STATE OF ILLINOIS

DEPARTMENT OF REGISTRATION AND EDUCATION

DIVISION OF THE

STATE GEOLOGICAL SURVEY

FRANK W. DE WOLF, Chief

Cooperative Mining Series

BULLETIN 11

COAL RESOURCES OF DISTRICT VII

(SOUTHWESTERN ILLINOIS)

(Coal No. 6 West of Duquoin anticline)

BY

FRED H. KAY

Field Work by K. D. White, Fred H. Kay and others

In cooperation with U. S. Geological Survey

(REPRINT FROM EDITION OF 1915)

ILLINOIS MINING INVESTIGATIONS

Prepared under a cooperative agreement between the Illinois State Geological Survey Division, the Engineering Experiment Station of the University of Illinois, and the U. S. Bureau of Mines

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

URBANA, ILLINOIS

1922

The Forty-seventh General Assembly of the State of Illinois, with a view of conserving the lives of the mine workers and the mineral resources of the State, authorized an investigation of the coal resources and mining practices of Illinois by the Department of Mining Engineering of the University of Illinois and the State Geological Survey Division in cooperation with the United States Bureau of Mines. A cooperative agreement was approved by the Secretary of the Interior and by representatives of the State of Illinois.

The direction of this investigation is vested in the Director of the United States Bureau of Mines, the Chief of the State Geological Survey Division, and the Director, Engineering Experiment Station, University of Illinois, who jointly determined the methods to be employed in the conduct of the work and exercise general editorial supervision over the publication of the results, but each party to the agreement directs the work of its agents in carrying on the investigation thus mutually agreed on.

The reports of the investigation are issued in the form of bulletins, either by the State Geological Survey Division, the Engineering Experiment Station, University of Illinois, or the United States Bureau of Mines. For copies of the bulletins issued by the State Geological Survey Division, address State Geological Survey Division, Urbana, Illinois; for those issued by the Engineering Station, address Engineering Station, University of Illinois, Urbana, Illinois; and for those issued by the U. S. Bureau of Mines, address Director, U. S. Bureau of Mines, Washington, D. C. (See list at end of book.)

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FRANK W. DeWOLF, *Chief*

Committee of the Board of Natural Resources and Conservation

W. H. H. MILLER, *Chairman*
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Representing the President of the University of Illinois

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Geologist

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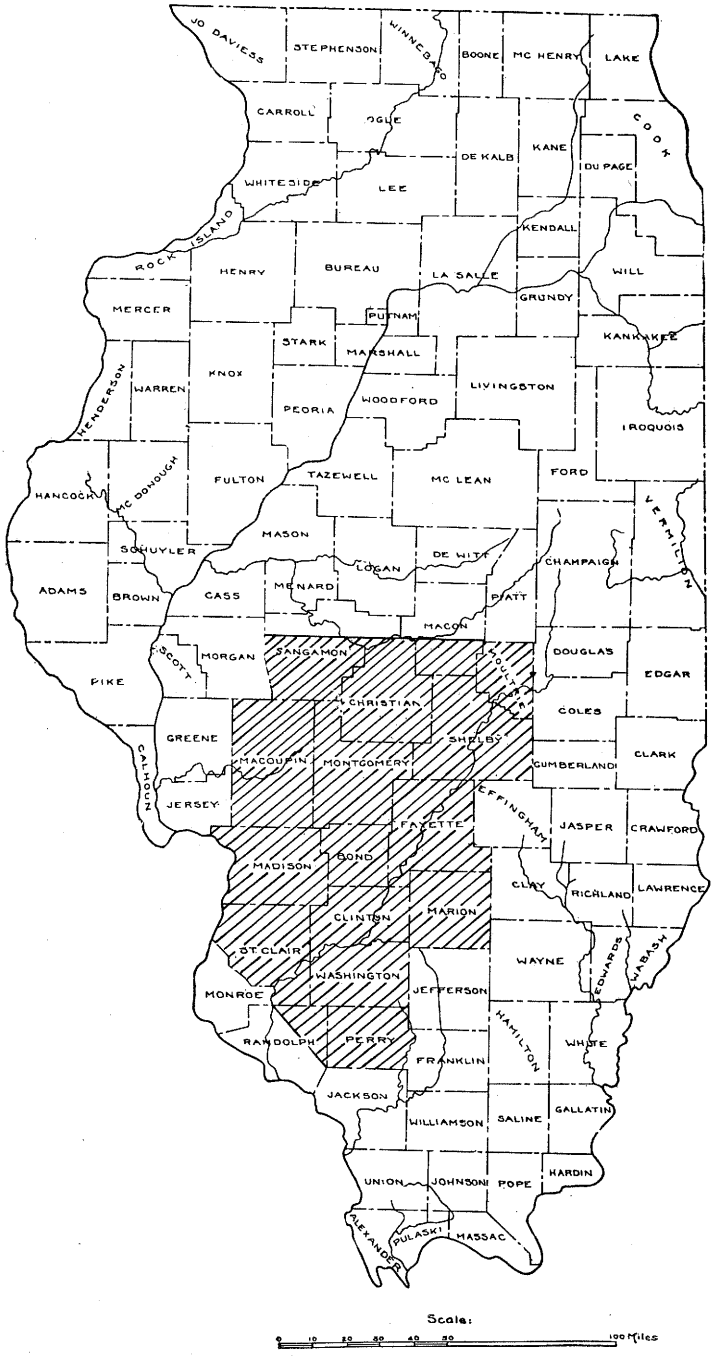


FIG. 1.—Map showing area covered in the report.

