Devonian in Crawford County.

Lawrence County has likewise had very little deep drilling. A well drilled in the Middaugh farm in Sec. 32, T. 4 N., R. 12 W., tested the St. Peter sandstone. This well was drilled on the axis of the anticline, $1\frac{1}{2}$ miles southeast of the crest as mapped on the Kirkwood sand. There was a showing of oil in the Devonian limestone at 2,965 feet. The top of the "Trenton" was 4,370 feet, the St. Peter sandstone 5,180 feet and the total depth 5,190 feet. No showings were recorded below the Devonian. Another well was drilled to the Devonian within the area of production but toward the south edge in the Lawrence County field. The L. Jenner, Central Refining Co. No. 21 in Sec. 35, T. 3 N., R. 12 W., was drilled to a depth of 3,515 feet. Two showings of oil were recorded in the Devonian limestone which was topped at 3,145 feet—one showing at 3,303 feet and the other at 3,348 feet. Another well was drilled to the Devonian at the eastern edge of the county and a number of miles from production; no showings were recorded.

Wabash County has had no wells that were drilled to the Devonian or deeper.

JACKSONVILLE GAS FIELD

Much of the gas and a small amount of oil has been produced from the Mississippian limestone in the Jacksonville gas field 2 miles east of Jacksonville, Illinois. Some gas has been produced from the Pennsylvanian sandstone, as well as from the underlying Mississippian limestone, correlated as the Salem (9). The principal production is from a porous dolomitic zone near the top of the limestone. The field, abandoned in 1937, had more than 50 gas wells. The gas was used for heat and light in local residences and was also piped to the city of Jacksonville. A few wells are still being used by the landowners.

The structure of the beds beneath the Pennsylvanian unconformity is not known in detail because the wells in the area were drilled only a short distance into the limestone. However, it is possible that the form of the erosional surface may have been controlled by the folding of the underlying Mississippian strata. Contours on the erosional surface at the top of the limestone show a high in Secs. 2 and 3, T. 15 N., R. 9 W., where gas was produced. Oil was found lower

structurally on saddles between structures. A well was drilled to the "Trenton" in Sec. 8, T. 15 N., R. 9 W., in one of the areas of gas and oil production. The well was drilled 148 feet in the "Trenton" and no showings were recorded in the Devonian or "Trenton" limestone. The top of the Warsaw shale and limestone is reached at a depth of approximately 400 feet in this area; this is the shallowest horizon below the unconformity suitable for a key horizon for structure testing. The Salem limestone is only 100 to 150 feet thick in the field.

COLMAR-PLYMOUTH FIELD

In 1914 oil was discovered on the Hoing farm in Sec. 16, T. 4 N., R. 4 W., McDonough County. The field was rapidly developed and resulted in two separate producing areas; one largely in Secs. 15 and 16, T. 4 N., R. 4 W., which has frequently been called the east pool and the other to the southwest in Secs. 19 and 30, T. 4 N., R. 4 W., and extending into the eastern edge of Hancock County. This pool has been referred to as the south pool. Four hundred seventy-seven wells have been drilled in the field and 2,416,000 barrels of oil were produced to the end of 1938.

The producing formation, the Hoing sand, is a lenticular sandstone averaging 21 feet in thickness, occurring in lenses at the base of the Cedar Valley dolomitic limestone and in depressions on top of the Maquoketa shale. In this area the Silurian is absent and the Devonian Hoing sand rests on the Ordovician Maquoketa shale. The character of deposition of the sandstone and subsequent erosion account for its irregular occurrence in the field.

Blatchley and Savage (4) considered the Hoing sand of Devonian age "Hamilton (?)" and later Morse and Kay (5) and Hinds (6) defined the "sand" as Silurian. After studying numerous sets of well cuttings from the field and adjacent area Workman (7) correlated the sand as Devonian in age because the sand grains of which the Hoing sand is composed are not present in the Maquoketa shale or in the Silurian which is present near by. The sand grains resembling those of the Hoing sand are found widespread in basal Devonian strata in Illinois.

