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UNIVERSITY OF KENTUCKY
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WALLACE W. HAGAN
Director and State Geologist

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**PENNSYLVANIAN CROSS SECTIONS
IN
WESTERN KENTUCKY**

Coals of the Lower Carbondale Formation, Part 1

Gilbert E. Smith

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Report of Investigations 6

Series X, 1967

UNIVERSITY OF KENTUCKY

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LETTER OF TRANSMITTAL

February 21, 1967

Dr. Raymond C. Bard
Assistant Vice President for Research
University of Kentucky

Dear Dr. Bard:

This Report of Investigations on coals of the lower Carbondale Formation should be of particular benefit to the cooperative areal geologic mapping program between the Kentucky and United States Geological Surveys; to the coal, oil and gas, and other mineral resources industries; and to educational institutions. The results obtained from the use of this information should aid in the mineral resources development of the Western Kentucky Coal Field and should afford a better understanding of the problems of correlation of western Kentucky coals.

Sincerely,

WALLACE W. HAGAN
Director and State Geologist
Kentucky Geological Survey

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PENNSYLVANIAN CROSS SECTIONS IN WESTERN KENTUCKY

Coals of the Lower Carbondale Formation, Part 1

Gilbert E. Smith

ABSTRACT

Preliminary electric-log cross sections were drawn across the Western Kentucky Coal Field to establish correlations of the coal horizons of the Carbondale Formation. The sections were begun from a published electric log and sample study in Henderson County and extended to the east toward the coal outcrops in Daviess County and southwest to the type areas of the Lower Pennsylvanian, along the Ohio River in Union County. A discrepancy was noted in the correlation of the coals between the Davis-No. 6 and the No. 8 above. Further study showed that a narrow north-south-trending zone could be established, east of which the Dekoven-No. 7 Coal horizon did not appear. The absence of the No. 7 Coal is attributed to nondeposition. That coal called the No. 7 to the east is identified as the "Schultztown" or the equivalent of the Colchester-No. 2 of Illinois, found next above the No. 7 at Dekoven.

The Davis-No. 6 Coal, selected as the base of the Carbondale Formation for the joint United States Geological Survey-Kentucky Geological Survey mapping program, was traced eastward to Daviess County where the horizon is represented by a coal with a prominent limestone beneath it. It is believed that this horizon is also correlative with that known in southern Indiana as the III.

INTRODUCTION

The problem of the correlation of coals and their associated rocks is by no means a new one in Kentucky. As Kentucky's statewide geologic mapping program, conducted jointly by the Kentucky and the United States Geological Surveys, began in the Western Kentucky Coal Field, it was deemed desirable to establish a stratigraphic framework to be used in correlating coal horizons between the several mapping areas.

The dipping of the coal-field strata in areas of broad, gravel-filled valleys and loess-covered hills makes it difficult to trace the thin, repetitious beds in outcrop for any great distance. Also, the presence of faulting in the area compounds the problem, as many of the faults lack surface expression.

The Western Kentucky Coal Field is, in general, the location of the greatest oil and gas exploratory activity in the Commonwealth. Consequently, the greatest source of subsurface information which can be used in the preparation of correlation charts is

the large number of geophysical logs which are obtained in conjunction with oil-well tests. Several types of geophysical logs are employed by the petroleum industry, but the standard resistivity or electric log constitutes the greatest source of subsurface data. The electric log has not been used by many coal-field stratigraphers as a correlation tool. The writer, however, has found that a great deal of useful information can be obtained from these logs. This type of log gives an accurate depth to a specific horizon as well as a usable indication of the types of lithologies penetrated, but it should be kept in mind that one cannot hope to match the details found by a field geologist in good outcrop exposures or by core studies.

Many different types of geophysical logs are employed by the petroleum industry today in the study of subsurface strata and suspected associated oil and gas accumulations. Many of the newer types of logs, such as gamma ray-neutron logs, show more clearly the coal horizons and perhaps give a better indication of coal thickness.

Experience shows that thin, resistive beds produce the same characteristic resistivity deflections or "kicks" on standard electric logs. This means that both coal horizons and limestone horizons may appear similar and that a working knowledge of the section being studied is necessary. It is convenient to have a series of core logs or sample studies with which to compare the electric logs but this is not always possible.

The No. 9 Coal is the most widely known and the most easily recognized coal bed in western Kentucky logs and there are more core data showing this bed than any other. It was, therefore, chosen as the key horizon of the preliminary framework.

The author is most grateful to his colleague, William D. Rose, for his patient guidance in the early studies of the electric logs and for the checking of the final correlations in relation to his Upper Mississippian studies.

