



ILLINOIS STATE GEOLOGICAL SURVEY



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C I R C U L A R

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STRUCTURE OF HERRIN (NO. 6) COAL BED IN
CENTRAL AND SOUTHERN JEFFERSON, SOUTHEASTERN WASHINGTON,
FRANKLIN, WILLIAMSON, JACKSON, AND
EASTERN PERRY COUNTIES, ILLINOIS

By

Gilbert H. Cady

Assisted by

E. T. Benson, Earle F. Taylor, and others

With notes on the
OIL AND GAS POSSIBILITIES

By

Alfred H. Bell

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LEGEND

- COAL MEASURES BOUNDARY
- BOUNDARY OF DEEP PART OF BASIN
- ▨ AREA COVERED BY STRUCTURE MAP ON TOP OF HERRIN (NO. 6) COAL

10 5 0 10 20 30 40 MILES



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STRUCTURE OF THE AREA

By
Gilbert H. Cady

The map of a considerable area of southern Illinois which accompanies this circular presents an interpretation of the attitude, structure of "lay" of Herrin (No. 6) coal based upon such information as is now available from the records of various kinds of drilling, from the records of mine shafts, from levels that have been run in mines, and from observations at outcrops. Similar individual structure maps of this coal bed representing parts of the area represented by the present map have previously been published by the Survey (see page 11). The growth of knowledge resulting from closer drilling and the extension of mining makes desirable revisions of such maps from time to time in order that there may be available as precise a picture as it is possible to make of the coal bed. The lay, attitude, or structure of the coal bed is of great importance in determining ease of extraction. As knowledge increases the details of information are increased, and maps of increasingly larger scale will be necessary to delineate features of importance.

The detail with which the structure can be delineated varies greatly within the mapped area. In Washington, most of Jefferson and northeastern Franklin counties datum points represented by drill holes are widely spaced, hence only a very generalized idea of the attitude of the coal bed is possible; in other parts of the area there is much more information, particularly where mine levels are available, and the contours indicate changes in level with considerable precision. This is particularly true throughout much of western Franklin and northwestern Williamson counties, and at places along the east side of the DuQuoin anticline. In such areas mine levels are much more important than drill hole levels in ascertaining the correct position of the coal bed.

Likewise great detail in structural delineation is possible in areas where the coal bed lies within 75 feet or less of the surface and exploration for strippable coal has been carried on by close drilling. Over considerable areas the drilling has been so closely spaced that it is impossible to show the datum points upon which the delineation of structure is based. In such areas the points of observation are nearly as closely spaced as in most of the mined-out areas where likewise it is impossible to indicate all the datum points upon which the structure is based. Although the structure is shown by broken lines within the closely drilled areas (cross-lined downward to right), it is essentially of the same order of precision as in the mined-out areas where contour lines are unbroken.

Delineation of Structure

Structure contours were located by assuming constant dip between datum points, crossing points mathematically determined with respect to accepted levels at each of two adjacent drill holes or other datum points. No attempt has been made to emphasize possible trends of structural irregularities which might readily have been done in some instances by a less strict adherence to the principle of mechanical spacing. Such trends must, in the present state of our knowledge, be considered largely speculative in character but will appear more probable in some places than in others. Some of these will be touched upon in the discussion of the oil and gas possibilities of the area by Dr. Bell.

Faulting

Numerous faults are present in the area but these can be grouped in three general zones: (1) The Campbell Hill-Cottage Grove structural zone crossing the area near Elkville across northeast Jackson, southwest Franklin, and most of northern Williamson counties; this zone is aligned with the Campbell Hill anticline on the west and the Cottage Grove fault (Gallatin County) on the east; (2) a narrow zone of faulting is present at the foot of the fairly steep east limb of the DuQuoin anticline or, more correctly, monocline; and (3) a third zone of faulting extends from outcrops of Herrin coal roughly north in Range 2 East probably as far as the vicinity of Buckner (Sec. 22, T. 6 S., R. 2 E).

Such faulting as is shown has been actually discovered in mines or at the surface, or is the limited extension of such faults suggested by drilling. The faulting indicated in eastern Williamson County, where there are no mines, is interpreted from surface outcrops in Range 4 East and from drilling alone in Range 3 East.

It is very probable that faulting is largely responsible for the notable irregularities in the altitude of the coal bed between Bush and Elkville in northeast Jackson County. The character, position and trend of irregularities is, however, open to such a variety of interpretations (because of the position of the area with relation to the first two zones of faulting noted above) that no special interpretation is suggested for this particular tract. It will be noted that the structure contours have been omitted and that, instead, the data on the altitude of the top of the coal bed is inserted. The matter is further complicated by the fact that at one of the drill holes, rather critically located, a channel sandstone (see below) has apparently removed both Herrin (No. 6) and Harrisburg (No. 5) coal and the altitude of the Herrin coal must be determined by reference to a coal believed to be number 4.