COAL RESOURCES OF DISTRICT VII

By Fred H. Kay

PART I—GEOLOGIC RELATIONS IN DISTRICT VII

INTRODUCTION

Importance of the Area

This report covers 7000 square miles in southwestern Illinois, including all or parts of the following counties: Sangamon, Christian, Montgomery, Macoupin, Bond, Madison, Shelby, Moultrie, Fayette, St. Clair, Clinton, Marion, Washington, Perry, and Randolph. (See figure 1). The area described contained originally 46,279,496,000 tons of coal in bed No. 6. From 1881 to June 30, 1913, inclusive, approximately 347,106,000 tons of this coal were mined in this area. Since only 55 per cent of the coal is recovered in this district[1] about 283,996,000 tons were left in the mines as pillars and will probably never be extracted. The total amount of coal mined and rendered unavailable is then 631,102,000 tons, leaving in the district 45,618,394,000 tons of coal No. 6. At the present rate of consumption and with only a 55 per cent recovery, coal No. 6 alone in District VII could supply the entire demand for bituminous coal in the United States for almost 100 years. The rate of consumption is however increasing very rapidly.

In view of the importance of the coal deposits, the State Geological Survey, in cooperation with the Department of Mining Engineering of the University of Illinois and the U. S. Bureau of Mines, undertook in 1912 to prepare a series of bulletins dealing with the coal resources of the State. The present report for District VII treats that part of southwestern Illinois underlain by coal No. 6 in commercial thickness. This bed underlies practically the entire area and presents reasonably uniform conditions for study. The other districts examined by the Investigation are listed in a previous publication.[2]

[1] Andros, S. O., Coal Mining Practice in District VII; Ill. Coop. Mining Invest., Bull. 4, Vol. I, No. 1, May, 1914, p. 17.

[2] Prelim. Bull. Illinois Coal Mining Investigations, p. 12, 1913.

ACKNOWLEDGMENTS

A large amount of the material embodied in this report is derived from the notes of other workers, especially those of K. D. White, who rendered most valuable assistance during the field work of 1912, and later in the compilation of material in the office. Mr. White visited a large number of the mines selected for examination, and his carefully prepared notes have been of great value in the preparation of the report. The notes of J. A. Udden, G. H. Cady, F. F. Grout, W. F. Wheeler, Thos. Moses, and others have been used freely.

Grateful acknowledgment is made for the use of Mr. Udden's report on the Belleville-Breese area published in Bulletin 8 of the Geological Survey in cooperation with the U. S. Geological Survey. The report on the "Carlyle Oil Field and Surrounding Territory" by E. W. Shaw, of the U. S. Geological Survey in cooperation with the Illinois State Geological Survey has been of great service to the author and has been quoted in a number of places.

Since the field work for the report was completed, Wallace Lee, of the U. S. Geological Survey, cooperating with the State Geological Survey, has made a detailed study of the Gillespie-Mt. Olive quadrangles, and his report will be published as a folio of the geological atlas of the U. S. by the Federal Survey. Mr. Lee has kindly made useful suggestions regarding details in the region examined by him.

Through the uniform kindness and generosity of a large number of operators, investors, and mining men, hundreds of drill records have been made available for study, and all of the mines have been opened without reserve to representatives of the Investigation. A. J. Moorshead, General Manager, and G. E. Lyman, Mining Engineer, Madison Coal Corporation, have been most generous in furnishing information regarding the district and in supplying many excellent underground photographs. The Fischer Fuel Company of St. Louis, through Mr. B. W. Hilgard, have kindly furnished photographs of their stripping mine at Millstadt. Special thanks for favors are due F. S. Peabody, Peabody Coal Company, who has not only furnished a great deal of information but also kindly consented to read this report in manuscript form and offered many helpful suggestions. F. H. Brown, H. S. Hargrave, and A. W. Crawford, of Hillsboro, have given unstinted assistance in many ways. Mr. Thomas Jeremiah furnished valuable information regarding the position of the coal outcrop in Perry and Randolph counties.

Throughout the investigation and the preparation of the report the author has received the hearty cooperation and the helpful suggestions of F. W. DeWolf, Director of the Illinois Geological Survey, under whose general direction the work has been carried on.

Topography and Drainage

The area is an undulating plain which slopes gently south and west except in the area southeast of Springfield, which is drained by tributaries of Sangamon River.

Except the territory drained by South Fork of Sangamon River, the entire area drains southwest. Macoupin and Shoal creeks, Kaskaskia River, and the tributaries of Big Muddy constitute the principal streams traversing the district. The streams are sluggish throughout the greater part of their courses and do not cut deep valleys, although near the Illinois and the Mississippi, which receive all the drainage of the area, some of the valleys show a relief of 200 feet. Along the divide which extends in a general north-south direction in the eastern part of the district, the surface reaches an elevation of 700 feet above sea level, or 400 feet above the river at St. Louis. For some distance on both sides of the rivers the topography is rugged, and farm land is restricted to the flood plains and the divides between the streams.

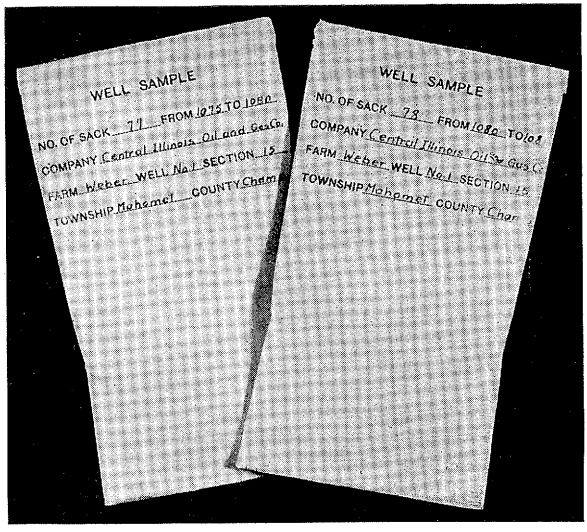
A network of railroad lines covers the southwestern part of Illinois and places it in close touch with Chicago, St. Louis, and the markets of the northwest.

