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WILLIAM G. STRATTON, *Governor*  
DEPARTMENT OF REGISTRATION AND EDUCATION  
VERA M. BINKS, *Director*

DIVISION OF THE  
STATE GEOLOGICAL SURVEY  
JOHN C. FRYE, *Chief*  
URBANA

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REPORT OF INVESTIGATIONS 182

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STRUCTURE OF THE SHOAL CREEK LIMESTONE AND  
HERRIN (No. 6) COAL IN WAYNE COUNTY, ILLINOIS

BY

ERNEST P. DU BOIS AND RAYMOND SIEVER



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# STRUCTURE OF THE SHOAL CREEK LIMESTONE AND HERRIN (No. 6) COAL IN WAYNE COUNTY, ILLINOIS

BY

ERNEST P. DU BOIS AND RAYMOND SIEVER\*

## ABSTRACT

Continued intensive drilling for oil in Wayne County since 1943 has made it desirable to revise the previously published structure maps of this area. Places where No. 6 coal is absent as a result of downcutting by the overlying Anvil Rock sandstone are connected to form a long, sinuous east-west "channel" across the county. The Shoal Creek limestone is absent over a broad area in the eastern part of the county where an overlying sandstone, the Mt. Carmel, occupies its position. The present structural configuration is a result of movements that took place during Late Mississippian, Pennsylvanian, and post-Pennsylvanian time. Wayne County lies near the deepest part of the Illinois Basin, and there is a regional dip from east and west to the central part of the county. The only large-scale anticlinal structure, the Clay City anticline, trends NNE and SSW in the north-central part of the county.

## INTRODUCTION

This report on Pennsylvanian strata in Wayne County (fig. 1) is essentially a revision of an earlier report by Sims, Payne, and Cady (1944, p. 27-32). Aside from that report, previous structural mapping of the county has been restricted to the detailed study of the Johnsonville oil pool (Cassin, 1951) and the mapping of the Herrin (No. 6) coal in the westernmost tier of townships (R. 5 E.) included in a larger report by Siever (1950). Since the publication of the Sims et al. report on Wayne County, structure maps of the No. 6 and other Pennsylvanian beds in all the adjacent counties, except the southern part of Jefferson County, have been published (Siever, 1950; Cady et al., 1951; Harrison, 1951). Discussions in these publications of the subsurface stratigraphy of the Pennsylvanian system in this part of the Illinois Basin serve as background material for this report. Figure 2 is a generalized section of the Pennsylvanian system in Wayne County, showing the position of

the more important coal and limestone beds. Plate 1 is a representative electric log of the Pennsylvanian section in the county.

The same kind of subsurface data used by Sims et al.—sample study logs and electric logs—was used in this report. As a result of continued intensive drilling for oil in the county, there are approximately 4,000 electric logs in the files of the Illinois Geological Survey. We selected 1,587 well records for use in map compilation, as



FIG. 1.—Index map of Wayne County and Illinois Basin.

\*The senior author identified the formations from well logs and prepared preliminary structure maps. The junior author is responsible for the final form of the maps (plates 2 and 3) and the report.

compared to the 510 well records used by Sims et al. The great density of wells has justified lowering the structure contour interval from 25 feet in the original maps to 20 feet in the revised maps. The quality of information, particularly of electric logs, has also been improved. Techniques of electric logging introduced in the last ten years, including laterolog and microlaterolog, and the use of gamma-ray and neutron logs have made possible greater accuracy in interpretation.

The map prepared by Sims (1944, p. 30), showing the thickness distribution of No. 6 coal, has not been revised. Electric log techniques are still not adequate to determine accurately the precise thickness of coal beds where they are overlain by beds of high electrical resistivity, such as some black shales and limestones, a condition which prevails over much of Wayne County. There has been no core drilling of the Pennsylvanian rocks and, therefore, no accurate determination of coal thickness. Evaluation of the minable reserves of coal by Cady and others (1952, p. 133) shows the total reserves of No. 6 coal over 28 inches thick in Wayne County to be 2,349,795,000 tons. Reserves of Harrisburg (No. 5) coal, about 70 feet below the No. 6 coal bed, are 1,700,575,000 tons for coal over 28 inches thick. These reserves, however, fall into the class II category (strongly and weakly indicated), rather than the class I category (proved and probable), into which most of the reserves of the mining districts fall. These categories represent an arbitrarily defined classification of coal reserves and do not imply reserves that are economically extractable at the present time.