Area of Split and Eroded Coal

One major irregularity in the Herrin coal of particular interest in the interpretation of the structural features of this bed is the large area in western Franklin, northeastern Jackson, and eastern Perry counties in which the Herrin (No. 6) coal is separated into several distinct benches by lenses of shale, sufficiently thick to render the bed unworkable, or is entirely missing due to the presence of a channel sandstone which crosses the position of the bed. In this split-coal area the coal bed does not lie parallel to the limestones and coal beds higher in the McLeansboro formation. A very definite understanding of the stratigraphic condition in this area is not possible because interpretation must be based almost entirely upon the results of core drilling at fairly widely spaced intervals. Mining usually stops before the lenses of shale have become sufficiently thick to justify assurance as to the true conditions. However, in one mine at least, investigations indicate the strong probability that the upper bench of coal commonly left as roof in rooms and entries, becomes separated from the rest of the bed by a gradual increase in the shale content of a bench which locally has the characteristics of split coal. This upper bench appears to be present in a number of drill holes 25 feet or more above the main body of the coal. Elsewhere, and more generally, it is not recorded in the drill records. Hence the proof of a split-off of the upper bench is not entirely established. Delineation of structure in this area is open to a variety of interpretations depending upon the datum horizon used. In the present map the top of the main body of coal is used, although it is realized that this surface is not parallel with beds higher in the McLeansboro formation. It should be stated that other lenses of shale in addition to the one noted occur within the bed so that locally it consists of a series of thin coal beds separated by shale beds of greater or lesser thickness, rendering the bed entirely unworkable in much of the area.

The channel sandstone which locally interrupts the continuity of the entire coal and shale lens series is present at a number of places in the "split-coal" area where the coal is indicated on the map as absent. No definite trend of the channel cut-outs has been worked out, although the evidence has not been studied carefully with this objective in view. So far as can be determined, the sandstone is a deposit made subsequent to the deposition of the coal and associated shale lenses, and consist of a channel phase of a sandstone lying some distance above the coal, possibly representing the Anvil Rock sandstone. Erosion in the channel in several places extends through the Herrin (No. 6) coal and even locally through Harrisburg (No. 5) coal so that the first Carbondale coal encountered in drilling appears to be a coal which has been called number 4. It is about 3 feet in thickness and lies 50 to 60 feet below the Harrisburg (No. 5) coal when both are present. Where Herrin (No. 6) coal has been removed by erosion prior to the deposition of the sandstone, it is obviously

impossible to use the bed as a structure datum. Interpretation of structure at such places is modified or more or less determined by an extrapolation of an altitude for the coal on the basis of higher or lower well-marked beds. From the facts presented, it is apparent that the interpretation of the structure in the split-coal area is less impersonal than is the case in other parts of the area.

Revisions of Present Map

The present map is a progress map subject to revision without special notice. Drilling is very active in the southern part of the State. Furthermore, the Survey does not have the logs of all holes that have been drilled. As new information is received the map will be revised and blue-print revision will be made available. It is not anticipated, however, that such a revision will be available for several months from the date of issue of the present map. Cooperation with the Survey, in supplying data on drill holes and mines not represented in the present compilation, is earnestly solicited.

OIL AND GAS POSSIBILITIES

By
Alfred H. Bell

The area mapped is situated in the southwestern part of the Illinois basin (see map. p. 2). The new oil fields discovered in 1937 lie to the north and northeast.

The principal structural features shown on the map are: (1) The DuQuoin monocline which occupies a belt of steep eastward-dipping formations which trend a little east of north from near the southern boundary of the area northward beyond DuQuoin, the dips becoming less steep in the vicinity of the Perry-Washington County line; (2) a faulted belt extending across the southern part of the area in a direction a little north of west, or about at right angles to the DuQuoin monocline; and (3) a relatively flat area having a regional northeast dip in which the dip is interrupted by local "rolls" and other irregularities.

The dip of the coal bed along the DuQuoin monocline south of DuQuoin, where it is known in greatest detail, is at the rate of about 200 feet in one-half mile, the approximate width of the monocline. The monocline appears to terminate southward at the Campbell Hill-Cottage Grove structure; north of DuQuoin the structure has been less closely explored and accordingly is indicated by a more generalized pattern.