Use of Drill Records

For the most part the drill records studied in the preparation of the report are copies of the logs kept by the drillers, but frequently it has been possible to arrange for the saving of samples from each screw for identification by the Survey. Figure 2 is a photograph of the heavy paper sacks that are furnished by the Survey for the purpose. The driller catches some of the material brought up by the bailer after each screw and places it in a sack which is properly marked as to depth. After 40 or 50 sacks have been filled, they are forwarded to the Geological Survey, Urbana, by express collect.

Some of the formations are identifiable only by fossils known to men of experience in this line of work. The identification is rendered more difficult in drillings, because only fragments of the rocks and fossils are available. It is highly desirable, therefore, that operators arrange for such a study as outlined in connection with any contemplated drilling operations. Diamond-drill cores are the best means of studying the formations in a drift-covered area like Illinois, and through the kindness of the operators, it has been possible for the Survey to secure such cores from a number of places for examination in the office.

The fact that every inch of the beds is represented in a core renders identifications and measurements far more satisfactory than in churn-drill cuttings.



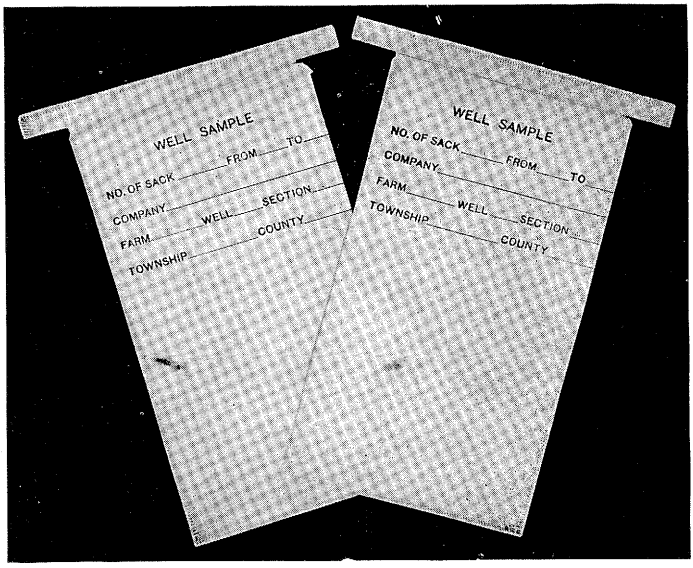


FIG. 2.—Well-sample sacks furnished by the State Geological Survey.

STRATIGRAPHY

Pennsylvanian Series ("Coal Measures")

General description

The main economic interest attached to the Pennsylvanian rocks in Illinois centers in the occurrence in these formations of all the workable coal beds known in the State. The series is underlain by the Mississippian strata, which are barren of coal, and is overlain only by the unconsolidated clays, sands, and gravels which constitute the glacial drift. Without this veneer, the coal-bearing beds would form the surface material for the entire area considered in this report with the exception of the western parts of Monroe and Randolph counties.

The Pennsylvanian consists of a series of shales and sandstones, and minor amounts of limestone, clay, and coal. The series thickens gradually toward the southeast part of the State, where it attains a thickness of 2000 feet.

The shales which compose the largest part of the section, range from the soft variety through all gradations of sandy shale to sandstone on the one hand, and by way of the limy shales to limestones on the other. The soft material is known as "soapstone" by the miner; whereas the harder forms which have well-developed bedding planes are called "slate", especially if the color is dark or black because of its high content of carbonaceous matter. Some of the shales contain a considerable amount of lime distributed irregularly, and this mixture is known to the driller as "lime shell", or simply "shell". In the black shales overlying the coals in many places the limy material was deposited or later collected in irregular masses between layers of the shale. In some mines these masses protrude through the roof and are commonly known as "niggerheads".

The sandstones are prominent in the lower part of the "Coal Measures". Near St. Louis these beds are less than 20 feet in thickness; whereas to the east near Carlyle, they reach 160 feet. Southward they thicken to 300 feet at Denny in Perry County; and still farther south in Johnson County the sandstones, including lenses of shale, attain an aggregate thickness of more than 700 feet. A few beds of sandstone occur in the upper part of the "Coal Measures", but they are more or less lenticular and can not be traced over large areas. The section is variable, and a thick bed of sandstone recorded in one drill hole may be absent in another perhaps a mile distant.

The limestones, although constituting but a small part of the "Coal Measures", are nevertheless stratigraphically important, since many beds are more persistent than the coal beds themselves. Three horizons especially have been identified and traced over a large part

of the area considered in this report. One of these is in most places found within 30 feet above coal No. 6 and, in many areas, is separated from the coal by only a few feet of shale. In other places it rests on the coal itself and is called by the miner "rock top". In the interval from 200 to 325 feet above coal No. 6, two persistent limestones are present in many places. The lower is known as the Carlinville; and the upper, or Shoal Creek, about 100 feet higher is probably the bed that Udden has correlated with the Carlinville. Recent work by Wallace Lee of the U. S. Geological Survey seems to prove that the Carlinville and Shoal Creek limestones, heretofore regarded as the same bed, are really distinct horizons. In many logs it is impossible to determine which of these limestone is present, if only one of them is recorded by the driller.

A fourth limestone lies about 200 to 250 feet above the Carlinville and is found in the eastern part of District VII. It probably is identical with the limestone at New Haven, Gallatin County, doubtfully correlated with the Carthage limestone of old Kentucky reports.

