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STRUCTURE OF CENTRALIA AND SANDOVAL OIL FIELDS,
 ILLINOIS¹

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INTRODUCTION

Ranking next after the eastern Illinois fields (situated chiefly in Clark, Crawford, and Lawrence counties) in total oil production for the State are the Carlyle field, Clinton County, and the Sandoval field, Marion County. The former has produced approximately 3,500,000 barrels of oil and the latter 2,500,000 barrels.

A detailed description of the Carlyle field was published² as a result of a study made after the greater part of the drilling had been done. For the Sandoval field, on the other hand, the only published information³ was the result of a study made when only two of the producing wells had been drilled, and hence little could be included in that report about the details of the structure. Since that time oil has been produced from about 100 wells in the Sandoval pool and the results of a study of all of the available data are embodied in the present paper.

The report deals with an area about 100 square miles in extent, situated in the southeast part of Marion County and adjacent part of Clinton County. This area includes the Sandoval pool, and a number of smaller productive pools which in order of importance are (1) Wamac, (2) Junction City,

¹This paper was planned as a contribution to the symposium recently organized by the American Association of Petroleum Geologists on the subject of "Relation of structure to petroleum accumulation in oil fields", the results of which, gathered from the oil fields of the entire country, will ultimately be published in one volume by the Association. As the present paper contains some structural data hitherto unpublished, gathered under the auspices of the Illinois State Geological Survey, it is desirable that such data be first published by the Survey.

²Shaw, E. W., The Carlyle oil field and surrounding territory: Illinois State Geol. Survey Bull. 20, pp. 45-80, 1915.

³Blatchley, H. S., Illinois oil resources: Illinois State Geol. Survey Bull. 16, pp. 130-146, 1910.

(3) Langewisch-Kuester, (4) Brown. Brief preliminary reports on all except the Sandoval pools have been published.⁴

ACKNOWLEDGMENTS

The writer is under obligation to the oil and coal operators of the district for placing at his disposal the information that rendered the work possible. Joseph H. Markley, Jr., acted as field assistant. Former publications of the Illinois Geological Survey have been freely drawn upon, chiefly for information about the history of development.

PHYSIOGRAPHY

The physiography of the region is not described in this report because it is controlled by Pleistocene glacial deposits and the thickness of these deposits obscures the structure of the Paleozoic rocks.

HISTORY⁵

"The discovery and use of oil from a seep in the mine of the Marion County Coal Company, sec. 30, T. 2 N., R. 1 E., attracted oil operators to this section of the State. The seep in the mine came through a fault. . . ."

The Marion County Oil and Gas Company drilled a well on the Sherman farm in sec. 29, T. 2 N., R. 1 E., half a mile east of the shaft of the mine. The well was completed by November 1, 1908, with only a showing of oil in a sand immediately below No. 6 coal (now known as the Dykstra sand). Three other wells were drilled just southwest of the Sherman well on the Dykstra farm in sec. 32. These had an initial production of 18 barrels a day each after shot and by the end of 1908 their production had declined to 3 barrels a day each.

The latter part of 1908 was a time of considerable leasing activity in the region. A north and south direction of leasing was maintained upon the supposition that an oil field in this locality would naturally parallel the La Salle anticline. In the early spring of 1909 the L. Stein No. 1 well was drilled in sec. 5, T. 2 N., R. 1 E. The shallow sand found in the Dykstra wells was not reported in this well but a sand producing oil was found at 1404 feet and was named the "Stein" sand. A thickness of 22 feet was reported and the yield was 50 barrels per day. Meantime, the Benoist No. 1 well of the Southwestern Oil and Gas Company was being drilled in the NE. cor. sec. 8, T. 2 N., R. 1 E. This well was located 1200 feet southeast of Stein No. 1. It found only a show of oil in the Stein sand, and drilling

⁴Bell, A. H., Oil investigations in the Centralia area—preliminary report: Illinois State Geol. Survey, Illinois Petroleum No. 4, pp. 6-12, Aug. 28, 1926.

Oil investigations in the Centralia area—preliminary report concluded: Illinois State Geol. Survey, Illinois Petroleum No. 5, pp. 1-10, Oct. 16, 1926.