The structure of the field as shown by the contours on the Colchester No. 2 coal consists of a dome with an east-west axis about half way between Comar and Plymouth and a terrace on the northeast edge of the dome $1\frac{1}{2}$ miles east of Colmar. The dome and terrace have a combined closure of 60 or more feet. Production occurs on top and well down the side of the dome.

The "Trenton" limestone has been tested in a number of wells

drilled on the dome, but to date no well has tested the "Trenton" on the terrace where the east pool is located.

DECATUR FIELD

In 1922 and 1924 several oil tests were drilled to the Devonian limestone in the vicinity of Decatur, Illinois. The top of the limestone was reached at a depth of 1,950 feet to 2,000 feet. A number of the wells had showings of oil in the Devonian but not sufficient for commercial production. In 1937, two of the old wells in Sec. 33, T. 17 N., R. 2 E., and Sec. 5, T. 16 N., R. 2 E., a short distance northwest of Decatur, were cleaned out, acidized, and made small producers. The Devonian limestone is only 10 to 20 feet thick in this area. Contours on coal No. 5 show an anticlinal nose northwest of town with a northwest trend. Last year a dry hole was drilled in Sec. 30, T. 17 N., R. 2 E., to the St. Peter sandstone and was found to be higher on the structure than the above mentioned producing wells. Here the Devonian was entirely removed and no showings were recorded in the Silurian or "Trenton" limestones.

PIKE COUNTY GAS FIELD

Gas was discovered on the Pittsfield-Hadley anticline in 1886, but the gas field on the anticline west of Pittsfield, Illinois, was not developed until after 1905. Gas was found in the Niagaran dolomite of Silurian age. The producing formation is overlain by shale of Upper Devonian and Lower Mississippian age (10, 11). On the highest part of the structure the Upper Devonian shale lies directly below the Pleistocene. The average depth to the top of the producing zone is 265 feet. The gas wells were scattered over an area of almost 9,000 acres. The gas was used locally by the landowners to heat and light their residences. The structure is an elongate anticline with small domes along the main axis, each dome having 40 to 60 feet of closure. The main axis of the fold has northwest trend and extends from Lewis County, Missouri, through Adams, Pike, and into Greene counties, Illinois (13). A number of wells on structure have been drilled to the St. Peter sandstone which is reached at the depth of 750 to 800 feet.

COLLINSVILLE FIELD

Near Collinsville, Illinois, four wells were drilled in Sec. 8, T. 3 N., R. 8 W., Madison County, and found production in Devonian-Silurian limestone. The "sand" according to the driller's logs was 20 to 30 feet thick. The greater part of the sand is in the Silurian as the Devonian is represented by approximately 5 feet of calcareous sandstone. The wells were small and were soon abandoned.

Although the available data are insufficient to determine the nature of the reservoir, there is a suggestion that a structure of small areal extent gave rise to the accumulation. The "Trenton" has not been tested in the vicinity of the production.

DUPO AND WATERLOO OIL FIELDS

The Dupo oil field discovered in 1928 is located on the Waterloo anticline which has a north trend and extends from St. Louis, Missouri, to Waterloo, Illinois (12). The Waterloo field which was discovered 8 years prior to Dupo was of less importance. It had only 23 producing wells and all were abandoned by 1930. The producing horizon in both fields is a porous zone in the light brown, crystalline Kimmswick ("Trenton") limestone occurring at the top of the limestone at a depth of 500 feet. The wells are drilled 40 to 50 feet in the limestone. To date 242 wells were drilled in the field and approximately 950,000 barrels of oil have been produced. Town lot drilling at the north end of the field hastened the rapid decline of the wells in that area and all but 25 of the wells have been abandoned. A few wells have recently been drilled at the eastern edge of the field and found production in crevices in the limestone according to information from drillers. This development has caused a revived interest in the field.

Both the Dupo and Waterloo fields on the Waterloo anticline are located on separate domes with 100 feet or more of closure. The anticline is a long, narrow structure with a steep west dip and a gentle east dip. The fold dies out to the north under St. Louis and to the south a short distance south of Waterloo. Only 200 feet of Mississippian strata are encountered in wells on the anticline; the Devonian is absent and the Silurian is represented by 50 or 70 feet of dolomitic limestone. I. G. Lockwood's Dyroff No. 1, Sec. 26, T. 1 N., R. 10 W., located on the flank of the structure, tested the St. Peter sandstone.

