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THE BEARING OF THE STRUCTURAL RELATIONS BETWEEN THE PENNSYLVANIAN AND OLDER FORMATIONS ON PETROLEUM PROSPECTING IN WESTERN ILLINOIS

By Gail F. Moulton

INTRODUCTION

Petroleum prospecting in western Illinois on the basis of structure determined from coal bed data has been moderately successful and according to a previous report<sup>1</sup> about fifty per cent of the favorable structures in western Illinois which have been completely tested have yielded important amounts of oil or gas. In view of the fact that other known structures remain untested and that still other structures are yet to be discovered, certain structural relations which have been observed in a few cases will be considered with a view to furthering petroleum prospecting.

The general structural relations of the Pennsylvanian and pre-Pennsylvanian beds are comparatively simple. In western Illinois the whole series of consolidated rocks has a general eastward dip toward the central part of the Illinois Coal Basin. The older formations have a slightly greater dip than the Pennsylvanian formations. Accordingly, unless the effect of folding increases in the lower beds, a more pronounced structure in the Pennsylvanian series would be required to determine favorable conditions for the accumulation of petroleum in the older rocks than would be necessary to determine a favorable structure in the Pennsylvanian itself.

<sup>1</sup> Collingwood, D. M., Oil production in Illinois: Illinois State Acad, Sci. Trans., Vol. 16, pp. 372-385, 1923.

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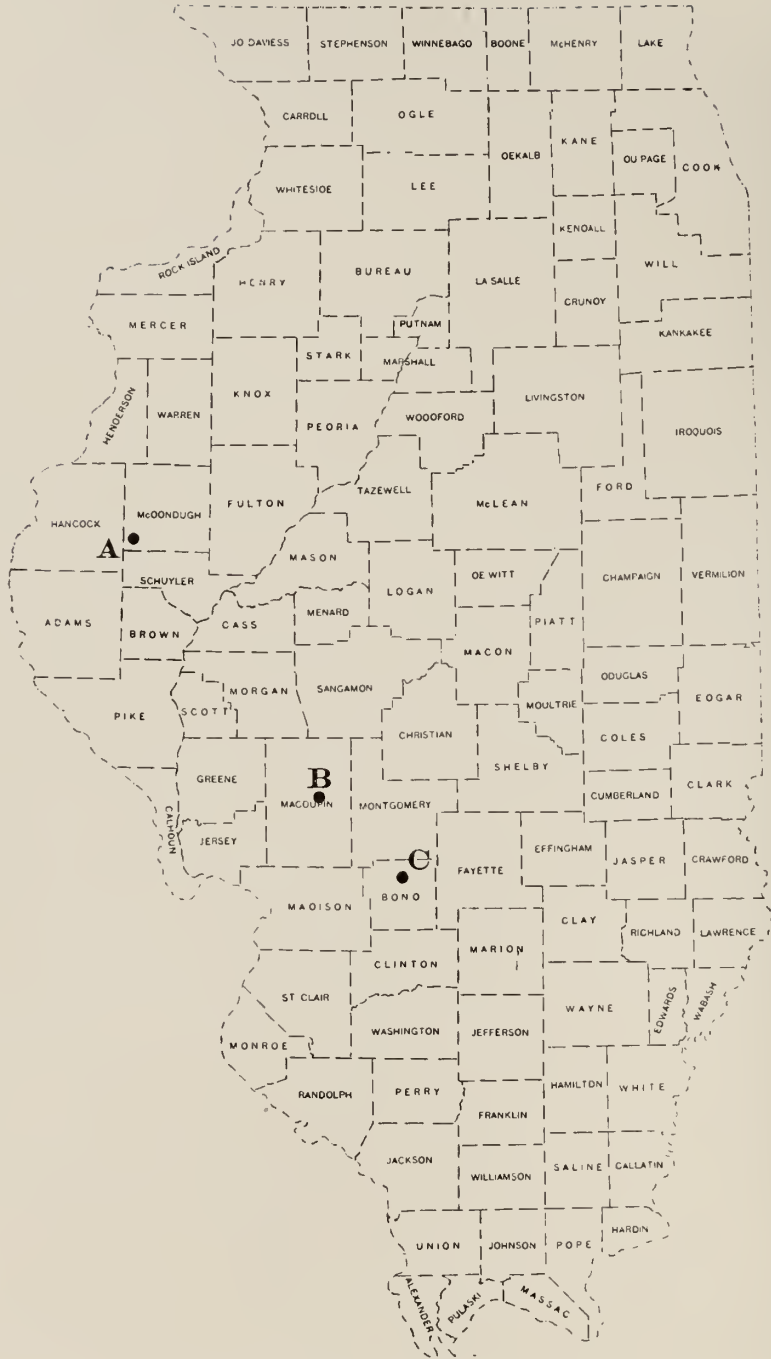


