

SOME QUESTIONS IN GENERAL AND PETROLEUM  
GEOLOGY WHICH ARE SUGGESTED BY OIL  
OCCURRENCES IN CRAWFORD COUNTY,  
PENNSYLVANIAN BEDS

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SUMMARY

Over a considerable part of Crawford County, oil production from Pennsylvanian sands is conditioned by other factors, perhaps as important as the LaSalle Anticline. Certain features indicate a nearby source for the oil and this may be important in future exploration work.

GENERAL

One of the controlling features, perhaps the most important, of the oil fields in southeastern Illinois is the LaSalle Anticline which extends from the vicinity of LaSalle southeast nearly to the Wabash River at St. Francisville. Productive territory has been developed through Clarke, Crawford, Lawrence, and Wabash Counties for a distance of seventy miles, and although this area of production varies in width up to sixteen miles, commercial accumulation of oil extends to a distance of eleven miles northeast from the axis on the less steeply dipping flank.

Thus far production has been developed from Pennsylvanian sands on down to the Trenton limestone, but the development in any one place is limited to a small portion of the vertical range. (Martinsville area excepted.) Thus in Lawrence County most of the oil produced comes from rocks of Mississippian age. In Crawford County production is chiefly from Pennsylvanian and Mississippian rocks, and in Clarke County, the Pennsylvanian, Mississippian and Ordovician rocks are each important locally.

All of this production is along the LaSalle anticline and is clearly related to it. During the past eight years detailed studies have brought to light certain features, which when better understood may assist greatly in

further development. In 1915, Rich<sup>1</sup> made a careful study of the Birds Quadrangle in Crawford County, and noted the alignment of the Pennsylvanian sand production at right angles approximately to the axis of the anticline. He concluded that the Pennsylvanian beds were essentially flat-lying over this area, and that oil accumulation in the Robinson sand seemed to be conditioned on its thick and massive development. Differences in elevation of the sands due to arching and folding are less in amount than differences due to irregularities in the sand lenses themselves.

Later work by Mylius<sup>2</sup> in Clarke County disclosed certain features in the northern part of the field, to account for which he hypothecates cross folding. As some of the production includes pre-Pennsylvanian rocks, the problem is modified somewhat, but the fact is noted that something other than the LaSalle anticline is involved in the oil occurrences in this part of the field. Recent field work, as yet incomplete, in the north one-half of Crawford County is adding its quota to the information relative to our south-eastern oil fields and furnishes some conspicuous contrasts between Pennsylvanian and pre-Pennsylvanian production. Here the upper sands (Robinson) are elongated in a direction approximately N. 52° E, whereas upper Mississippian production (Chester), developed here in only a small way, follows the direction of the anticline. As noted by Rich in the Birds Quadrangle, differences in elevation of the top of the Robinson sand are influenced less by folding and warping than by lensing. Some of these areas are irregular in shape with no conspicuous or symmetrical elongation. Others are several miles in length, and these longer dimensions are in the northeast-southwest direction. Another noteworthy feature is the occurrence of all of these elongated areas on the northeast side of the axis of the anticline. In no instance have they been reported or observed on the west flank of the fold. The most prominent development of this nature occurs between Birds and Annapolis, a distance of about twenty miles.

<sup>1</sup> Rich, J. L., Oil and Gas in the Birds Quadrangle, Ill. State Geol. Survey, Bull. 33, pp. 105-145.

<sup>2</sup> Mylius, L. A., Extract from Bulletin 44, Ill. State Geol. Survey.

Summing up the observations to date, we have the following:

1. Robinson sand production is commonly elongated in a northeast-southwest direction. This does not hold true for the Chester. Perhaps correlation is at fault.
2. These elongated areas are all east of the fold, but are found very close to it.
3. The sand top drops less rapidly from west to east than to the north or south. Available data, though too meagre to be very satisfactory, indicate overlapping sand lenses.