GEOLOGIC SETTING

The Pennsylvanian or coal-bearing rocks of western Kentucky are found as the southern extension of the Eastern Interior Basin, that area which also contains the large coal fields of southern Illinois and southwestern Indiana (fig. 1). This area of Kentucky covers some 6,000 square miles and all or parts of 14 counties. In some areas a thickness of more than 3,000 feet of Pennsylvanian rocks has now been determined from the electric-log studies.

This paper is a report on the correlation of the coals of the lower part of the Carbondale Formation. This formation, as used on the combined United States Geological Survey-Kentucky Geological Survey geologic mapping program, is defined as those beds in the section with the base of the Davis-No. 6 Coal as the bottom and the base of the Providence Limestone as the top. Particular interest is paid to the correlation of the No. 6, or Davis, Coal because it appears to be the lowest Pennsylvanian bed with great lateral extent that can be easily traced by use of the electric logs. In this phase of the study little attention is given to the picking of the No. 11 Coal horizon and Providence Limestone where their positions are shown on the logs. As previously noted, both coals and limestones tend to produce similar deflections, and the complicated, irregular coal-limestone sequence at this position in the section was not studied in detail at this time.

PREVIOUS WORK

It is interesting to note that the first geological study undertaken in Kentucky was in the western coal areas. David Dale Owen (1856) and his associates began the study in 1854 and established a relationship of the recognizable coals by numbering them from the bottom upward.

In investigating coals of the Tradewater River region, L. C. Glenn (1912) made a further study of the Pennsylvanian rocks and revised Owen's numbers for the "Three Foot" and "Four Foot" seams. The "Three Foot," or No. 6 of Owen, became the No. 7 of Glenn, and the "Four Foot," or No. 5 of Owen, became the No. 6. Today the No. 7 of Glenn is also known as the Dekoven and the No. 6 of Glenn is called the Davis.

Wallace Lee, in his *Geology of the Kentucky Part of the Shawneetown Quadrangle* (1916), reported the next major study of the Dekoven area, making significant contributions to the upper part of the section. Lee also made a new, more complete section of coals, including one coal that Glenn

(1912) had failed to note in his sections. This coal was correlated by Lee with Owen's No. 7. More recent workers have correlated the coal with the Colchester-No. 2 of Illinois and the IIIa of Indiana, but there is no record of the first application of the name "Schultztown" to the coal in this area. It has not as yet been fully correlated to the type Schultztown of Gardner (1912) in Ohio County.

Glenn had failed to note this additional coal and therefore misnamed the coals in the West Kentucky Coal Co. Drill Hole No. 15 (Glenn, 1912, p. 17). His correlations for Webster County (Glenn, 1922), where the Dekoven-No. 7 is believed by the present author to be absent, are incorrect in that the coal referred to as the No. 7 is actually that coal now called "Schultztown," the next coal above the No. 7 in the section. This "Schultztown," or the Colchester-No. 2 of Illinois, is said by Wanless (1939) to be the most extensive coal horizon known. It has been reported in eastern Daviess County from spore studies by Kosanke (1964).

USE OF ELECTRIC LOGS

Electric logging of oil-test holes was introduced in the Eastern Interior Basin in 1937 and these logs have since been extensively used for stratigraphic and structural studies by the petroleum industry. The first use of the Pennsylvanian section of these logs was for the correlation of oil-producing sands. Later studies of the logs were made by Walker and others (1951) and Cathey (1955). Also, studies were made during the joint water programs of the U. S. Geological Survey Ground Water Branch and the Kentucky Geological Survey. The most recent detailed study of the coal information on western Kentucky came about during the continuing programs of the Tennessee Valley Authority and the Kentucky Geological Survey to compute and map the coal reserves of the area.

COAL CORRELATIONS

The cross sections which are a part of this report were drawn to show the relationship of the several coal beds of the Carbondale Formation, or those from the Davis-No. 6 up to the No. 11. As previously mentioned, the relationship of the coals and limestones in the section at the top of the Carbondale and bottom of the Lisman Formations is to be studied in more detail later.