⁵Blatchley, R. S., Illinois oil resources: Illinois State Geol. Survey Bull. 16, pp. 130-132, 1910.

was continued. At 1528 feet it struck what is known as the Benoist sand which gave gas and oil. The upper 12 feet of the sand contained gas having a pressure of 370 pounds per square inch. The lower portion of the sand from 1540 to 1546 yielded 200 barrels of oil per day.

In the succeeding years about 150 wells were drilled in an area of 6 square miles around the discovery well, and a boundary of production was found on all sides.

STRUCTURE

REGIONAL FOLDING

The Centralia-Sandoval area is situated a little west of the center of the Illinois structural basin, and, accordingly, the regional dip is to the east. To the south and southwest is the Ozark highland, a geanticline of major importance and extent. About 70 miles to the northeast, is the La Salle anticline. In many localities throughout southern Illinois the rock strata have been affected by gentle folding and in some places by faulting. One of the most pronounced of these gentle folds is the Duquoin anticline, or, more accurately, monocline.⁶ It is known to extend for a distance of 20 miles north from Elkhaville to a point 2 miles east of Dubois closely parallel to the Illinois Central Railroad. Certain well-defined structural features of the Centralia-Sandoval area are approximately in line with the axis of the Duquoin anticline, though it is not known whether the latter fold is continuous across the intervening gap of 18 miles.

DETAILED FOLDING

Detailed subsurface structure of the Pennsylvanian strata in the Centralia-Sandoval area is shown in figure 1 by means of contours representing the elevations of Herrin (No. 6) coal with reference to sea level. The depth of the coal was obtained from well logs and mine surveys at as many points as possible. Elevations were determined by plane table survey.

The boundaries of mine workings have been indicated on the map by shaded lines. Elevations had been determined by the mine engineers in only one of the five mined areas, namely the Centralia Coal Company's mines Nos. 2 and 5 south of Centralia. For the Marion County Coal Company's Glen Ridge mine at Junction City, elevations were determined by an underground plane table survey by the writer's party. For the other three mined areas, namely at Odin, Sandoval, and the Centralia Coal Company's mines Nos. 3 and 4, underground elevations had not been determined and since none of these mines had been in operation for a number of years it was not possible to enter them. The best available information was that given from memory by former engineers and superintendents of the mines. It con-

⁶Fisher, D. J., Structure of Herrin (No. 6) coal seam near Duquoin: Illinois State Geol. Survey Report of Investigations No. 5, p. 24, 1925.

sisted of estimates of per cent grades in various parts of the mines and these formed the basis for determining the position of some of the contours in figure 1.

The regional dip of the Paleozoic strata in the Centralia-Sandoval area is to the east. For Herrin (No. 6) coal it varies from 35 feet per mile across the southern part of the area to 20 feet per mile across the northern part. The maximum dip for the area (in Centralia Coal Company's mine No. 5) is 140 feet in half a mile (5.3 per cent or 3°).

Two conspicuous structural features are shown in figure 1. One, the Centralia monocline, is a north-south belt of relatively strong east dip which is associated with a fault zone of similar trend. The most continuous fault is about 6 miles long. The upthrow is to the east; the maximum displacement of 110 feet occurs in sec. 7, T. 1 N., R. 1 E., east of the shaft of the Centralia Coal Company's mine No. 4. The displacement decreases northward and southward from this point. The other conspicuous feature is a series of anticlines and synclines with an east-west alignment which are interrupted by the Centralia monocline. The best example is the Sandoval anticline which seems to be a feature of an east-west trending fold rather than of the north-south Duquoin fold.

Two cross-sections in an east-west direction (fig. 2) show the attitude of No. 6 coal and illustrate the fault with the downthrow on the west.