The new map contains structural data presented for the first time making possible greater detail than was shown on previously published maps. The area noted under (3) above, contains structural features of particular interest in considering possibilities of oil and gas production.

(1) Ina Dome. - A dome having approximately 25 feet of closure on coal No. 6 is located about two miles west of Ina. The crest of this dome lies in the north part of sec. 25 and adjacent parts of secs. 23, 24, and 26, T. 4 S., R. 2 E., Jefferson County. A dry hole (map No. 59) on the north flank of this structure had a good show of free oil in the McClosky (Ste. Genevieve) oolitic limestone at a depth of 2761-2794 feet. This well was abandoned without trying acid treatment. As the coal rises to the south (about 29 feet in one-half mile), there appears to be a fair probability of finding oil in commercial quantity in the McClosky zone on the crest of the structure if porosity and permeability are favorable.

(2) Dome southwest of Sesser. - The new map shows a dome with approximately 50 feet closure, located near Little Muddy Creek, about 5 miles southwest of Sesser and 4 miles west-northwest of Valier. This dome occupies a central position in a broad syncline lying between the DuQuoin monocline on the west and a broad anticlinal nose on the east that has been called the Valier anticline.

The crest of the dome is established by point 228, from which the dip of coal No. 6 to point 226, two miles southwest, is 78 feet; to point 230, 1 1/4 miles south is 49 feet. The details of the structure to the north and northeast are not well defined, because of lack of drilling and the fact that the coal is split.

As pointed out by Dr. Cady (p. 5), the structure of the coal bed in the area designated on the map, "The approximate area of split coal" can be variously interpreted depending upon the hypothesis upon which one proceeds in designating the position of the top of the coal bed where the bed has been separated into several benches by shale partings or is entirely removed at the position of a channel sandstone. In some instances a different interpretation than that employed might shift contours to the extent of a single contour interval but rarely more than that. Unfortunately the information provided by the tabulations does not provide adequate information for alternative interpretations particularly different from that presented. Many of the logs of the holes drilled in the split coal area are confidential and available from the Survey only by special permission of the operators or owners.

At point 227 the coal appears to be abnormally high (-43 feet), and this point was not used in drawing the contours. It is possible that an anticline extends east-northeast from point 228 to point 227 (approximately 3 miles) but further drilling in the intervening area would be necessary to determine this definitely.

Because of the considerable amount of reverse dip, this dome (or anticline) appears to have favorable oil possibilities, provided the structure extends downward to the possible oil-bearing beds, and that the conditions of porosity and permeability are favorable.

Based on the available data, a point near map No. 228 appears to be the most favorable location for an oil and gas test.

(3) The Pinckneyville anticline. - The Pinckneyville anticline was described and recommended for testing on April 11, 1931 (Illinois Petroleum No. 1), following which a test well was drilled on the anticline by the Ohio Oil Company - C. H. Roe, Jr. No. 1, SE. corner SW. 1/4 NE. 1/4, sec. 24, T. 5 S., R. 3 W., total depth 1433 feet (Map No. 1203). This well reached the basal Chester and did not test the McClosky. Untested formations include the McClosky, the Devonian-Silurian limestone and the Kimmswick limestone. Because of the strong reverse dip (west) and the definite north-south trend, this structure probably extends downward to the pre-Pennsylvanian strata and, therefore, has a fair chance to be oil-bearing.

(4) Woodlawn-Drivers anticline. - Oil tests have been drilled on this structure (T. 2 S., Rs. 1-2 E.), but as yet none has been located on the crest. Although no closure on the coal is indicated, this structure appears to have some merit.

(5) Anticlinal nose south of Whittington. - A broad gentle structural feature in T. 2 S., R. 3 E.

(6) Dome east of Bessie. - Slight closure indicated. Most favorable area for testing is inside the closed -225 contour (T. 6 S., R. 4 E.).

(7) The DuQuoin anticline. - The DuQuoin anticline has recently been tested by a well to the St. Peter sandstone (T.D. 5,256 feet), now the deepest well in the State (Map No. 1951). This well was located 0.9 mile southwest of the crest of the structure as shown by Fisher (Report of Investigations No. 5, "Structure of Herrin (No. 6) Seam near DuQuoin"). The present map does not outline the crest because the contour interval is 25 feet instead of 20 feet.

The series of irregularly shaped closed structures in the shaded (closely drilled) area west of DuQuoin are believed to be insignificant from the standpoint of the oil prospector.

Along the belt of steep east dip called the DuQuoin monocline, there is believed to be opportunity for oil accumulation in sand wedges. However, drilling data to date do not indicate the presence of such sand wedges.