A geologic cross section was begun near Henderson in sec. 16-Q-25 (Carter Coordinates) with a log and sample study of the Kingwood Oil Co. No. 1 Rash well (pl. 4, in pocket) published originally

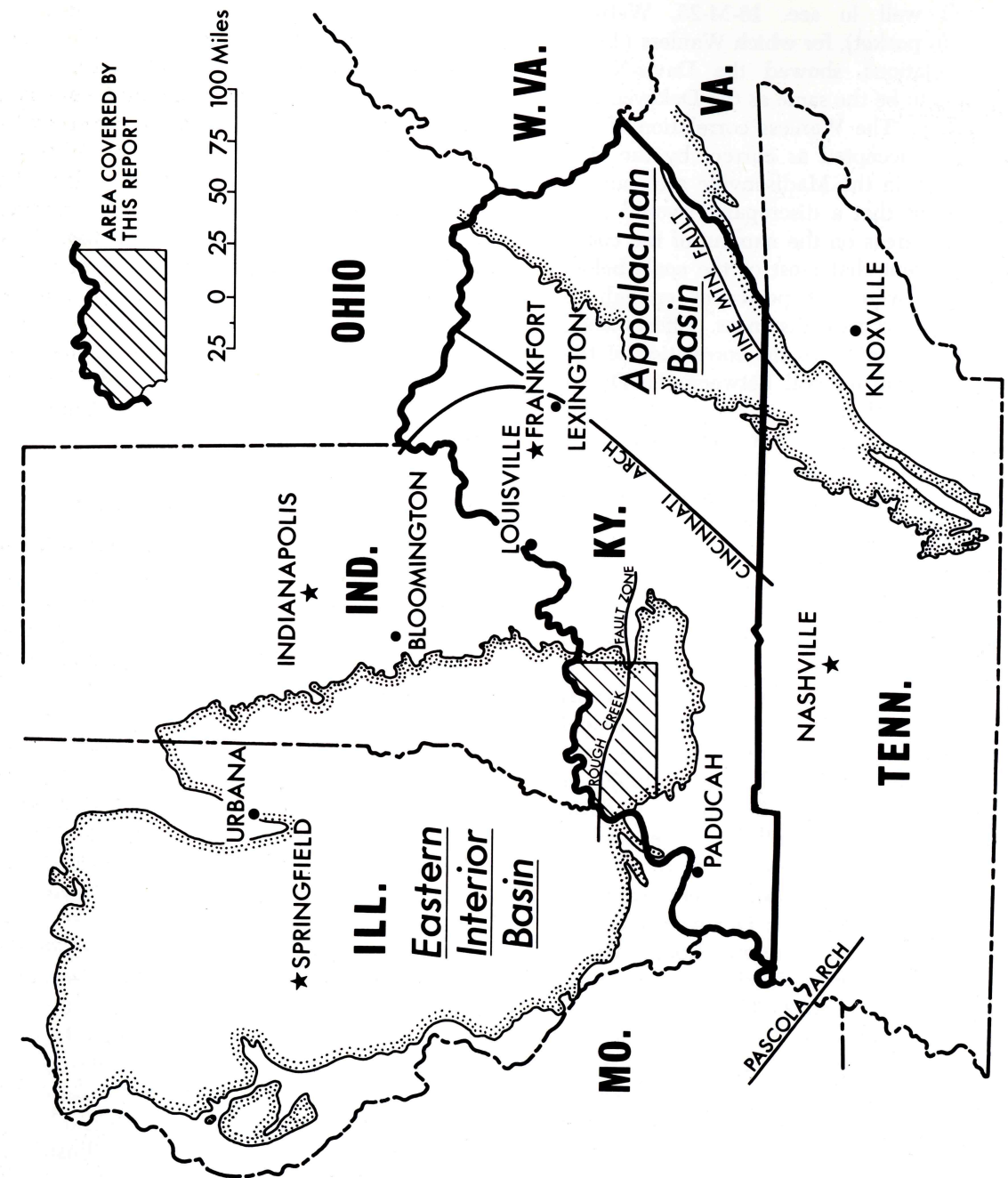


Figure 1. Regional map showing the area covered by this report.

in Cathey, 1955. The section was first extended east to the area being mapped from the Owensboro U. S. Geological Survey-Kentucky Geological Survey field mapping office. A later correlation of this section with a log of the Lacy, George and Wrather No. 1 Russell well in sec. 18-M-23, Webster County (pl. 6, in pocket), for which Wanless (1955) published correlations, showed the Davis-No. 6 Coal of Wanless to be the same as the Dekoven-No. 7 Coal of Cathey. The Wanless correlation of the Davis-No. 6 was accepted as correct by the U.S. Geological Survey in the Madisonville area, and it was thus apparent that a discrepancy would exist between the two areas on the naming of the coals. It was also apparent that most of the coals below the Davis-No. 6 were not persistent enough to follow on the logs for great distances. Efforts were, therefore, directed mainly to the correlation of the series of coals in the interval between the Davis-No. 6 and No. 9 Coal above.