Fire clays are normally associated with the coal beds, and in a carefully kept log may serve to identify the horizon of a coal, although the bed itself has been removed by erosion. These underclays in connection with the limestones mentioned above afford good key horizons for the correlation of the coals.

STRATIGRAPHIC DIVISIONS

For convenience of study, the coal-bearing beds of Illinois have been separated by geologists into the following divisions, which are numbered in the order of age and deposition:

3. McLeansboro
2. Carbondale
1. Pottsville

POTTSVILLE FORMATION

The Pottsville formation is a series of sandstones, shales, and thin coals, comprising the base of the "Coal Measures". The name is applied to the beds below coal No. 2 and above the Mississippian sediments. The Pottsville beds were deposited upon an old land surface which had been exposed to erosion, and are consequently variable in thickness and in composition.

Sandstone is the predominating constituent of this formation and ranges from fine-grained material to typical conglomerate. Its composition is so irregular, however, that no definite character can be assigned to it. The study of a large number of drill records shows that individual beds of sandstone or shale can be traced but a short

distance, that one grades into the other laterally, that in one place the entire formation is represented by sandstone, whereas in another the sandy beds are almost absent. The variable character is well illustrated in the Carlinville oil field where 30 or 40 feet of porous sandstone may be found in one well, but within a few hundred feet may be absent or may be so closely cemented that it cannot act as a reservoir for oil.

A few thin coals lie within the Pottsville, but they have been explored only locally and are more or less lenticular; consequently their correlation presents great difficulties. T. E. Savage[3] and E. W. Shaw mention a persistent, 10-inch coal 40 to 70 feet below the Murphysboro (No. 2) coal. At Taylorville, Christian County, a coal 2 feet 5 inches thick lies 32 feet below No. 2 and is probably to be correlated with a similar bed reported in holes near Springfield. At the latter place several logs show a thin coal 130 to 150 feet below No. 2. This probably corresponds to coal No. 1 as described by A. H. Worthen, a former state geologist of Illinois.

The thickness of the Pottsville is variable. It averages 160 feet at Carlyle and attains a thickness of 250 feet in parts of Sangamon, Montgomery, Bond, and Fayette counties. It ranges from 20 feet in some places along the western part of St. Clair County to as much as 500 feet in Jackson County, and 700 feet in southern Gallatin County, where it forms conspicuous bluffs along the Ohio and farther west in the valley of Eagle Creek.

In most drill records the base of the Pottsville can be placed at the first limestone after the drill has passed through all the main coal beds and has been working for some distance in a series composed mostly of sandstones and conglomerates. The top of the formation is difficult to identify where coal No. 2 is absent; throughout most of the district it averages 250 feet below coal No. 6.

The general characteristics of the Pottsville may be seen in the general section (Pl. II).

David White[4] has studied the fossil plants found in the formation, and regards the Illinois beds as corresponding in age to the beds of the same name in Pennsylvania.

CARBONDALE FORMATION

GENERAL DESCRIPTION

The Carbondale formation, which is typically exposed near Carbondale, Jackson County, includes all the beds from the base of coal No. 2 to the top of coal No. 6. Shales are predominant in this for-

[3] Savage, T. E., and Shaw, E. W., U. S. Geol. Survey Geol. Atlas, Murphysboro-Herrin folio (No. 185), 1912.

[4] White, David, Paleontological work in Illinois in 1908; Ill. Geol. Survey, Bull. 14, p. 293, 1910.

mation, and only irregular sandstones and minor amounts of limestone are present. The Carbondale includes all of the productive coal beds in Illinois, except the Rock Island (No. 1), Danville (No. 7), and three beds below No. 2 mined locally in Gallatin County. This series of beds, ranging from 250 to about 300 feet in the district, has a more uniform thickness than the Pottsville. Its total thickness is practically the same at Springfield, at Carbondale, and in the southeastern part of the State, although the individual beds composing the formation are more or less lenticular.

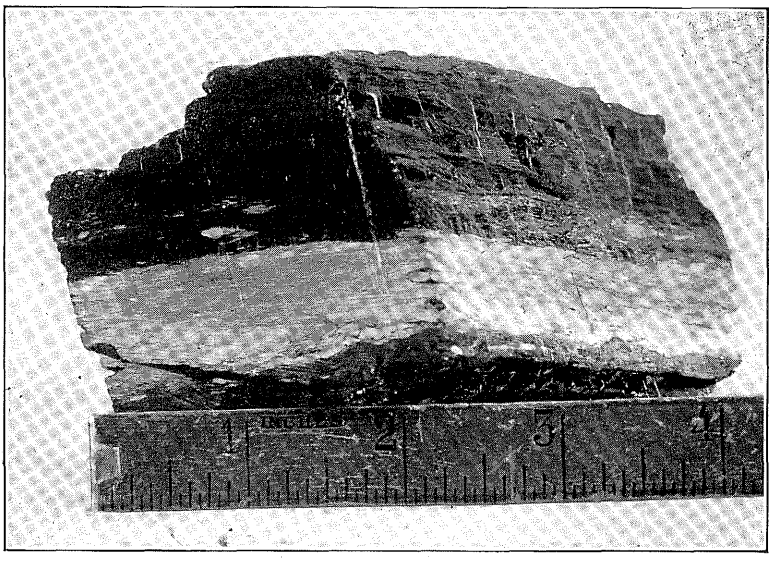


FIG. 3.—Photograph of "blue band," a characteristic feature in the lower part of coal No. 6.