(8) Faulted area. - The Campbell Hill-Cottage Grove fault zone in northern Williamson and southern Franklin counties has not been thoroughly explored for oil. Oil and gas may possibly be discovered in some of the numerous small anticlines and fault blocks in this territory. However, the results of oil and gas testing to date in this general region suggest that the probability of important production in the highly faulted area is less than it is in the less disturbed areas to the north, farther down dip in the basin.

LOGS

Summary log of H. Forester No. 1, Perry County
(Map No. 1951 - Elevation 465)

	<u>Thickness</u>	<u>Depth</u>
Pleistocene system	28	28
Pennsylvanian system	586	614
Mississippian system		
Chester series		
Kinkaïd formation	27	641
Degonia sandstone	31	672
Clare formation	23	695
Palestine sandstone	37	732
Menard formation	123	855
Waltersburg sandstone	23	878
Vienna formation	45	923
Tar Springs sandstone	47	990
Glen Dean formation	44	1034
Hardinsburg sandstone	19	1053
Golconda formation	137	1190
Cypress sandstone	116	1306
Paint Creek formation	82	1388
Bethel sandstone	39	1427
Renault formation	8	1435
Aux Vases formation	135	1570
Meramec series		
Ste. Genevieve formation	180	1750
St. Louis formation	400	2150
Salem formation	174	2324
Osage series		
Warsaw, Keokuk and Burlington formations	731	3055
Fern Glen formation	32	3087
Kinderhook series		
Chattanooga formation	13	3100

H. Forester No. 1 (Continued)

	<u>Thickness</u>	<u>Depth</u>
Devonian system	748	3848
Silurian system	388	4236
Ordovician system		
Cincinnati series		
Maquoketa formation	56	4292
Mohawkian series		
Kimmswick formation	220	4512
Decorah formation	28	4540
Plattin formation	252	4792
Joachim formation	237	5029
Glenwood formation	101	5130
Chazy series		
St. Peter sandstone	126	5256 T.D.

Phillips Petroleum - Moss No. 1, Jefferson County
 (Map-No. 59 - Elevation 416.8)

	<u>Thickness</u>	<u>Depth</u>
Pleistocene system	54	54
Pennsylvanian system	1648	1702
Mississippian system		
Chester series		
Kinkaid formation	63	1765
Degonia sandstone	45	1810
Clore formation	90	1900
Palestine sandstone	41	1941
Menard formation	89	2030
Waltersburg sandstone	22	2052
Vienna formation	53	2105
Tar Springs sandstone	68	2173
Glen Dean formation	44	2217
Hardinsburg sandstone	27	2244
Golconda formation	241	2485
Cypress sandstone	53	2538
Paint Creek formation	82	2620
Bethel sandstone	10	2630
Renault formation	40	2670
Aux Vases formation	60	2730
Meramec series		
Ste. Genevieve formation		
Lower O'Hara member	22	2755
Rosiclare sandstone member	39	2794
Fredonia limestone member	134	2928 T.D.

Previously published data on the structure of parts of the area follow:

Kay, Fred H., Coal Resources of District VII: Illinois Mining Investigations, Bull. 11, 233 pages. Price \$1.00.

Cady, G. H., Coal Resources of District VI: Illinois Mining Investigations, Bull. 15, 94 pages. Price 75 cents.

Fisher, D. J., Structure of Herrin (No. 6) Seam near DuQuoin: Report of Investigations 5, 34 pages. Price 50 cents.

Bell, Alfred H., Ball, Clayton, and McCabe, Louis, Geology of the Pinckneyville and Jamestown Area, Perry County, Illinois: Illinois State Geol. Survey Illinois Petroleum No. 19. April 11, 1931. 22 pages. Price 25 cents.

Shaw, E. W., and Savage, T. E., Murphysboro-Herrin, Illinois: U. S. Geol. Survey Geol. Atlas (Folio No. 185), 15 pages. Price 25 cents.

Estimated Depths to Key Horizons in the Map Area

Horizon	Mt. Vernon El. 463	Nash- ville El. 505	Pinck- ney- ville El. 439	Ina (Top dome) El. 411	West Frank- fort El. 408
No. 6 coal	680	440	80	632	468
Base Pennsylvanian (Top Chester)	1790	940	650	1675	1510
Cypress (Top)	2575	1390	1180	2140	2300
Bethel (Top)	2710	1515	1280	2565	2425
McClosky (Top)	2882	1700	1450	2745	2600
Devonian (Top)	4390	2750	2980	4255	4100
Trenton (Top)	5590	3575	3905	5480	5725
St. Peter (Top)	6390	4120	4735	6280	6525

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