FIG. 1. Map of Illinois showing locations of areas A, B, and C



FEET ABOVE  
SEA LEVEL

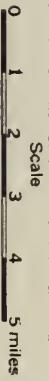
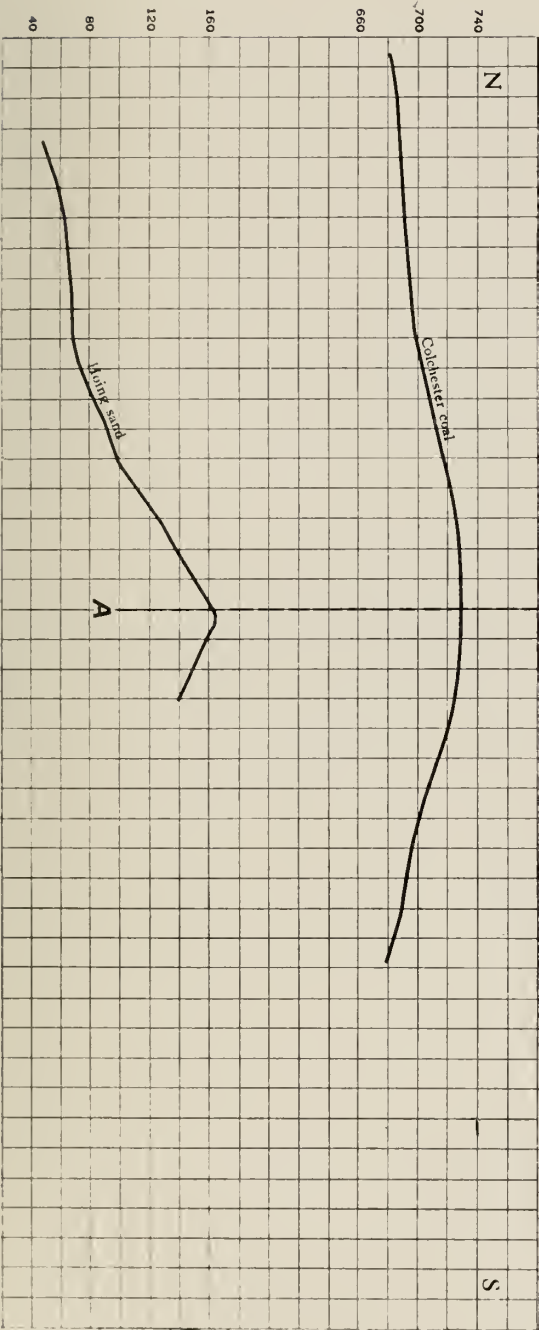
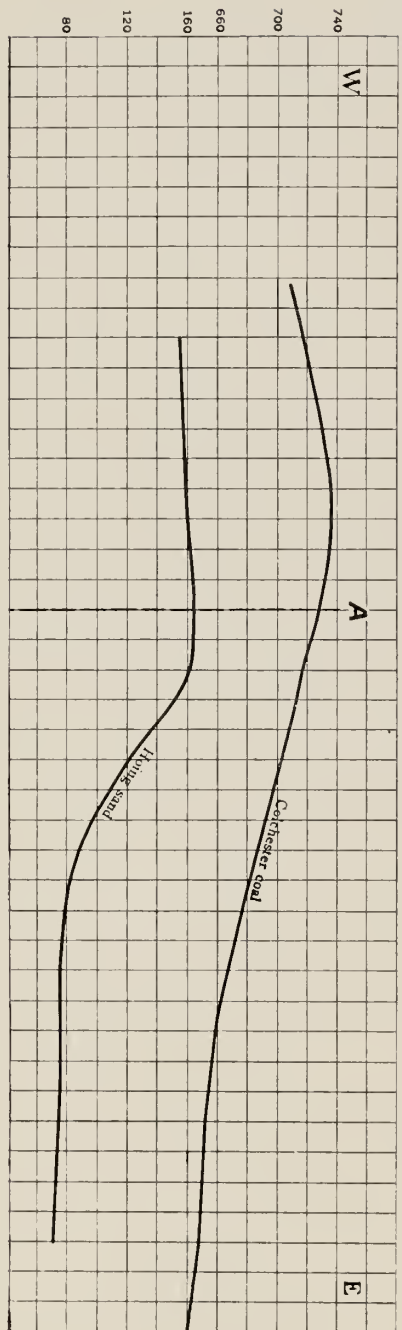