COAL BEDS

In the earlier geological reports, the Illinois coal beds were designated by number beginning with the first one deposited. It was soon learned, however, that many of the coals are lenticular and could be traced but a short distance. Furthermore, numbers applied independently in different counties did not always agree. Since that time, only the beds that are present over a large area, or possess characteristic features for correlation, are regarded in nomenclature. The United States Geological Survey, in order to avoid the confusion of more or less meaningless numbers, has adopted place names and now designates the coals by such terms as *Belleville* or *Herrin* for the thick "blue-band" bed (No. 6), and *Springfield* or *Harrisburg* for the bed (No. 5) mined in the vicinities of those cities. Other names include *Rock*

Island (No. 1); *La Salle, Colchester,* or *Murphysboro* coal (No. 2); *Danville* coal (No. 7); *Grape Creek* coal (No. 6?).

The objection may be raised that in the commercial world, place names naturally come to carry a quality significance. Again, although the "third vein" at La Salle was probably deposited contemporaneously with coal No. 2 mined at Murphysboro, considerable confusion results in the designation of the bed by a single place name at so widely separated localities. It has been regarded advantageous by the State Geological Survey, to continue the use of numbers as synonymous with place names. The principal coal mined in the area of District VII will be called the Belleville coal or coal No. 6. It is locally called the "blue-band" coal on account of the band (fig. 3) which is commonly present not more than two feet above the bottom of the coal. The same bed is mined in Franklin and Williamson counties, but it was formerly designated as coal No. 7 in that region.

Although the Carbondale formation covers a large part of the State, no single coal bed is coextensive with the formation. Northward from an east-west line a few miles south of Springfield coal No. 6 becomes too thin for commercial recovery. At this place coal No. 5 develops to a thickness of 6 feet and is mined throughout the Springfield-Peoria district.

Coal No. 2 is probably the next in importance, although it is not present over the entire district. It commonly lies about 250 feet below No. 6 and is separated into two benches by a layer of shale or sandstone which varies in thickness from a fraction of an inch to 20 or 30 feet. The beds between coals No. 2 and No. 6 are irregular. A few of these are shown in the record given below.

Carbondale formation in the vicinity of Taylorville, Christian County

Byrd and Taylor Hole No. 8. Location—SE.¼ NE.¼ sec. 35, T. 13N., R. 1W.

(See Fig. 10)

Description of Strata		Thickness		Depth	
		Ft.	*In.*	*Ft.*	*In.*
Coal	No. 6	3	2	3	2
"Blue band"	No. 6	....	1	3	3
Coal	No. 6	2	3	5	6
Fire clay		1	10	7	4
Shale, gray		7	4	14	8
Shale, black		2	....	16	8
Shale, limy		5	6	22	2
Bone coal		....	3	22	5
Shale, dark		....	3	22	8
Shale, dark blue		1	4	24	0
Limestone		1	8	25	8
Limestone, sandy		4	6	30	2

Description of Strata		Thickness		Depth	
		Ft.	*In.*	*Ft.*	*In.*
Shale, gray		3	----	33	2
Limestone, shaly		8	6	41	8
Shale, sandy		15	----	56	8
Shale, blue, tough		27	----	83	8
Limestone		3	----	86	8
Shale, black		6	8	93	4
Coal		----	6	93	10
Clay		1	----	94	10
Limestone		----	6	95	4
Shale, soft		2	2	97	6
Shale, gray		1	----	98	6
Sandstone		1	2	99	8
Shale, sandy		18	----	117	8
Shale, blue		4	----	121	8
Coal		2	----	123	8
Shale, sandy		9	----	132	8
Shale, tough, blue		25	----	157	8
Shale, black		1	6	159	2
Coal		2	2	161	4
Clay		----	4	161	8
Shale, gray		6	8	168	4
Shale, dark		2	2	170	6
Coal		----	1	170	7
Shale, blue		----	7	171	2
Coal		2	10	174	0
Shale, gray		5	7	179	7
Sandstone		4	----	183	7
Shale, sandy		7	----	190	7
Shale, blue with brown bands		16	3	206	10
Coal		1	1	207	11
Clay		8	----	215	11
Shale, gray		24	----	239	11
Shale, sandy		4	----	243	11
Sandstone		3	5	247	4
Shale		1	3	248	7
Coal		----	3	248	10
Shale		1	6	250	4
Bone coal		----	3	250	7
Coal	No. 2?	1	2	251	9
Shale, blue	No. 2?	1	10	253	7
Coal	No. 2?	----	5	254	0
Shale, dark		3	7	257	7
Shale, sandy		14	8	272	3
Coal	No. 2?	3	11	276	2
Shale, sandy	No. 2?	3	5	279	7
Sandstone	No. 2?	8	4	287	11
Coal	No. 2?	3	8	291	7

DISTRIBUTION OF THE CARBONDALE

The outcrop line of coal No. 6 as shown on the general map (Pl. I) marks the upper boundary of the Carbondale. Part of the formation is exposed at the surface in valleys along the south and west sides of the district, but in most places it is covered by glacial drift. East and north of the coal outcrop the Carbondale dips deeper and deeper beneath the surface and is overlain not only by the drift, but by the McLeansboro formation as well.

MCLEANSBORO FORMATION

GENERAL DESCRIPTION

The McLeansboro formation includes all of the "Coal Measures" rocks above coal No. 6. It takes its name from McLeansboro, Hamilton County, Illinois, where borings have penetrated it to a depth of one thousand feet. It underlies the entire region north and east of the outcrop line of coal No. 6 and in most places is covered by a variable thickness of glacial drift.

The formation consists of shale and a minor amount of sandstone, limestone, and coal. Although two of the coals above No. 6 are persistent, neither has been found sufficiently thick to be of commercial value; and they are significant only as correlation horizons. In its barrenness of productive coals, and in general age, the McLeansboro is similar to the Conemaugh formation of Pennsylvania.