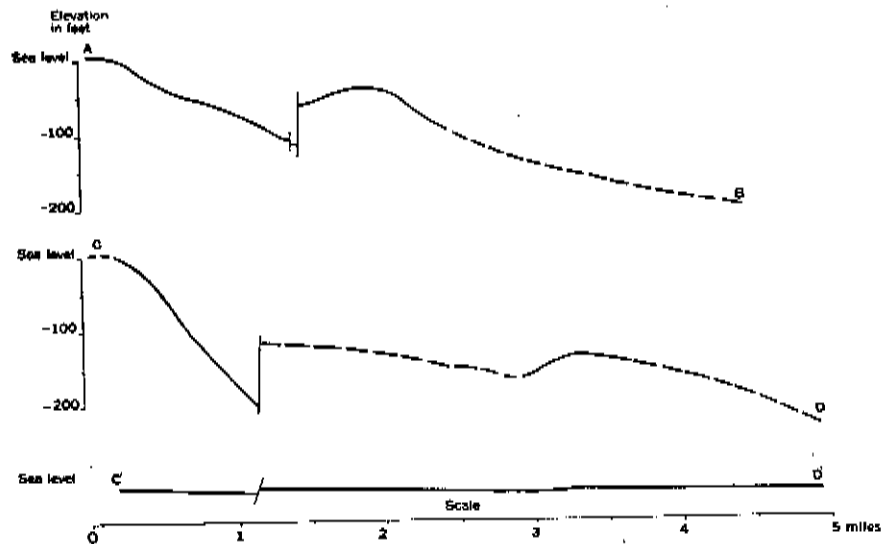


FIG. 2. A—B, cross-section through Glen Ridge anticline and Junction City dome.
C—D, cross-section through Hanseman well and Langewisch-Kuester pool.
C'—D', same cross-section as C—D with vertical and horizontal scales equal. (See fig. 1 for lines of cross-sections.)