FIG. 2. East-west and north-south sections through area A in southwestern McDonough County

Detailed work in several areas of western Illinois has established the fact that rock folding took place in the Illinois area during the time immediately preceding the deposition of the Pennsylvanian series. Accordingly, all of the rock formations older than the Pennsylvanian were affected by the disturbance. The structure of the Pennsylvanian rocks has been greatly influenced by one or more periods of folding since Pennsylvanian times. This later folding has also modified the structure of the rocks underlying the Pennsylvanian.

In attempting to interpret the structural conditions of the pre-Pennsylvanian formations from structural data on the Pennsylvanian for use in petroleum investigations, two important questions arise. These are: (1) Was the post-Pennsylvanian folding localized along axes determined during pre-Pennsylvanian movements? (2) What type of structure of the Pennsylvanian deserves the most favorable consideration for oil prospecting? It is believed that the data herein considered have a pertinent bearing on both of these questions.

#### DETAILED STRUCTURAL RELATIONS

For the purpose of this paper the detailed structural conditions which have been determined for each of three areas will be described in order to contrast the structure of the Pennsylvanian rocks with that of those underlying older strata in which oil and gas are most commonly found. These areas are indicated on a general map of the State (fig. 1). Since they are scattered over a considerable portion of western Illinois, the data may be considered as representative of general conditions.

The cross sections made for this investigation are all drawn to scale, but the vertical scale is larger than the horizontal scale. Accordingly there is a vertical exaggeration which makes all of the dips appear steeper than they really are. At the same time the dips shown in the different beds in each structure section are comparable and the true relations of the amount of dip are indicated.

The sections across area A in southern McDonough County (fig. 2) are taken across the structure on which the Colmar oil pool is located. The sections show the structure of the Colchester coal and the Hoing sand (at the base of the Silurian lime) along an east-west and a north-south line. The section along the north-south line shows considerably different relations, for here the dips in the oil bearing horizon are much steeper than in the coal bed.

The structural relations of the Pennsylvanian and pre-Pennsylvanian as indicated by the sections across area B (fig. 3) are similar, for here, too, the structure of the Chester formation (oil sand) along an east-west line is similar to that of the Pennsylvanian coal bed above, but along the north-

south line the fold indicated by the lower beds is more pronounced than that in the coal.