DISTINCTIVE HORIZONS

General section.—The well-marked stratigraphic units of the McLeansboro in this region may be enumerated as follows:

7. New Haven limestone, 200 to 250 feet above Carlinville limestone.
6. Shoal Creek limestone, about 100 feet above the Carlinville.
5. Carlinville limestone, so called because of typical outcrops near town of this name in Macoupin County. Its position is from 200 feet to a little more than 300 feet above coal No. 6.
4. Coal No. 8 ranging in thickness from 8 inches where present to 2 feet and lying 150 to 180 feet above coal No. 6.
3. A bed of pink, red, or variegated shale, variable in thickness, seldom exceeding 15 feet, averaging from 35 to 50 feet above coal No. 6.
2. Coal No. 7, generally only a few inches thick, 25 to 40 feet above coal No. 6.
1. A hard limestone, averaging 7 feet in thickness overlying or slightly above coal No. 6.

The beds mentioned above are reasonably persistent and serve as correlation horizons on which considerable dependence may be placed. The intervening beds vary so greatly in character that they are of little use in the determination of geologic age.

1. *Limestone above coal No. 6.*—In most of the area under consideration coal No. 6 has a limestone "cap rock." In some places this is underlain by black slate a few feet in thickness, and in others by a gray shale known as "white top." In restricted areas the limestone is absent, as in Tps. 9 and 10 N., R. 6 W., Macoupin County, where 30 to 40 feet of shale overlie the coal and render roof conditions unsatisfactory. The roof limestone varies considerably in thickness. It is generally not less than 2 feet thick, but a large number of records show the average to be between 5 and 10 feet.

It is not to be understood that "rock top" is invariably good roof. Here and there it lacks uniform bedding and is so weakened by vertical fractures that great difficulty is experienced in supporting it. In one mine having a 7-foot limestone roof bad falls continue to be troublesome despite all reasonable efforts for their prevention, and it is not uncommon to see "roof falls" as much as 50 feet long and 30 feet high. Ordinarily, however, the limestone possesses much greater strength than any of the other roof materials except a thick hard sandstone. The latter type is exceptional in District VII.

2. *Coal No. 7.*—A bed of coal, commonly not more than 3 or 4 inches thick and locally absent, is in most places present 25 to 40 feet above coal No. 6. In the Springfield Quadrangle,[5] this coal averages only 2½ inches in thickness, and in places is represented only by a thin bed of black shale.

In Montgomery, Christian, Bond, and St. Clair counties, most of the careful records show this coal bed. Its thickness is ordinarily less than 1 foot, but here and there it is reported as thick as 2½ feet. Its roof is variable, commonly a dark shale overlain by a thin limestone, but no uniform succession prevails.

3. *Pink, red, or variegated shales.*—Considering that the thousands of records used in this study of Illinois coals were made by many different drillers, it is remarkable that the presence of a thin bed of colored shales has been so regularly reported within 50 feet above coal No. 6. Such shales exist over most of the area in which coal No. 6 is present. As a rule they lie a short distance above the horizon of coal No. 7. They are important only because they are easily distinguished from the bluish-gray shales so common in the "Coal Measures" and are restricted to the horizon mentioned. They are not so thick nor so brilliantly colored as are the Chester red beds of the Mississippian, which outcrop in southwestern Illinois and underlie the south half of the State.

4. *Coal No. 8.*—In a majority of the records from this district, a thin coal is reported from 150 to 180 feet above No. 6. This bed

[5] Shaw, E. W., and Savage, T. E., U. S. Geol. Survey Geol. Atlas, Tallula-Springfield folio (No. 188), p. 5, 1913.

is not of commercial importance, but its wide distribution makes it of some use in correlation. It is associated with shales above and below in most places, although a few records indicate thin limestones underlying the coal. Its position is approximately halfway between coal No. 6 and the Carlinville limestone.

5. *Carlinville limestone.*—The Carlinville limestone is one of the most widely distributed beds in the "Coal Measures" of Illinois. It has been traced from north of Carlinville, Macoupin County, southeast to the Indiana line in Gallatin County.

In the type localities this limestone is, according to Udden, "generally bluish gray, compact, close textured, and very hard, breaking into irregular, splintery pieces. On weathering it assumes a rusty color. It averages about seven feet in thickness. There are two features that are characteristic of this limestone, one a blotchy appearance and another its tendency to weather into seams two and one-half or three inches in thickness."[6]

In most places the limestone is covered by glacial drift and is seen only along its western border. Even here it outcrops only where streams have removed the surface covering. It dips toward the east and can be traced by a study of drill records.

In most of the district, the interval between this limestone and coal No. 6 averages from 275 to 325 feet. However, in the vicinity of Carlinville, Macoupin County, it decreases to 200 or 220 feet. At the Virden shaft, on the north side of the county, the interval measures 249 feet.

Some confusion has resulted in attempts to correlate the Carlinville limestone with certain beds in Kentucky and Indiana. Earlier reports have given the impression that the Carthage limestone of Kentucky, named by Owen, is equivalent to the Carlinville of Illinois, and the two terms have been used indiscriminately. Owen's section, quoted in Bulletin 17 of the Kentucky Geological Survey, places the Carthage limestone 440 feet above coal No. 11 (No. 6 of Illinois). Recent studies in Illinois, and private correspondence with Mr. L. C. Glenn, formerly of the Kentucky Geological Survey, indicated that the Carlinville corresponds to a limestone 250 to 300 feet above coal No. 11 (Illinois No. 6) well exposed at Madisonville, Kentucky.