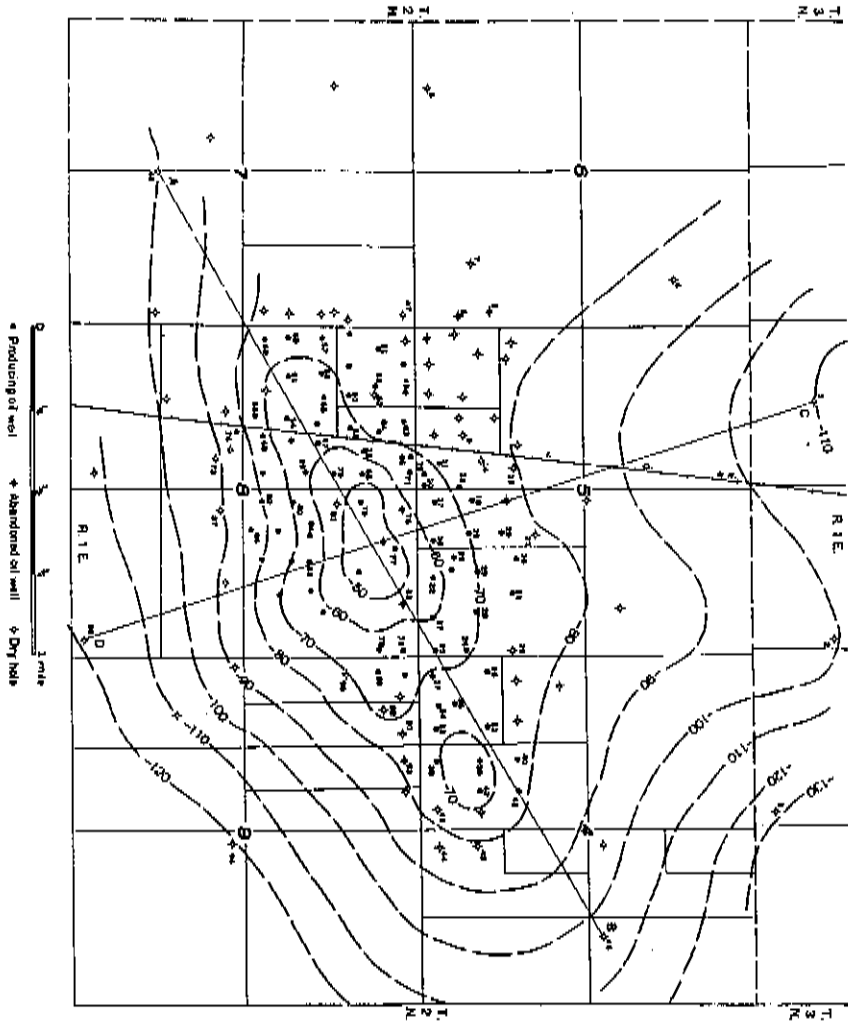
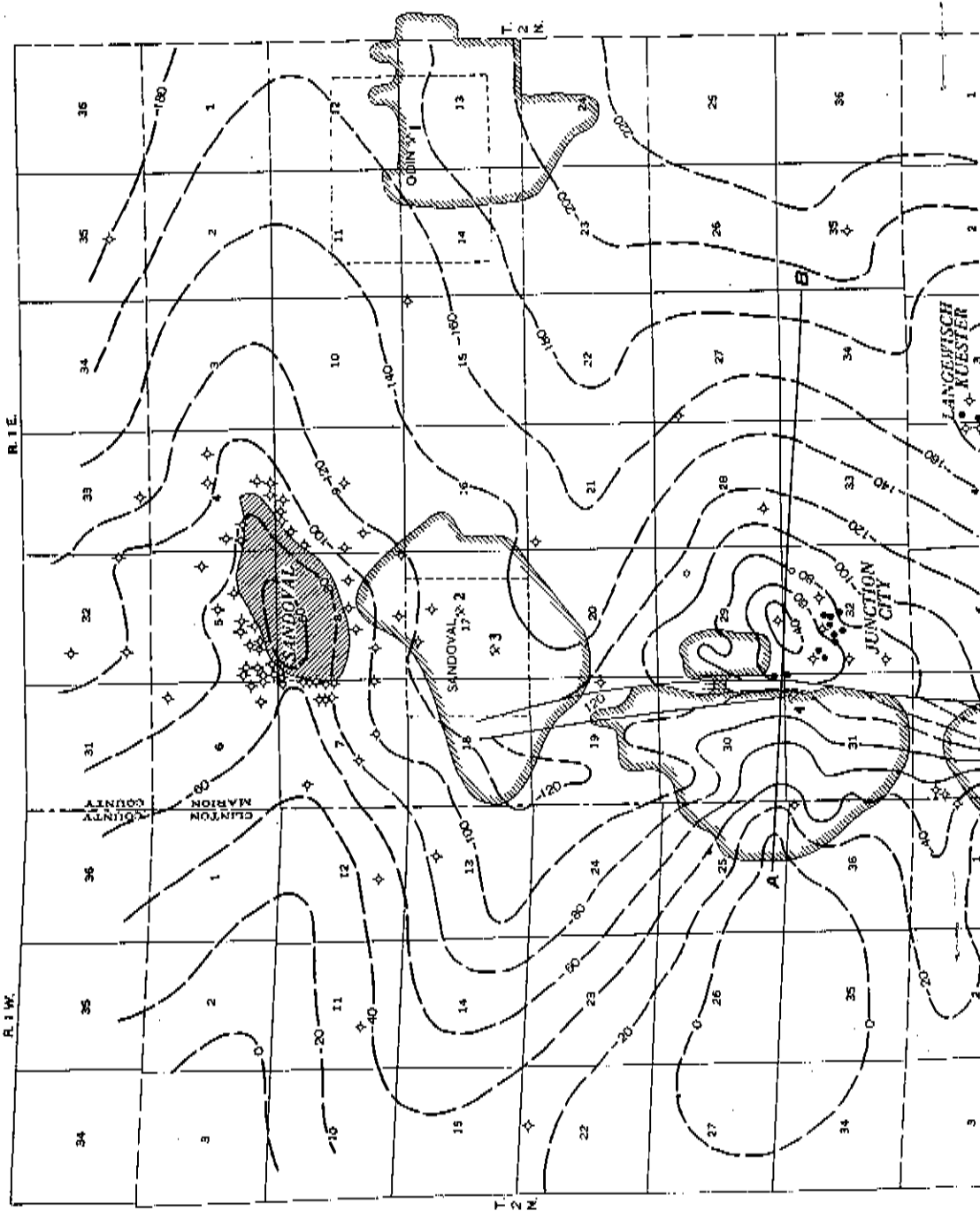