The data available permitted the construction of only the section along a north-south line across area C in Bond County (fig. 4). The beds which

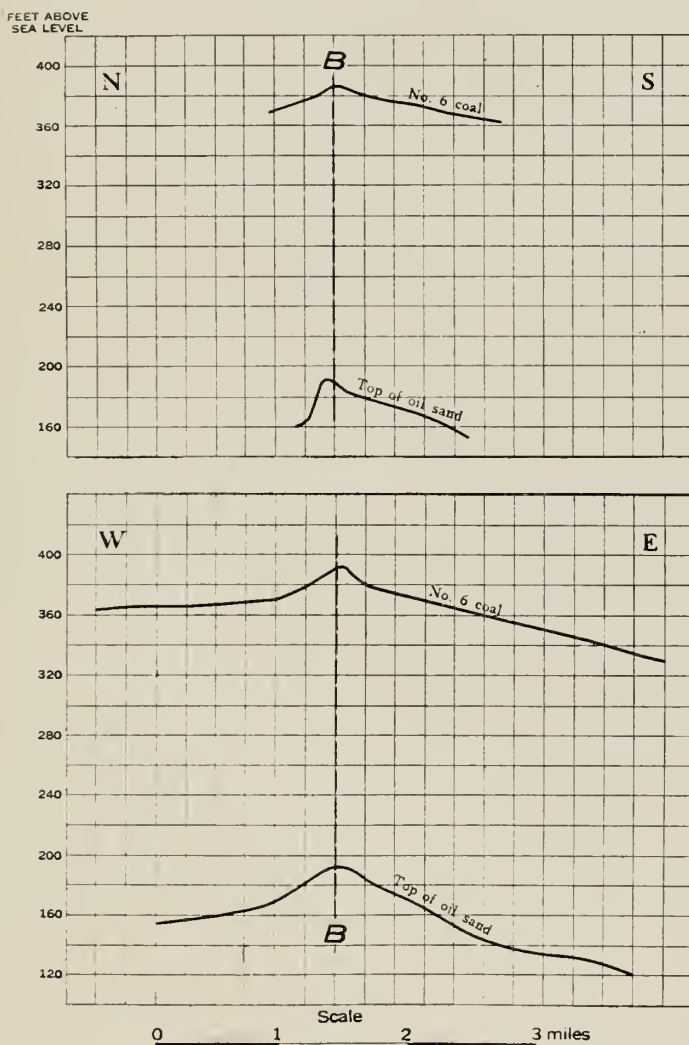


FIG. 3. East-west and north-south sections through area B in Macoupin County

show the structure are the Herrin coal and the gas sand of Chester age. In this case the folding of the Chester is notably more pronounced than that of the coal. This feature is common to each of the other sections along north-south lines.

A review of the data shows that in general the structure of the Pennsylvanian along east-west lines is closely parallel to the structure of the Chester, but that it is much gentler than the Chester along north-south lines.