#### QUESTIONS

Since these occurrences are somewhat independent of the general structural conditions along the LaSalle anticline, they raise some interesting questions.

1. Are these transverse elongations due to cross folds, faults, sand lenses, or some other agency?
2. Why are they confined to the east side of the anticline? Perhaps the final solution will show that they are not so confined.
3. Are they limited in occurrence to the immediate vicinity of the anticline, and if so, why?
4. Do these occurrences suggest certain phases of Paleogeography? What are some possibilities?
5. What and where is the probable source of this oil? Is it local or may it be remote? Has any of the oil migrated very far?
6. What is the general artesian circulation of the Illinois basin? Is there a critical relation between the oil accumulation and the present artesian circulation through the basin? If so, what?
7. How are these questions related to future exploration?

#### SOME TENTATIVE SUGGESTIONS

At present studies are too incomplete to answer finally most or all of these questions, but some points seem reasonably clear.

Cross folding is not apparent here because the sands appear to be missing where the synclines should be found. Contours on the top and the bottom of the Robinson sands



would be at variance. Is cross folding known to occur anywhere?

Displacement or faulting of the sands does not seem to be shown from a study of the well logs. This hypothesis, however, is not untenable so far as the writer knows. Sufficient confirmatory evidence is lacking.

A study of the well logs indicates the existence of elongated sand lenses and bodies. This material is somewhat variable, and shale or lime breaks are commonly reported within such sand bodies.

Studies of present development fail to show these transverse zones on the west side of the anticline, although recorded dry holes indicate a fairly thorough testing of the west flank. The Pennsylvanian beds are more nearly flat on the east flank than on the west. Perhaps this is sufficient reason either for occurrence of the sand lenses or for their gathering oil. Only the higher portions of such sand lenses might favor commercial accumulation of oil, and hence the importance of a position near the crest of the anticline. Do these sand lenses indicate near-shore phases of Pennsylvanian geography? No fossils from them are available for study, but the interspersed limestones are marine. This is demonstrated by a study of samples from outcrops and from diamond drill cores. Were the sand lenses formed as off-shore bars, beaches, dunes, river channel fillings, or composites on a delta? Rich favors the delta hypothesis for the Birds Quadrangle, and it seems in harmony with conditions to the north and northwest of that area. If this were the case, was the shore line parallel approximately to the LaSalle anticline as has been commonly supposed? Did a large river discharge its debris into the sea in or near Crawford County, and in what direction did it flow?

Some differences of opinion are held as to the probable source of the oil, but greater favor is now accorded the idea of a local source and of limited migration to the present sand reservoirs. Abundant organic material was present in the muds (both lime and siliceous) at the time of deposition, and only a small fraction of this would be needed to furnish the amount of oil now known to have been present. Most of the geologic section is made up of

shales and limes, and as most if not all of these were marine, the local supply of organic material was perfectly adequate.

Present conceptions of artesian circulation, in a basin such as our Illinois Paleozoics form, favor the idea that marginal movements are much more rapid than are those in the deeper part of the basin. Such circulation doubtless has been changed many times since the Illinois Paleozoics were deposited as rock debris, but most of this circulation has probably moved southward. During Pennsylvanian time the LaSalle anticline formed a structural high, along both sides of which there may have been relatively rapid movement of meteoric water. If not too rapid this would favor oil accumulation in suitable reservoirs. With an oil content in some of the shales of 12 to 16 gallons per ton<sup>3</sup> the adequacy of material is no problem. If this hypothesis should prove correct, the oil now developed is local in origin and large areas to the west of the fold may justify test drilling where structural and textural conditions can be determined as favorable. Similarly, reserves in the Mississippian and lower rocks were developed under physiographic conditions unlike those of the Pennsylvanian, and for obvious reasons may be expected to conform more closely to the larger structural features.

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<sup>3</sup> Ashley, G. H., Bulletin 641, U. S. Geol. Survey, pp. 314-319.