#### CUT-OUTS OF NO. 6 COAL

At the many places in Wayne County where No. 6 coal is absent, its stratigraphic position is occupied by sandstone or sandy shale. Such interruption of No. 6 coal is widespread in the Illinois Basin, and has been found in Jefferson, Franklin, White, Wabash, and Gallatin counties. The "cut-

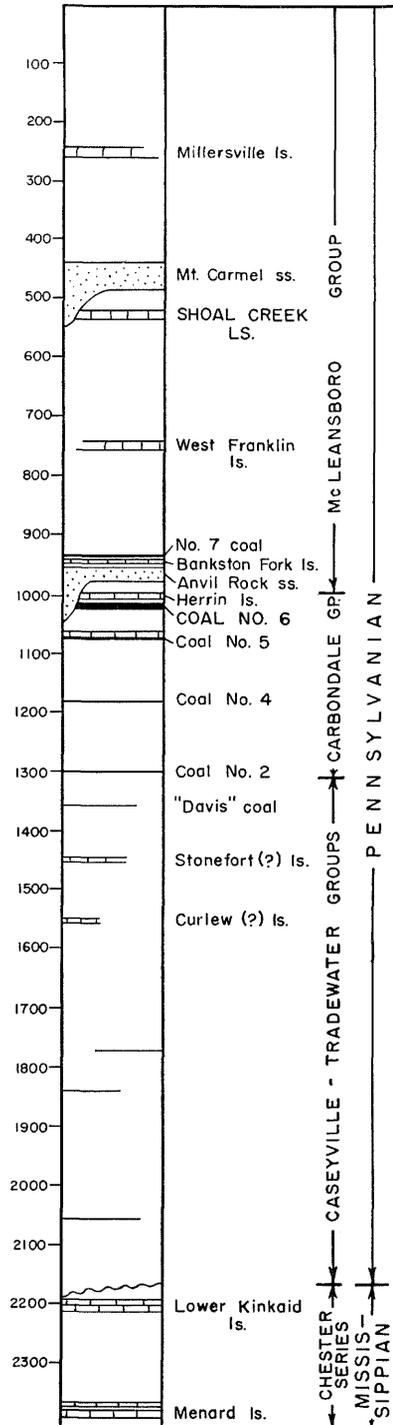


FIG. 2.—Generalized section of Pennsylvanian strata in Wayne County, Ill.

out" areas in Wayne County, shown on the structure map of No. 6 coal (plate 2), form a narrow, somewhat sinuous belt running roughly east-west across the county. The fact that the coal cut-out is continuous in the heavily drilled areas supports the conclusion that cut-outs in more sparsely drilled areas are also connected. This long continuous cut-out is directly connected to similar ones in Jefferson County to the west and Edwards County to the east.

The Anvil Rock sandstone, which occupies the position of the No. 6 coal where it is cut out, is present at a higher stratigraphic level over most of the county. In the normal (nonchannel) stratigraphic succession, the No. 6 coal is overlain in vertical sequence by a black shale (2 to 5 feet thick), the Herrin limestone (4 to 8 feet), the thin Jamestown coal and limestone (1 foot or less), a gray silty shale (5 to 20 feet), and the Anvil Rock sandstone. In the cut-out areas the Anvil Rock sandstone extends down to a stratigraphic position below the underclay beneath No. 6 coal. In some places it is over 100 feet thick, as contrasted with a normal thickness of 10-20 feet in areas away from the coal cut-outs. The sandstone is white to light gray, medium- to coarse-grained, and well cemented. Most of the rock is quartz; there are minor amounts of mica, feldspar, clay minerals, and calcite. Although the Anvil Rock is dominantly sandstone, in places as much as 30 percent of the stratigraphic section is siltstone or silty shale.

#### AREAS WHERE SHOAL CREEK LIMESTONE IS ABSENT

The stratigraphic position of the Shoal Creek limestone is occupied in places by a sandstone normally lying 20 to 50 feet above the Shoal Creek. This sandstone is probably equivalent to the sandstone at the same stratigraphic position that crops out in the west bluff of the Wabash River at Mt. Carmel, Ill., about 20 miles east of the eastern edge of Wayne County (Cady et al., in press). It was called the "Mt. Carmel" sandstone (Worthen, 1875, p. 52).