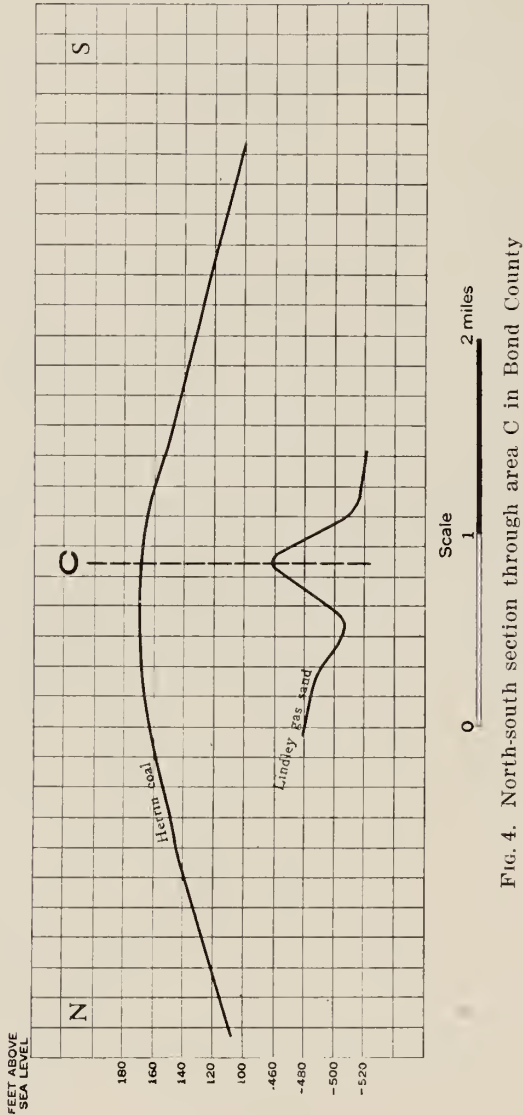


FIG. 4. North-south section through area C in Bond County

The uniformity of these relations in the areas examined strongly suggests that there was folding in western Illinois in post-Chester-pre-Pennsylvanian time which resulted from compressional forces acting along a north-south line. It appears that these folds in the underlying rocks were modi-

fied by folding due to compression along an east-west line after the Pennsylvanian deposition and that they caused slight localized uplifts in the Pennsylvanian in some places.

The important conclusions from the point of view of the oil prospector are that in areas where Pennsylvanian structure can be determined, the folding of the underlying rocks may be expected to be somewhat similar except that folds along east-west axes should be much more pronounced. For locating structures in Pennsylvanian beds favorable for petroleum prospecting, first consideration should be given to those with an east-west axis which appear to have a reverse dip along this axis. Such structures are probably competent to cause the accumulation of oil and gas.

## OIL PROSPECTS IN CENTRAL PIKE COUNTY

By Alfred H. Bell

### INTRODUCTION

Along with the active search for prospective oil territory remote from developed fields there may be a tendency to overlook possibilities still existing in areas which have been exploited in the past and which, from a superficial view, appear to be exhausted. The Pittsfield-Hadley anticline in central Pike County was at one time the scene of an extensive drilling program but in recent years this territory has been inactive. Certain considerations set forth below seem to warrant further drilling in this area.

### STRUCTURE

The Pittsfield-Hadley anticline has been described by H. N. Coryell.<sup>1</sup> Its general relation to the surrounding structure is shown on a structure map prepared by Frank Krey.<sup>2</sup> A line of folding extends northwest-southeast across parts of Lewis County, Missouri, and Adams and Pike counties, Illinois. In Pike County it bends to the east and culminates in a dome centering in sec. 21, T. 5 S., R. 4 W., 4 miles west and one mile north of Pittsfield. Between Pittsfield and Hadley a series of small domes are arranged along a fairly well defined axis and some others lie to the south of the axis. (See fig. 5.)

### DEVELOPMENT

Gas was discovered in Pike County in 1886 in sec. 1, T. 5 S., R. 5 W. By the close of 1912, 100 wells had been drilled, 39 of which were productive

<sup>1</sup> Coryell, H. N., Parts of Pike and Adams counties: Illinois State Geol. Survey Bull. 40, pp. 69-95, 1919.

<sup>2</sup> Krey, Frank, Structural reconnaissance of the Mississippi Valley area from Old Monroe, Missouri, to Nauvoo, Illinois: Illinois State Geol. Survey Bull. 45, Plate I, 1924.

in 1918. At that time only those wells enclosed by a 590-foot contour (fig. 5) had sufficient gas supply for all seasons of the year. Between the 590-foot and the 500-foot contours the supply of gas was sufficient only for cooking and lighting. Coryell concluded in 1918 "the field has been thoroughly exploited. The productive area is bounded on all sides by dry wells and it is decreasing in size from year to year by failure of some of the wells that are near the margin."<sup>3</sup>

## PRODUCING HORIZONS

### THE GAS ROCK

"The porous stratum forming the reservoir for the gas is a yellowish-brown dolomite, probably belonging to the Niagaran."<sup>4</sup>