6. *Shoal Creek limestone.*—In many of the drill records, three or four thin limestones are noted in the zone from 250 to 350 feet above coal No. 6 and in such a case, it is impossible to identify the Carlinville. Indeed, recent co-operative work by Wallace Lee, of the U. S. Geological Survey, in the typical area of the exposed Carlinville limestone, leaves small room for doubt that the Shoal Creek limestone correlated

[6] Udden, J. A., Shoal Creek Limestone: Ill. State Geol. Survey Bull. No. 8, p. 119, 1908.

by Udden with the Carlinville, is really a bed which lies about 100 feet above the latter. The following paragraphs, describing the Carlinville, Shoal Creek, and other limestones in the Gillespie and Mt. Olive quadrangles, were kindly furnished by Mr. Lee. A more detailed report will appear under his name in folios to be published by the State and Federal surveys in cooperation.

Two continuous limestone beds, and a thinner somewhat discontinuous but persistent limestone between, outcrop in the Gillespie and Mt. Olive quadrangles. The lowest, the Carlinville limestone, lies from 200 to 225 feet above the Herrin coal, but this interval fluctuates irregularly, and at the eastern margin of the field where the drill logs show the limestone to become thin and irregular the interval falls to 175 feet. The bed, where best developed, is six to seven feet thick and is tough, gray, dense, and homogeneous. At the head of Cahokia Creek, where all three limestones are exposed, the uppermost bed is about 75 feet above the Carlinville. Its base is from 275 to 325 feet above the Herrin coal, but toward the south the interval increases, being 350 feet at the Future mine at Breese. The limestone is from 12 to 25 feet thick but lacks the homogeneity of the Carlinville. It consists of a series of more or less argillaceous limestone layers, but in certain localities either the top, bottom or middle of the bed is replaced by limy shale. The weathered face presents a ragged appearance due to fine conchoidal jointing and is in sharp contrast to the cleanly weathered and regularly jointed faces of Carlinville outcrops.

Examination of a series of drill holes extending south along Shoal Creek indicates that the upper limestone is probably to be correlated with the Shoal Creek limestone of the Breese area, though the distance above the Herrin coal is slightly greater. The Carlinville limestone, however, becomes thin and less regular to the south, but cannot be indentified positively in the drill logs of the Breese area. The intermediate limestone, although exposed at a number of localities west of Gillespie, is not a continuous bed; it is usually only two to three feet thick. Its reported presence in drill logs in close association with a continuous black shale or thin coal bed is frequent enough to suggest that it occupies a definite position in the section, and that it may prove to be better developed in adjoining areas. Its position varies from 30 to 50 feet below the base of the Shoal Creek.

On the outcrop, the beds may be distinguished by a difference in physical appearance, but in drill records it is impossible to differentiate them positively. In most places a thin coal lies only a short distance below the Shoal Creek bed. Where careful record has been kept, it is often possible to make correct correlations by noting the position of this coal.

7. *New Haven limestone.*—About 200 to 250 feet above the Carlinville is a limestone which is encountered in nearly every drill hole that reaches coal No. 6 at a depth of 700 feet or more. The persistent nature of the bed is shown graphically in records from Moultrie, Shelby, Montgomery, and Fayette counties (fig. 4). Owing

to the eastward dip, the outcrop line of the limestone parallels that of the Carlinville at a distance of fifteen or twenty miles east of the latter.

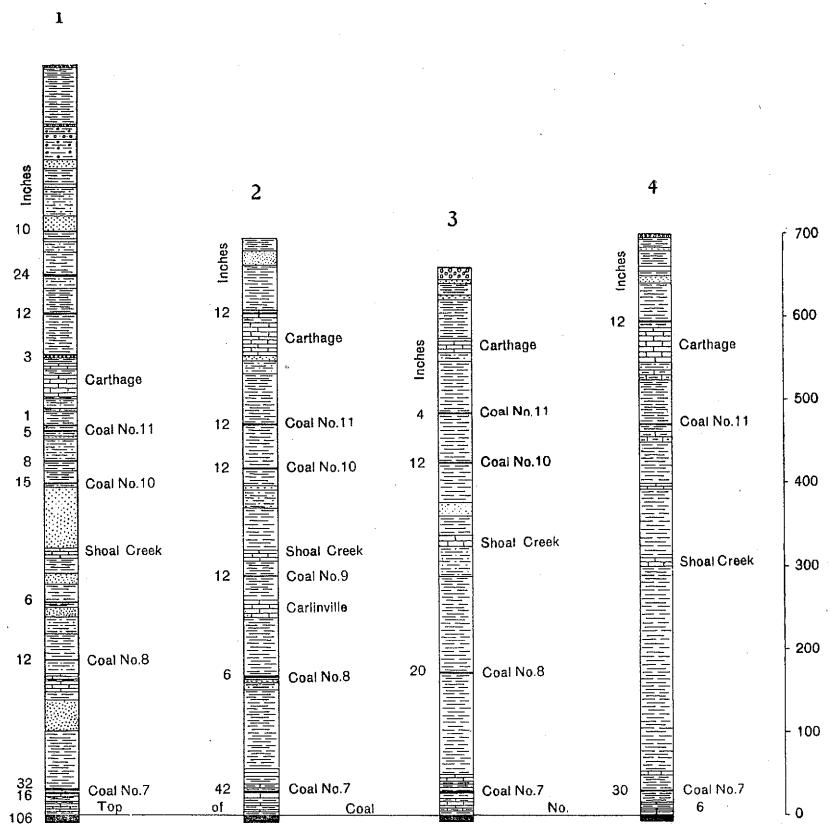


FIG. 4.—Sections showing persistent nature of limestones in the McLeansboro formation.
1 Lovington, Moultrie County.
2. Sec. 8, T. 10 N., R. 1 E., Shelby County.
3. NW.¼ NW.¼ sec. 8, T. 9 N., R. 1 W., Montgomery County.
4. Sec. 29, T. 9 N., R. 1 E., Fayette County.

In drill records this upper limestone appears to be a solid bed which in most of the logs is given a thickness of at least 25 feet. It may be traced on outcrop and in drill holes to New Haven, Gallatin County, where it shows in typical exposure, NE. ¼ sec. 20, T. 7 S., R. 10 E.