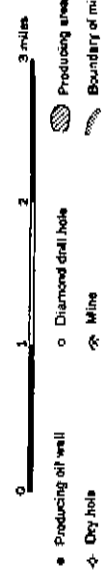
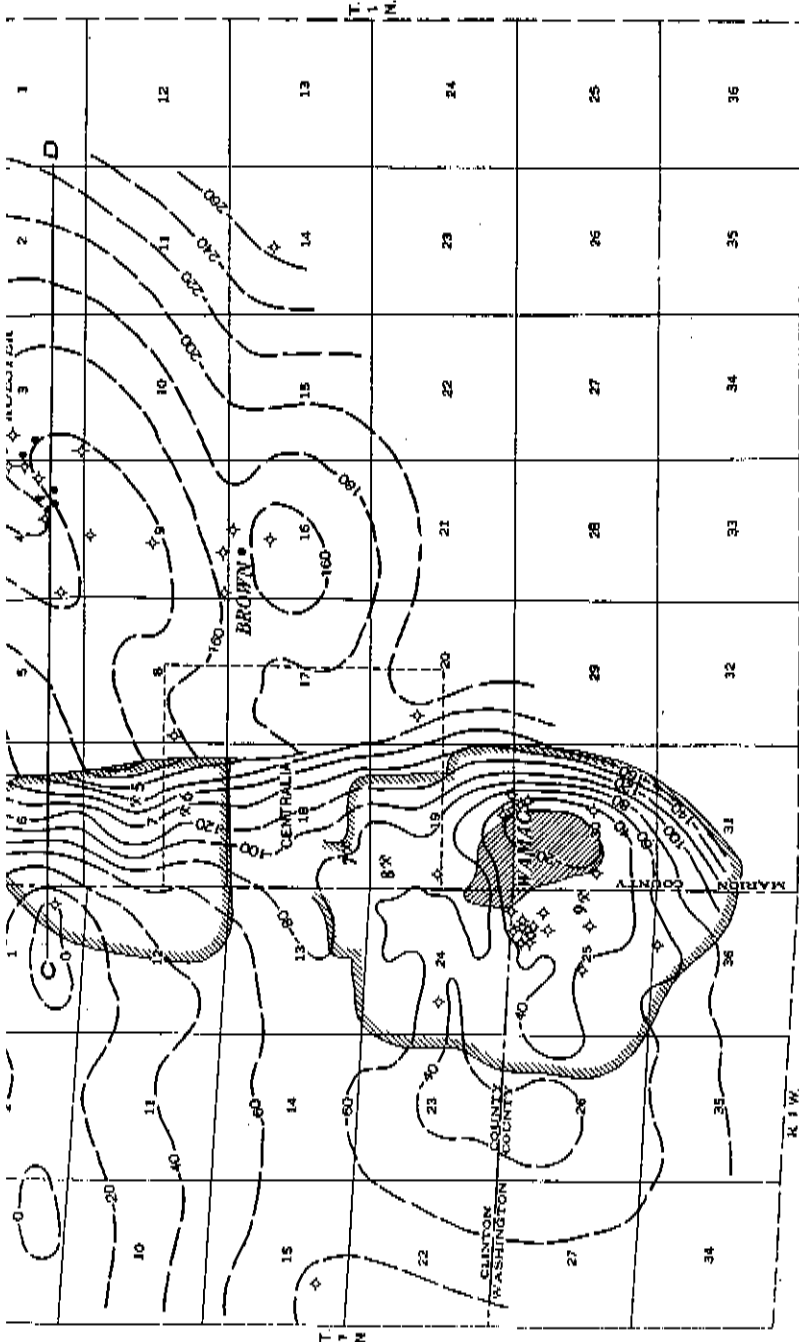