A large number of coal-test logs from near Dekoven in Union County have been collected. The study of these logs showed the presence of four coals between the No. 6 and No. 9 in this, the area first described by Owen (1856) and modified by Glenn (1912). A study of all the coal-test holes put down near where the coals were first named was made. Holes that penetrated the Davis-No. 6 horizon, as it is known today, were correlated to establish the proper sequence and number of coals that were noted between the No. 6 and No. 9 Coal above. This sequence was correlated to the west with work done by William H. Smith (1957) of the Illinois State Geological Survey in Gallatin County, Illinois, but here called, in descending order, No. 9, 8b, 8, "Schultztown," Dekoven-No. 7, and Davis-No. 6. Cross sections were extended eastward from the type area at Dekoven—one was carried north of the Shawneetown-Rough Creek fault zone and one to the south where there is relatively little subsurface control. The discrepancy in correlation at the position of the two coal horizons still existed. As the cross sections had been made using one log for each Carter section, or about 1 mile between logs, it was evident that a study of more closely spaced data was needed. As there were more data north of the fault zone, a detailed cross section through this area was constructed.

An illuminating sequence of logs was consequently uncovered in secs. 6- and 7-O-21 in Union County. Plate 1 (in pocket) shows the locations of representative logs of this sequence, as well as the numerous oil tests of the area. Thus, while the illustrations concern only five logs, there is a great amount of other information for the area here de-

scribed. Plate 1 shows only those portions of these logs that depict the interval from the No. 9 Coal downward through the Davis-No. 6. The log on the left, No. 1, is typical of those around Dekoven where the entire series of coals is found in the core holes. The log on the right, No. 5, is typical of those found from here eastward and southward. Log No. 2 still shows all the characteristic coal "kicks," but those two representing the No. 7 and "Schultztown" coals are now closer together, No. 7 Coal being slightly upsection from No. 6. The third and fourth logs clearly show the interval between the No. 7 and "Schultztown" coals to be less than 10 feet and reveal a massive sandstone between the No. 7 and the No. 6 below. Log No. 5, about 2,200 feet east of No. 4, has only a trace of the No. 7 Coal horizon.

As these logs illustrate the facies change under which only one coal is present instead of two, and as this change affects that coal horizon correlated with the Dekoven-No. 7 at the type area, it is concluded that the remaining horizon (shown on the logs as "S") is the same as that found at Dekoven and correlated with the Colchester-No. 2 of Illinois.

Having established this stratigraphic change, it was possible to utilize previous work in carrying the correlations of this interval across the Basin in Kentucky.

Applying the information gained from this group of logs to the many other logs of the area, a line was established which appears to denote the eastern edge of deposition of the Dekoven-No. 7 Coal in western Kentucky (fig. 2).^{*} The presence of the No. 7 Coal and an underlying sandstone in some logs indicates that the absence of No. 7 to the east is due to nondeposition rather than erosional channeling. It appears, therefore, that the Dekoven-No. 7 Coal horizon has migrated upsection to the east and feathered out over an increasing thickness of clastic sediments representing a shoreline or delta deposit in the original coal swamp. Using the sequence of coal horizons as depicted on the electric logs, these units were extended outward from Union County. The lines of these cross sections are shown on the map (pl. 2, in pocket). The general locations of all logs used are shown and those illustrated in this report are further indicated. At this point it is worth noting that many hundred other logs were interpreted before a selection of the logs shown was made. Correlations between logs relatively far apart can be hazardous because of lateral changes of the beds, particularly the sandstones. Also, as

^{*} A brief comparison of a number of electric logs from recent drilling appears to confirm the position of this line through the Camp Breckinridge area.