HERSCHER AREA

An area of passing interest which produced some oil and gas from the "Trenton" is in Sec. 32, T. 30 N., R. 10 E., Kankakee County (14). Nine wells drilled in the north half of the section produced oil and gas for a short time before being abandoned. The largest well produced only $\frac{1}{2}$ barrel a day. All wells produced some gas, the largest being 32,000 cubic feet per day. The "Trenton" was reached at a depth of 140 feet and it is not known at what depth below the top of the limestone the oil was reached. Several wells were drilled in the area, but few logs are available and the available data are not sufficient to explain the structural conditions which gave rise to this

local occurrence of oil off the flank of the Kankakee arch. There are several areas in northwestern Indiana along the Kankakee arch in which oil was produced from the "Trenton" (15).

CONCLUSION

In view of the numerous areas of Devonian and "Trenton" production in the state and the recent finding of Devonian production in the Sandoval field, the possibilities for new production below the McClosky "sand" deserve serious consideration. Up to the beginning of the recent development production from these strata amounted only to about one per cent of the state's total production. It is possible that they will be important producing zones in such fields as Loudon (Beecher City), Salem (Lake Centralia), Centralia, Patoka, and certain central-basin fields. In the central-basin fields the depth of the Devonian is estimated to be 4,500 to 5,100 feet and the "Trenton" 5,900 to 6,500 feet.

ACKNOWLEDGMENTS

For certain areas discussed in the manuscript the writers wish to acknowledge use of information from the publications listed as references.

REFERENCES

1. L. A. MYLIUS, "Oil and Gas Development and Possibilities in East Central Illinois," *Illinois State Geol. Survey Bull.* 54 (1927).
2. G. F. MOULTON, "Areas for Further Prospecting Near the Martinsville Pool, Clark County, Illinois," *Illinois State Geol. Survey Illinois Petroleum* 4 (1926).
3. ———, "Structure and Oil Prospects of Eastern Clark County, Illinois," *ibid.* 14 (1928).
4. R. S. BLATCHLEY, "Plymouth Oil Field," *Illinois State Geol. Survey Bull.* 23 (1917), pp. 51-53.
5. W. C. MORSE and F. H. KAY, "The Area South of the Colmar Oil Field; the Colmar Oil Field, a Restudy," *ibid.* 31 (1915).
6. HENRY HINDS, "Colchester-Macomb," *U. S. Geol. Survey Geol. Atlas Folio* 208 (1919).
7. L. E. WORKMAN, "The Stratigraphic Position of the Hoing Sand," *Illinois State Acad. Sci.*, Vol. 26 (1934), p. 107.
8. D. M. COLLINGWOOD, "Oil and Gas Development in the Vicinity of Jacksonville," *Illinois State Geol. Survey Bull.* 44B (1923).
9. ALFRED H. BELL, "Recent Development in the Vicinity of Jacksonville," *Illinois State Geol. Survey Illinois Petroleum* 11 (1927).
10. H. N. CORYELL, "Parts of Pike and Adams Counties," *Illinois State Geol. Survey Bull.* 40 (1919), pp. 70-95.
11. ALFRED H. BELL, "Oil Prospects in Central Pike County," *Illinois State Geol. Survey Illinois Petroleum* 3 (1926), pp. 7-10.
12. ALFRED H. BELL, "The Dupon Oil Field," *ibid.* 17 (1929).
13. FRANK KREY, "Structural Reconnaissance of the Mississippi Valley Area from Old Monroe, Missouri, to Nauvoo, Illinois," *Illinois State Geol. Survey Bull.* 45 (1924), Pl. I.
14. L. F. ATHEY, "Geology and Mineral Resources of the Herscher Quadrangle," *ibid.* 55 (1928), pp. 109-110.
15. W. N. LOGAN, *Handbook of Indiana Geology*, Pt. 5, Chap. 10 (1922).