FIG. 3. Structure map of Sandoval pool, Marion County, Illinois. Key horizon—top of Herpin (No. 6) coal. See fig. 5 for cross sections along lines A—B and C—D. (By A. H. Bell, Illinois Geological Survey.)



STRUCTURE OF CENTRALIA AND SANDOVAL OIL FIELDS



- Mine No. 1.—Oxin Coal Co.
- 2.—Chicago and Sandoval Coal Co. (No. 1).
- 3.—Chicago and Sandoval Coal Co. (No. 2).
- 4.—Marion County Coal Co. (Glen Ridge).
- 5.—Centralia Coal Co. (No. 4).
- 6.—Centralia Coal Co. (No. 3).
- 7.—Centralia Coal Co. (No. 1).
- 8.—Centralia Coal Co. (No. 2).
- 9.—Centralia Coal Co. (No. 5).

FIG. 1. Structure map of the Centralia-Sandoval area. Key horizon, top of Herrin (No. 6) coal. Broken contours represent structure based on incomplete data. See fig. 2 for cross-sections along lines A-B and C-D. (By A. H. Bell, Illinois Geological Survey.)

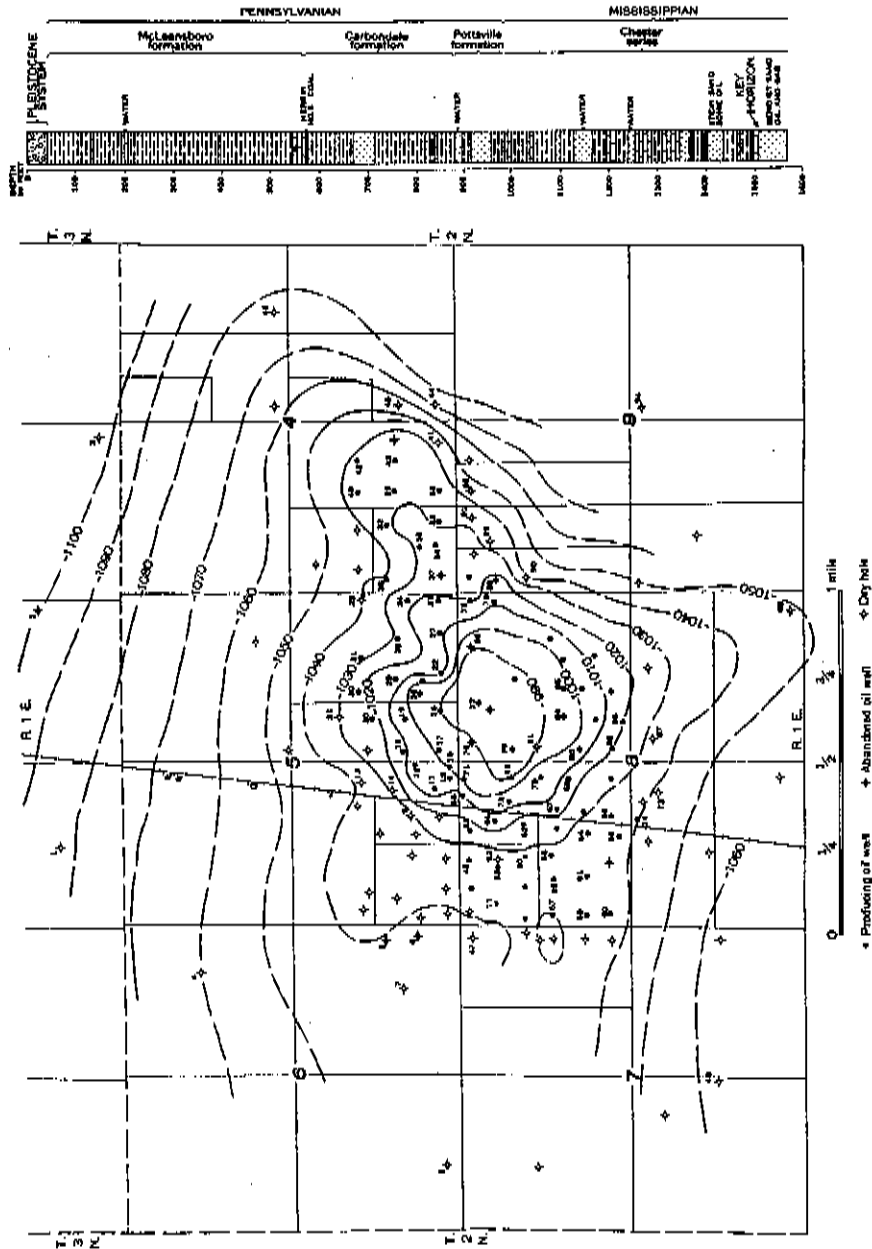


FIG. 4. Structure and typical log of Sandoval pool, Marion County, Illinois. Key horizon—top of Benoist sand. (By A. H. Bell, Illinois Geological Survey.)

Two structure maps were drawn for the Sandoval area, one with No. 6 coal as the key horizon and the other on the Benoist sand which is here 930 to 980 feet below No. 6 coal stratigraphically (figs. 3 and 4). These two maps show closed anticlines of essentially similar outline and trend. The chief difference between them is that the dips are in most directions more pronounced on the sand than on the coal.