### THE HOING SAND

This sand is the producing horizon in the Colmar field,<sup>5</sup> 45 miles to the north of the area under consideration. Its stratigraphic position is beneath the "second lime" and at the base of the Niagaran formation. Its areal distribution is spotty and it is absent over considerable areas. One well in the Pittsfield-Hadley gas field located in SW.  $\frac{1}{4}$  SE.  $\frac{1}{4}$  sec. 21, T. 5 S., R. 4 W., had 3 feet of Hoing sand. About 12 miles to the north a well in the NE.  $\frac{1}{4}$  NW.  $\frac{1}{4}$  sec. 8, T. 3 S., R. 4 W., had 18 feet of broken Hoing sand.

## FUTURE PROSPECTS

The Pittsfield-Hadley anticline has been thoroughly tested with respect to the Niagaran gas rock. The presence of the Hoing sand in the well in sec. 21, T. 5 S., R. 4 W., suggests the possibility that lens-like sand bodies may be found elsewhere on the flanks of the domes in this vicinity. With the favorable structural conditions that obtain here it seems probable that oil accumulation may have taken place provided that there is an impervious stratum between the Hoing sand and the gas rock. Sufficient data are not at hand to decide this important point. For that reason the area appears to merit further testing with the drill. Successful drill tests in this area would suggest the practicability of similar tests in other areas, where analogous conditions are known to exist.

One of the most favorable locations for a test is intermediate between the summit of the structure in the NE.  $\frac{1}{4}$  sec. 21, T. 5 S., R. 4 W., and the well in the SW.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  of the same section where Hoing sand was found.

<sup>3</sup> Coryell, H. N., *op. cit.*, p. 83.

<sup>4</sup> *Idem*, p. 83.

<sup>5</sup> Morse, Wm. C., and Kay, F. H., Area south of the Colmar oil field; Illinois State Geol. Survey Bull. 31, pp. 8-56, 1915.