Areas in which the Shoal Creek limestone is absent are mainly restricted to the eastern quarter of the county; there are some spotty areas in the north-central quarter. The main area is broad and does not have the narrow, winding form of the No. 6 coal cut-out. In this area, the limestone occurs in a few small, isolated patches. As little is known of the detailed stratigraphy of the upper part of the Pennsylvanian system in Wayne and adjacent counties, it is uncertain whether the absence of the Shoal Creek limestone is due to erosion following deposition or to a facies change related to changed conditions of sedimentation.

#### STRUCTURE

Wayne County occupies a central position in the Illinois Basin. The county lies southwest of the structurally deepest part of the basin as mapped on No. 6 coal, which is more than 600 feet below sea level in southwestern Jasper County (Williams and Rolley, in press). Wayne County lies just north of the structurally deepest part of the basin as mapped by Siever (1951, p. 566-67) on the Menard limestone (in the upper part of the Chester series), which is at its lowest elevation in northern Hamilton County. The shift in location of the structurally deepest points in these two beds indicates that the Illinois Basin subsided and received sediment unevenly in Late Mississippian and Pennsylvanian time. Uneven subsidence resulted in moderate structural deformation during the interval in which Pennsylvanian sediments were being deposited in the broad, shallow Eastern Interior Basin. The present structural configuration, however, is mainly the result of much greater deformation superimposed on the earlier mild deformation at some time after the end of Paleozoic sedimentation and before the beginning of Cretaceous sedimentation.

The locus of points of lowest elevation of No. 6 coal in Wayne County is a trough trending roughly north and south just east of the middle of the county, along the east side of the Clay City anticline. In some

places along this trough No. 6 coal is more than 660 feet below sea level. A similar trough, not quite so deep, trending north and south in the western part of R. 7 E., flanks the Clay City anticline on the west. No. 6 coal gradually rises eastward from the eastern trough. The gradual rise is part of the regional dip of the Illinois Basin from its eastern border. Similarly, the coal gradually rises westward from the western trough to the western rim of the basin (the DuQuoin monocline), about 25 miles to the west of Wayne County. These regional dips are general trends only and are interrupted in many places by small anticlines, synclines, domes, and basins.

A comparison of the structure maps of No. 6 coal and the Shoal Creek limestone (plates 2 and 3) shows a similarity of types of structure as well as general structural configuration. The main kind of structure is linear, i.e., the folds are relatively narrow in relation to length. The linearity is often masked by irregularities such as noses, saddles, and re-entrants. In contrast to these linear structures, small domal uplifts are scarce in Wayne County. The most prominent is that containing the Johnsonville oil pool. The form of this pool is largely the result of reef sedimentation in Lower Mississippian time (Swann, personal communication, 1955) and is reflected in higher rocks which are draped over the reef and differentially compacted.

Both the No. 6 coal and Shoal Creek limestone structure maps show a general tendency towards subparallel alignment of many of the structures. The dominant trend of the alignment is NNE and SSW.

A minor northwest-southeast trend crosses the major trend nearly at right angles. In contrast to the many structures lying along these trends, relatively few folds strike north and south or east and west.

The Clay City anticline is the only prominent one in the county. It is a semicontinuous series of anticlinal uplifts, separated by saddles, which trends north and northeast from its southern end, near Fairfield. It extends through northern Wayne, eastern Clay, northwestern Richland, and southern Jasper counties. The Clay City anticline ranks with the Salem-Louden anticline in Marion and Fayette counties as one of the major structures of the Illinois Basin.

The amplitude of many of the anticlinal folds increases with depth so that the closure of structures when mapped on a Mississippian horizon is generally greater than when mapped on a Pennsylvanian horizon. Similarly, closure of some structures on the Shoal Creek limestone is less than closure on No. 6 coal, some 400 feet lower in the section.

No faults of more than a few feet displacement are known in Wayne County.

#### TABULATED DATA

A set of tabulated data used in compiling the structure maps for Wayne County is on open file at the Illinois State Geological Survey, Urbana. These tabulations show, in addition to location, name, and surface elevation of each drill hole, the depth and sea-level elevation of No. 6 coal and the Shoal Creek limestone. The tabulated lists were prepared by Margaret A. Parker.

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