The logs for the wells drilled by the Southwestern Oil and Gas Company, which owns nearly two-thirds of the productive acreage in the

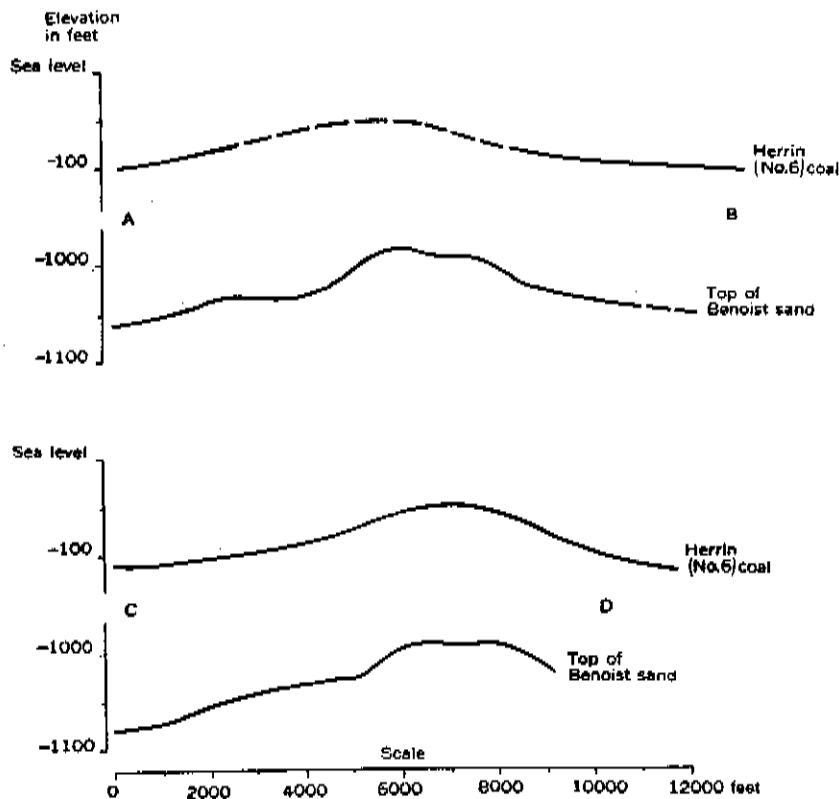


FIG. 5. Cross-sections through the Sandoval pool, comparing the attitude of Herrin (No. 6) coal with that of the top of the Benoist sand. (See fig. 3 for lines of cross-sections.)

Sandoval field, are "skeleton" logs and most of them give the depth of only a coal and the Benoist sand. The coal recorded in some of them is probably Herrin (No. 6) coal. In determining the structure of the Benoist sand the skeleton logs could be used with very few exceptions, but many of them could not be used in constructing the structure map of the coal bed because of difficulty in correlating the coals. Accordingly the structure of the coal was determined from a smaller number of datum points than that of the sand.

Two cross-sections through the Sandoval pool (fig. 5) compare the attitude of No. 6 coal with that of the top of the Benoist sand. They show an increase of interval of 30 feet to the west and north.

PRODUCING HORIZONS

In order to consider the relation of production to structure a brief resumé of the producing sands is here given, and for the purpose of showing their relative importance some production figures are included. Oil has been produced from five sands in the Centralia-Sandoval area, three of which are in the Pennsylvanian and two in the Chester. Named in order from the top downward these are the (1) Dykstra, (2) Wilson, (3) Petro, (4) Stein, and (5) Benoist sands. Although no locality is known in which they are all present, their approximate stratigraphic positions are illustrated in one generalized section (fig. 6).

Pennsylvanian sands: The Dykstra sand, lying closely below Herrin (No. 6) coal, is the sand in which oil was first discovered in the area. The total production obtained from it has been insignificant. It is one of the two producing sands in the Junction City pool; the other one is the Wilson sand which is situated about 100 feet lower in the section. In the summer of 1926, 6.6 barrels per day were being produced by nine pumping wells from the Wilson sand and 2.5 barrels per day by two pumping wells from the Dykstra sand.

The most important Pennsylvanian production in the area is that of the Wamac pool and here the oil comes from the Petro sand which has been placed tentatively in the Pottsville, although it may possibly belong in the lower part of the Carbondale. This field was opened early in 1922. During the period of five years from the beginning of 1922 to the end of 1926, a total of approximately 200,000 barrels of oil was produced.

Chester sands: The Benoist sand has produced nearly all of the two and one-half million barrels of oil obtained from the Sandoval pool. It lies from 930 to 980 feet below Herrin (No. 6) coal. About 100 feet above the Benoist sand in the section is the Stein sand from which the first oil at Sandoval was produced. The Stein sand production was relatively small and short-lived as compared with that from the Benoist sand and all the oil now produced in the field is from the Benoist sand. The producing sand in the Langewisch-Kuester and Brown pools is in the lower Chester and it has been tentatively correlated with the Stein sand of the Sandoval pool. This production, although small, has proved to be long-lived.