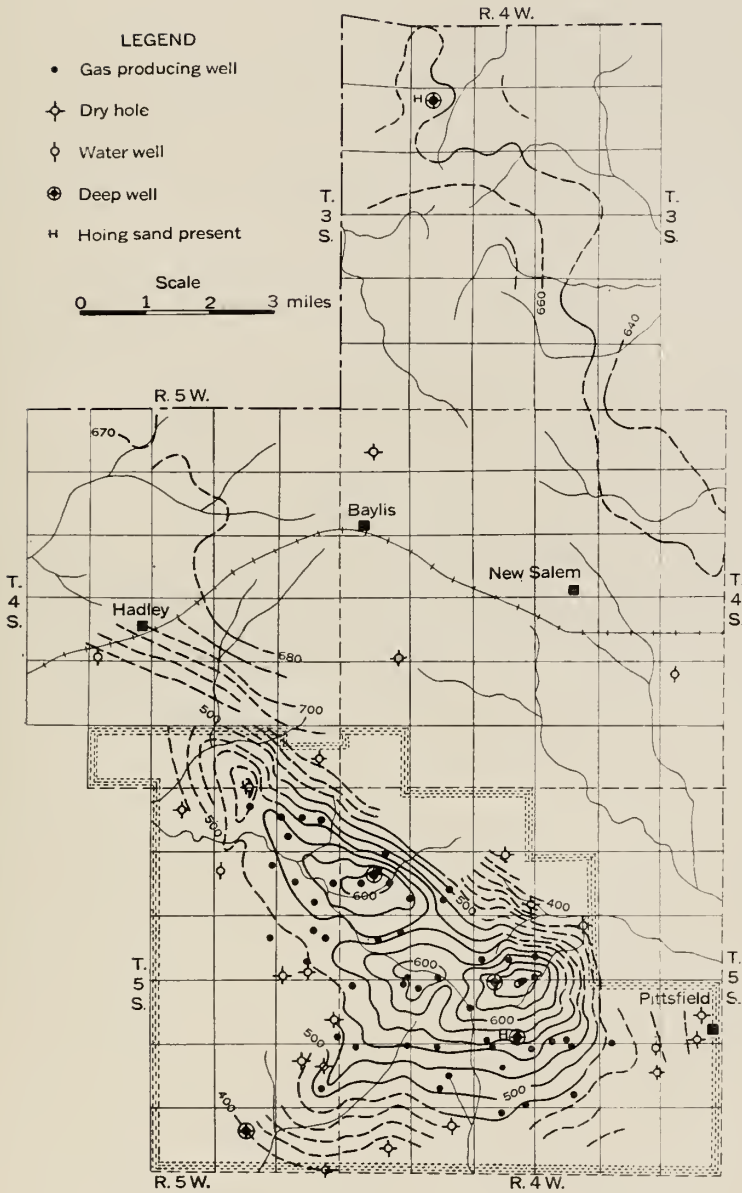


FIG. 5. Map showing the structure of central and northern Pike County

Other locations on the flanks of the domes such as near the center of sec. 19 and near the center of sec. 17, T. 5 S., R. 4 W., have similar possibilities.

Since Hoing sand was found in the well in sec. 8, T. 3 S., R. 4 W., it is considered that some of the surrounding area has prospects for production. The structural conditions here are less favorable than in the area of the Pittsfield-Hadley anticline. The dips, which are comparatively gentle, are from 10 to 20 feet per mile. The most favorable locations for future tests will be at positions higher on the structure than the old well,—possibly to the west of it about a quarter of a mile, and also  $1\frac{1}{2}$  miles south of it in the S.  $\frac{1}{2}$  sec. 17, T. 3 S., R. 4 W.

In making future tests it would be advisable to take samples frequently from the top of the Niagaran "cap rock" to the top of the Maquoketa shale which underlies the gas rock and the Hoing sand. The study of such samples is of great importance in estimating the advisability of further tests, even though the well in question should not be a producer.

## CURRENT OIL FIELD OPERATIONS IN ILLINOIS

By Gail F. Moulton

Good completions during the past month have helped to maintain interest in oil development in the eastern fields, and a high proportion of dry holes has served to diminish interest in prospecting in western Illinois. Clark and Wabash counties continue to lead the State in the amount of new work and the size of the wells completed.

The following table summarizes oil field operations which have been reported to the Survey.

TABLE 1.—Summary of current oil field operations in Illinois

Location		Section	Company	Farm and well No.	Production		Remarks
County	Township				Bbbs.	Depth	
Southeastern field							
Clark (Martinsville pool) Completions:		25	W. C. McBride, Inc.	Rush farm No. 24	.....	1474	Opens new producing area.
			Mahutka Oil Company Gambill, Rogers, et al	C. W. Slater No. 4 C. McFarlan No. 1	125	1320	Good showing before shot.
Drilling:		25	Arkansas Fuel Oil Company	A. W. Baker No. 2			
		25	Trenton Rock Oil and Gas Company	Wm. Slater No. 1			
	Wabash	25	Holmes, et al	Chas. Lowe No. 3			Spudded July 10. Contract for 2000 feet.
		17	Albon et al	Hodson No. 1			Drilling with hole full of water at 720 feet.
Coles	Ashmore		Shrider et al	L. Houghton No. 1			Drilling at 2000 feet.
Lawrence	Russell	3	Hartman et al	A. J. Vaught			
Wabash Completions:	Wabash	2	Snowden & McSweeney	Trimble No. 2	dry	1500	
		2	Mayhew et al	Kogan No. 4	200	1400	