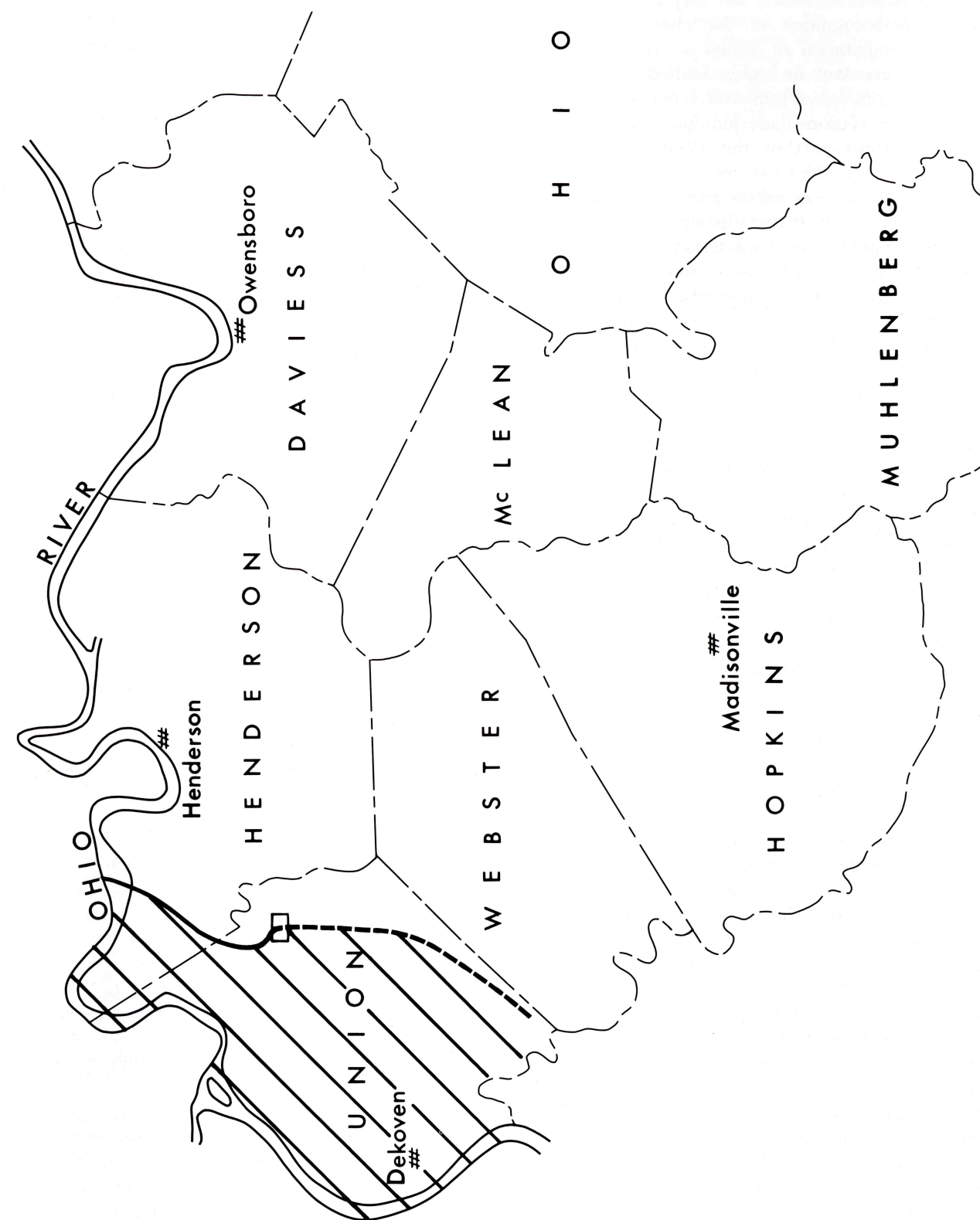


Figure 2. Areal extent of recognizable Dekoven-No. 7 Coal horizon in western Kentucky. The rectangle in northeastern Union County represents the area shown in plate 1 (secs. 6- and 7-O-21).

the Pennsylvanian section largely consists of the repetition of typical sequences of beds, care is necessary in distinguishing one sequence from another. The recognition of the characteristics of individual sequences, or cycles of deposition, is especially important in highly faulted areas.

Other Carbondale Formation cross sections are now in preparation in these highly faulted areas in the southeastern part of the Western Kentucky Coal Field.

Little difficulty was experienced in tracing the other coal horizons of the Carbondale Formation. The No. 9 Coal is quite characteristic in appearance on electric logs and is absent in only a few places where it is cut out by sandstone channels. The distance between the No. 9 and No. 6 Coals gradually shortens eastward from approximately 265 feet at Dekoven to approximately 230 feet in western Daviess County. The intervals between the other coal horizons vary rather erratically from area to area but these horizons are all recognizable on the logs. Some log "kicks" may represent coals of minable thickness but this information is not noted at this time. The base of the Carbondale Formation (No. 6 Coal) has been traced from the type areas near Dekoven eastward through Daviess and Hancock Counties and southward through Webster to Hopkins County. In the eastern areas a prominent limestone is present just below the coal and this combination of beds is readily identifiable. Kosanke (1964) correlated the thin coal overlying the limestone with the Dekoven-No. 7 by the use of spores, but the author holds the bed to be the Davis-No. 6 and correlative with that known as the No. III of Indiana (Hutchison, 1959) to the north.