THE RELATION OF PRODUCTION TO STRUCTURE

The productive areas are so situated with respect to the structural features of No. 6 coal as to suggest the probability of the accumulation of

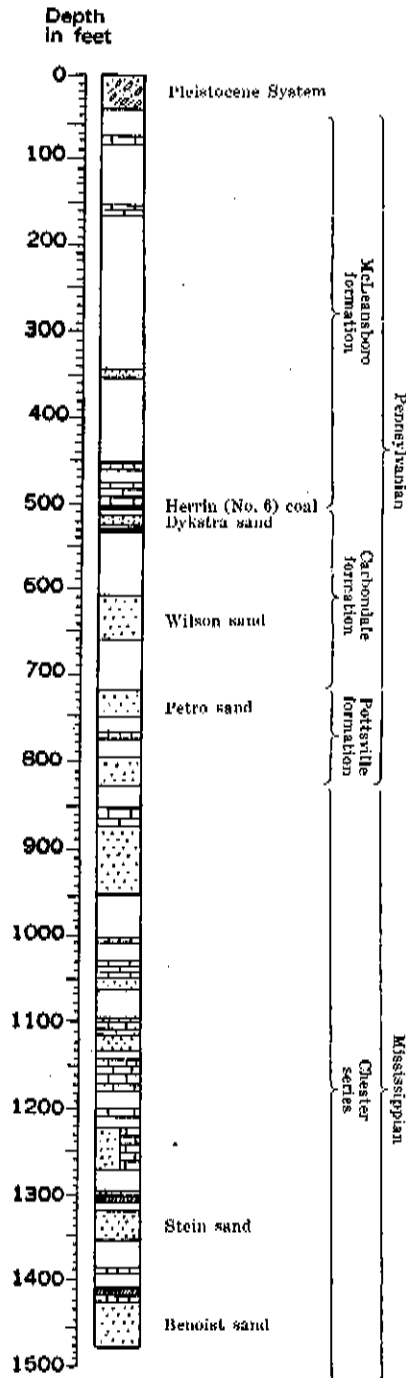


FIG. 6. Generalized columnar section of Centralia-Sandoval area

the oil into pools under two sets of geological conditions. In the Sandoval and Wamac pools, production extends over the tops of domes, and the boundaries of production tend to be parallel to the structure contours. The location of these pools seems to have been determined by the folding of porous sand strata of relatively wide lateral extent. On the other hand, the minor pools, Junction City, Langewisch-Kuester, and Brown, are situated on the flanks of anticlines, and the determining condition in their location appears to have been the occurrence of localized bodies of porous sand which were features of original deposition.

NEW PRODUCING HORIZON IN WABASH COUNTY

By Gail F. Moulton

The Eastern Gulf Company have been successful in their attempt to discover a deeper producing horizon in Wabash County in their test on the Jesse Cisel farm in the SE. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 2, T. 1 N., R. 12 W. The early reports are that this well is obtaining its production from the McClosky sand which was found at a depth of about 2200 feet. At the present time no information is available regarding the size of this well, but it is believed that it will make a commercial producer.

The fact that production has been found in the McClosky sand is of considerable importance to Wabash County, for new work of prospecting deeper sands in localities where earlier drilling had failed to find the Bichl and the 1500-foot sands on favorable parts of the structure is encouraged. The McClosky sand production in the Murphy pool in Lawrence County only seven miles northeast of the new well has been very satisfactory. Some of the wells produced more than 3000 barrels per day, and were the largest in the State.

In the Murphy pool and adjacent territory, the McClosky sand is notably irregular in productivity, and occurs in several lenses. No statement can be made regarding its character in Wabash County until further drilling has been done, but it is believed that similar conditions will be found.

From the point of view of the Illinois operators, it will be of great assistance to have a map giving a revised interpretation of the structural conditions in the area north of Allendale, so that those desirous of making tests of the new producing horizon will be able to choose locations on the higher parts of the structure. A map and a brief statement in regard to prospecting for this new deeper producing horizon will be included in an early number of Illinois Petroleum.