TABLE 1.—Summary of current oil field operations in Illinois—Continued

Location		Township	Section	Company	Farm and well No.	Production		Remarks
						Bbls.	Depth	
			2	Eastern Gulf Oil Company	Jesse Cisel No. 2		<i>Fect</i>	
			2	Mt. Carmel Oil Company	Leek No. 5	15	1540	
			5	Bell Brothers	Robt. Yelton No. 1	200	1400	
			5	Bell Brothers	Robt. Yelton No. 2	100		
			7	Adams Corners Oil Company	M. Madden No. 7	dry	1500	
			7	Lindsay, Samuels, et al	M. Madden No. 4	100		
			18	Mac Oil Company	Holson and Dorney No. 7	100		
			18	Dane Oil Company	Holson and Dorney No. 4	75		
			22	Adams Corners Oil Company	Jake Smith No. 6	75		
			24	W. C. McBride, Inc.	Norah Marcote No. 4	20		
			24	W. C. McBride, Inc.	J. H. Cisel No. 2	15	980	
				J. W. Whiteside & Company	Howard Armstrong No. 3	25		
	Friendsville		19	Young et al	J. W. Price No. 2	dry	1600	No sand.
			19	Oldendorf, Clark, et al	J. O. Woods No. 2	35		
			19	Miller et al	E. Bass No. 2	30		
			27	Henneberger et al	R. R. Liddle No. 1	10 (approx.)		
	Wabash		1	Allendale Oil Company	Alka Heirs No. 3			
			2	Mayhew et al	Kogan No. 5			
			2	Mayhew et al	Kogan No. 6			
			11	Eastern Gulf Oil Company	Sallie Compton No. 1			
			11	Eastern Gulf Oil Company	Jesse Cisel No. 3			

*Drilling:*

		12	Collison Farm Oil Company	Collison Heirs				
		27	Henneberger et al	Litherland No. 1				
	Friendsville	19	G. W. Miller et al	Wm. Crump No. 1			Drilling at 950.	
	Lick Prairie	6	Bell Brothers	R. R. Fisher No. 1				
	Coffee	(NE. corner)	Grayville Oil Syndicate	James Helm No. 1, 1½ miles southwest of Grayville			Drilling below 1500.	
			Western field					
McDonough		22	Ohio Oil Company and S. Bacon	W. Allison farm		dry	904 In St. Peter sandstone.	
Plymouth-Columar district	T. 5 N., R. 4 W.		Ohio Oil Company and S. Bacon	W. Clayton farm, southwest of Tennessee		dry	615 In Hoing sand.	
Madison	Nameoki	1	Goodrich Brothers	Goodrich Brothers			2020 2 strings of tools in hole under 500 feet of cavings.	
	Pin Oak	33	Assembly Oil Company	Gas Gusewillie			Underreaming at 650 feet.	
St. Clair	T. 1 N., R. 10 W.	26	Prairie Oil and Gas Company	Geo. Dyroff			2903 Being plugged.	
			Southwestern Illinois					
Randolph			Hotze et al	J. C. Foster farm, east of Sparta		dry	..... New test; missed sand.	

TABLE I.—Summary of current oil field operations in Illinois—Concluded

Location		Township	Section	Company	Farm and well No.	Remarks		Production
County						Bbls.	Depth	
	T. 4 S., R. 6 W.		1	E. G. Mason et al	Andrews No. 1		<i>Feet</i> .....	Missed S p a r t a sand; drilling at 973; set 6% inch casing at 973.
Central field								
Macon	Hickory Point		33	Powers et al	A. Parish No. 1		.....	Standing at 1820.
Marion	T. 1 N., R. 1 E.		4	James Oil Company	McIntosh No. 4		.....	Being plugged; unable to shut off bottom wa- ter.
	T. 1 N., R. 1 E.		3	Ohio Oil Company	Kiester No. 3		.....	Plugging back to test sand at 1604 feet.
Morgan	T. 15 N., R. 9 W.		18	P. C. Irwin et al	Conklin		.....	Rigged up.
Shelby	Holland		25	A. L. Ginther	W. Prosser		.....	Shut d o w n to raise funds.