Further studies of the ever-increasing number of electric logs and subsurface data are continuing as the cross sections are expanded to include the other Pennsylvanian formations of western Kentucky.

SUMMARY

Comparisons of coal-test data and electric logs taken in nearby oil-test holes have shown that certain coal and limestone horizons may be identified on the logs by characteristic "kicks" indicative of thin, resistive beds. Correlations of these horizons are possible over wide areas if the spacing of the electric-log data is not too great.

The results of this study of coals of the Carbon-dale Formation of western Kentucky show that the Dekoven-No. 7 Coal has a very limited extent, and that the coal horizon called the No. 7 by Glenn

(1922) in Webster County is actually a correlative of the Colchester-No. 2 of Illinois, the next coal above the No. 7 in the sequence of the type area at Dekoven in Union County. The Davis-No. 6 Coal of Union County is shown to be correlative with that coal in Daviess County which overlies a prominent limestone. This coal (Davis-No. 6) is also shown to be the same as that called Coal III in southern Indiana.

Valuable stratigraphic information may thus be obtained from the use of electric logs in correlating Pennsylvanian rocks, but it must be kept in mind that this method cannot match the results of detailed field geology on good outcrop exposures.

BIBLIOGRAPHY

Cathey, J. B., Jr., 1955, Geology and mineral resources of the Newburgh quadrangle, Kentucky: Kentucky Geol. Survey, ser. 9, Bull. 15, 51 p.

Gardner, J. H., 1912, Preliminary report on the economic geology of the Hartford quadrangle: Kentucky Geol. Survey, ser. 3, Bull. 20, p. 1-25

Glenn, L. C., 1912, A geological reconnaissance of the Trade-water River region, with special reference to the coal beds: Kentucky Geol. Survey, ser. 3, Bull. 17, 75 p.

Glenn, L. C., 1922, The geology and coals of Webster County: Kentucky Geol. Survey, ser. 6, v. 5, 249 p.

Hutchison, H. C., 1959, Distribution, structure, and mined areas of coals in Spencer County, Indiana: Indiana Geol. Survey Prelim. Coal Map 8

Kosanke, R. M., 1964, Palynological investigations in the Pennsylvanian of Kentucky—I: U. S. Geol. Survey open-file report

Lee, Wallace, 1916, Geology of the Kentucky part of the Shawneetown quadrangle: Kentucky Geol. Survey, ser. 4, 73 p.

Owen, D. D., 1856, Report of the Geological Survey in Kentucky made during the years 1854 and 1855: Kentucky Geol. Survey, ser. 1, v. 1, 416 p.

Smith, G. E., 1966, Correlation problems of Davis No. 6 and DeKoven No. 7 Coals in western Kentucky, p. 263-264 in The Geological Society of America, Abstracts for 1965: Geol. Soc. America Special Paper 87, 366 p.

Smith, W. H., 1957, Strippable coal reserves of Illinois, Part 1—Gallatin, Hardin, Johnson, Pope, Saline, and Williamson Counties: Illinois Geol. Survey Circ. 228, 39 p.

Walker, F. H., Puryear, R. E., and Cathey, J. B., Jr., 1951, Geology and mineral resources of the Henderson quadrangle, Kentucky: Kentucky Geol. Survey, ser. 9, Bull. 7, 32 p.

Wanless, H. R., 1939, Pennsylvanian correlations in the Eastern Interior and Appalachian coal fields: Geol. Soc. America Special Paper 17, 130 p.

Wanless, H. R., 1955, Pennsylvanian rocks of Eastern Interior basin: Am. Assoc. Petroleum Geologists Bull., v. 39, p. 1753-1820

CROSS SECTIONS

The data for section A-A' (pl. 3) were taken from coal-test information. In the electric-log sec-

tions (pls. 3-8), only those portions of the logs representing the Carbondale Formation are depicted.

The electric log shown on plate 2 illustrates the relationship of the Middle and Lower Pennsylvanian formations to the underlying Upper Mississippian beds.

The electric logs of cross sections B-B' through J-J' are given in the following list. The logs illustrated in plates 3-8 are indicated by an asterisk (*).

Cross Section B-B'

3-M-19 * Robinson-Puckett, Inc. No. 1 Ben Dyer

22-N-19 * Barron Kidd No. 1 Annie Meacham

20-N-19 * Joe Bander No. 1 R. H. Stodghill

9-N-19 Basin-Buchman-O'Neal No. 1 Robinson Estate

1-N-19 Carter Oil Co. No. 12 W. H. Hagan

25-O-20 * Ashland-Basin-Yunker No. 1 A. J. Bickett

16-O-20 W. E. Styles and E. T. Wix No. 1 Morganfield Coal & Coke

14-O-20 Sohio Petroleum Co. No. 1 Tucker

13-O-20 * Farmer-Chenault No. 1 Young Estate

12-O-20 * H. H. Weinert No. 1-B Greenwell

11-O-20 Buchman and O'Neal No. 1 M. Drury

10-O-20 * Lacy and Royer No. 1 Drury

10-O-20 Sun Oil Co. No. 1 Tapp

1-O-20 * Carter Oil Co. No. 1 Drury

1-O-20 * Carter Oil Co. No. 1 Emma Fleming

2-O-20 * George A. Hoffman No. 4 Drury-Turnquist

2-O-20 Joe Reznik No. 1 Charles Davis

24-P-20 D. E. Schock No. 1 R. A. Brisby

16-P-20 * Kingwood Oil Co. No. 1 Ryan Minerals

11-P-19 * Sohio Petroleum Co. No. 2 Robinson

Cross Section C-C'

19-P-20 * Cherry and Kidd No. 1 Edward Culver

9-P-20 * W. E. Styles No. 1 W. E. Styles

9-P-20 Mt. Carmel Drilling Co. No. 1 A. G. Mason et al.

2-P-20 * Reynolds and Igleheart No. 1 Alves

25-Q-21 Gulf Refining Co. No. 1 C. L. Ramsey

24-Q-21 * Indiana Farm Bureau No. 5 Burbank

17-Q-21 Paul Rossi No. 1 Sam H. Gaines

18-Q-21 * Ralph Halbert No. 1 B. B. Dorsey

19-Q-21 * Carter Oil Co. No. 1 M. E. Duncan

20-Q-21 * Clarence Wood No. 1 Cavanaugh

Cross Section D-D'

16-Q-24 * Canterbury-Balderson No. 1 Barret Heirs

17-Q-24 Ellis, Morrison, et al. No. 1 M. W. Barret

18-Q-24 * J. V. Canterbury No. 1 Barret Heirs

19-Q-24 J. D. Turner No. 1 Ben Rash

20-Q-24 Kingwood Oil Co. et al. No. 1 R. E. Givins

20-Q-24 * George and Wrather No. 1 B. C. Rash

16-Q-25 * Kingwood Oil Co. No. 1 Rash

17-Q-25 Stanoco Oil Co. No. 1 Jack Crafton

18-Q-25 R. E. Hupp No. 1 Harding

19-Q-25 * Slagter Producing Co. No. 1 Spain-Howard

20-Q-25 Hupp Oil Co. No. 1 Blair

17-Q-26 Basin Drilling Co. No. 1 D. Purgeason

18-Q-26 * George A. Hoffman No. 1 Gus Strehl

19-Q-26 Harvey, Snyder, et al. No. 1 J. H. Cole

20-Q-26 * Rotstein-Curtis No. 1 N. K. Hynes

Cross Section E-E'

13-M-19 * George A. Hoffman et al. No. 1 Union Co. Airport

Cross Section F-F'

13-L-21 * Miami Oil Producers No. 1 Baker Estate

23-L-21 * Big Chief Drilling Co. No. 1 Watson Heirs

3-K-21 * Barron Kidd No. 1 Givins

12-K-21 * Ashland Oil & Refining Co. No. 1 L. G. and N. Wyatt

20-K-21 * L. and H. Drilling Co. No. 1 J. C. Barnhill, Sr.

16-K-22 * L. and H. Drilling Co. No. 1 R. M. Traylor et al.

24-K-22 * Ed E. Rehn No. 1 Pittsburgh and Midway Coal Co.

Cross Section G-G'

18-M-23 * Lacy, George and Wrather No. 1 Russell

13-M-23 * Skiles Oil Corp. No. 1 Casner

7-M-23 * Stanford Oil Co. No. 1 W. Biggs

23-N-23 Indiana Farm Bureau et al. No. 1 Hobgood

23-N-23 * Royalco, Inc. No. 1 Fraser Community

18-N-23 * A. W. Cherry No. 1 Melton

19-N-23 Eakle and Holder No. 1 Powell

20-N-23 * B. M. Heath No. 1 N. Newton

16-N-24 DeBeauford and Portis et al. No. 1 Harry Sutton

17-N-24 * George Engle No. 1 Allen

18-N-24 George Engle No. 1 Henry Warren

19-N-24 * Richard W. Portis No. 4 Arthur Ashby

20-N-24 * Colfax Oil Co. No. 2-C A. R. Sellers

15-N-25 Powell and Hamilton No. 1 Weatherford

15-N-25 * J. P. Washburn No. 1 Ike Warren

14-N-25 George Engle No. 1 E. E. Warren

14-N-25 * J. C. Ellis and Sun Oil Co. No. 1 L. P. Lindsey

13-N-25 * J. C. Miller and Ashland Oil & Refining Co. No. 1 Lightfoot

12-N-25 * T. M. Egan No. 1 Eubanks

11-N-25 J. C. Ellis and Sun Oil Co. No. 1 Warren Hunt

15-N-26 * Grandin-Oeth Drilling Co. No. 1 Brown

13-N-26 * Felmont Oil Corp. et al. No. 1 Edds

12-N-26 Felmont Oil Corp. No. 1 W. V. Bohannon

11-N-26 * W. C. McBride No. 1 Whittaker

15-N-27 R. O. Wilson II No. 1 Clarence Hulsey et al.

14-N-27 * Joe L. Sunderland et al. No. 1 Eugene Hayden

Cross Section H-H'

13-N-27 * G. L. Reasor No. 1 J. T. Hayden

9-N-27 Slagter Producing Co. No. 1 Erwin

3-N-27 * John J. Hassler No. 1 Edgar Hayden

23-O-27 * Ashland, Basin, and Kaufman No. 1 Joe Stuart

17-O-27 Cities Service Oil Co. No. 1 Academy

15-O-27 * G. W. Miller No. 1 F. X. Oberst

5-O-27 Eakle and Holder No. 1 Frank Schadler

24-P-27 * G. L. Reasor No. 1 Edgar Chinn

17-P-27 Farmer-Chenault No. 1 K. A. Jones

14-P-27 * F. M. Ashby No. 1 H. B. Hazelwood

15-P-27 Ralph Halbert No. 1 H. Ball

4-P-27 Kingwood Oil Co. No. 1 R. C. Murphy

5-P-27 * K. R. Ingle No. 1 Fred Boone

25-Q-27 Cox Drilling Co. No. 1 John Rooney

16-Q-27 * Calstar Petroleum Co. No. 1 Reno

15-Q-27 Kingwood Oil Co. No. 1 Reisz

6-Q-27 * Dale Hopkins No. 1 L. H. Remole

7-Q-27 * Walton and Pledger No. 1 Bower Bros.

Cross Section J-J'

Plate 1 -
 6-O-21 * J. D. Turner No. 1 R. S. Cruz
 6-O-21 * J. D. Turner No. 3 R. S. Cruz
 6-O-21 * J. D. Turner No. 3 J B. Berry
 6-O-21 * John D. Evans No. 1 John Markham
 7-O-21 * Ashland Oil & Refining Co. No. A-3 Verona
 Coal
 8-O-21 Mid Oil Field Drilling Co. No. 1 Clements
 9-O-21 * C. E. O'Neal No. 1 J. A. Head
 6-O-22 * Carter Oil Co. No. 1 Brantley
 7-O-22 A. J. Slagter No. 1 Waller
 8-O-22 * Tuley and Carter No. 1 G. H. McMurtry
 9-O-22 B. M. Heath No. 1 Jackson
 6-O-23 * Delta Drilling Co. No. 1 A. B. Eblen
 8-O-23 Carter Oil Co. No. 1 Galloway
 9-O-23 * Slagter Producing Co. No. 1 Cates
 10-O-23 Stanford Oil Co. No. 1 W. C. Wright

6-O-24 Lacy, Royer, et al. No. 1 Pentecost Heirs
 14-O-24 * Slagter Producing Co. No. 1 Eula Spencer et al.
 12-O-24 Hupp Oil Co. No. 1 Thomas Berry
 15-O-25 * National Associated Petroleum Co. No. 1 Miller
 12-O-25 * Ryan Oil Co. No. 1-A Triplett
 11-O-25 Westfall Drilling Co. No. 1 Reid
 14-O-26 Sun Oil Co. No. 1 Leo Sandefur
 13-O-26 * Basin Drilling Co. No. 1 Denton
 12-O-26 J. C. Miller et al. No. 1 Tyler
 11-O-26 * George A. Hoffman No. 1 Albert Pinkston
 15-O-27 G. W. Miller No. 1 F. X. Oberst
 14-O-27 * J. C. Ellis No. 1 Green-Crabtree
 12-O-27 * Stanoco Oil Co. No. 1 Riney
 11-O-27 Sun Oil Co. No. 1 Henry Bicket
 15-O-28 * Ohio Oil Co. and Basin Drilling Co. No. 1 St.
 Raphael Church
 18-O-28 * Basin Drilling Co. No. 1 Brumley