Older Kentucky reports[7] describe a limestone as lying 450 feet above a coal corresponding to No. 6, and to the limestone the name

[7] Geol. Survey Kentucky, vol. 3, 1857, p. 20.

Carthage is given. In recent years, however, L. C. Glenn in private correspondence suggests that in the early reports, too great a thickness was assigned to the interval between the coal and the limestone at Uniontown, Ky., and that in reality the interval is only about 200 to 275 feet.

At present it seems best not to attempt correlation of the Illinois limestone with that of Kentucky; but in order to designate the bed 450 to 500 feet above coal No. 6 in Illinois, it will be known in this report as the New Haven limestone.

The following log is typical of the eastern part of District 7:

Drill record typical of eastern part of District VII

Operator—H. H. Brown. Hole—W. H. McNichols.
Location— NW.¼ NW.¼ sec. 8, T. 9 N., R. 1 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Surface	14	....	14	....
Sand	3	....	17	....
"Softpan"	13	....	30	....
Sand	8	....	38	....
"Softpan"	48	....	86	....
Wash	4	....	90	....
Limestone (New Haven)	13	....	103	....
Sand and shale	10	....	113	....
Shale, gray	63	7	176	7
Coal	....	4	176	11
Clay	4	....	180	11
Clay shale	12	....	192	11
Shale, gray	40	1	233	....
"Slate," black	2	....	235	....
Coal	1	....	236	....
Clay	2	....	238	....
Clay, shale	20	....	258	....
Shale, brown	22	....	280	....
Sand rock	15	....	295	....
Shale, light	26	8	321	8
Limestone (Carlinville)	13	....	334	8
Sand shale	35	4	370	....
Sand shale, gray	7	....	377	....
Shale, dark	18	....	395	....
Slate, black	1	....	396	....
Shale, gray	5	....	401	....
Clay shale	24	....	425	....
Shale, brown	51	3	476	3
Shale, light	9	3	485	6
Coal (No. 8)	1	8	487	2
Clay, light	2	7	489	9
Shale, blue	9	3	499	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, dark	85	6	584	6
Shale, blue	5	6	590	....
Shale, light	2	....	592	....
Shale, blue	17	....	609	....
Shale, various colors	4	....	613	....
Shale, dark	3	....	616	....
Limestone	5	....	621	....
Shale, blue	1	....	622	....
Shale, dark	3	....	625	....
"Slate," black	4	....	629	....
Shale, dark	2	....	631	....
Coal (No. 7)	1	10	632	10
Shale, dark	3	2	636	....
Lime shale	6	6	642	6
Limestone	5	6	648	....
Lime shale	4	5	652	5
Limestone	....	6	652	11
"Slate," black	5	7	658	6
Coal (No. 6)	7	6	665	....
Fire clay				

STRUCTURE

Explanation of Geologic Structure

DEFINITION

The term *geologic structure* is used to denote the attitude or "lay" of rock beds. It is common belief that in Illinois all of the formations are horizontal. This belief is due to the gentleness of dips over most of the State, and also to the surficial drift cover, which obscures the underlying formations. It is only upon studying large areas in detail that the real structure may be determined.

METHOD OF DETERMINING STRUCTURE

The large map (Pl. I) was prepared for the purpose of showing the position of the beds underlying the district. In favorable regions a map would be prepared from data collected at the outcrops of the different formations, but as has been mentioned, over most of the region all the beds are covered by unconsolidated sands, clays, and gravels, known as glacial drift. In such an area, it is necessary to collect and study all available data from drill records. On Plate I drill holes, the logs of which are filed in the office of the State Geological Survey, are indicated by appropriate symbols. These records have been obtained from many sources. For the most part they represent test holes for coal and petroleum. Almost without exception the opera-

tors have furnished their logs for purposes of study. The Survey is requested to hold a large number of records confidential, and for this reason the thickness of the coals is not shown on the map. All of the information has been available for study in the office, and it is believed that the correlations from one hole to another and from one county to another are correct.

STRUCTURE CONTOURS

Prominent, irregularly curved, red lines bearing conspicuous numbers ranging from 450 to –400 extend in a general north-south direction across the map. These contour lines show the position of coal No. 6 above sea level. Since in this area the beds above and below No. 6 are essentially parallel to it, the general geologic structure is indicated by the lines representing the top of this coal bed. Coal No. 6 was selected for contouring because of the ease of its identification over most of the area.

Figure 5 has been prepared to illustrate in a concrete manner, the significance of contour lines. It is merely a reduced copy of Plate I with shading to accentuate the folds indicated by the contours. A clear understanding of figure 5 will enable the reader to use the large map intelligently.

The reader is requested to imagine all the rocks removed to the top of coal No. 6. In other words, suppose this coal bed to be the surface of the ground. Again, imagine the area to be flooded by an arm of the ocean, the water standing at present sea level. The shore line would be represented by the contour marked 0 on the map. If the level of the water were raised by 50-foot intervals, the successive shore lines would be indicated by the corresponding contours. The upward folds, or anticlines, would extend out into the sea as long arms of land; whereas the downward folds or synclines would be covered by bays and lagoons. In places, as at Centralia, Marion County, and others which are evident, isolated portions of the surface would rise above the level of the sea as islands.

On Plate I the contour interval is 50 feet. The elevation of the coal above sea level was determined in each case by subtracting from the surface elevation the figure representing the depth to the top of coal No. 6 as given in the drill record or shaft record.

ACCURACY OF STRUCTURE CONTOURS

The accuracy of structure contours depends directly on (1) the number and distribution of the drill holes whose records are used, and (2) the correctness of the surface elevations.

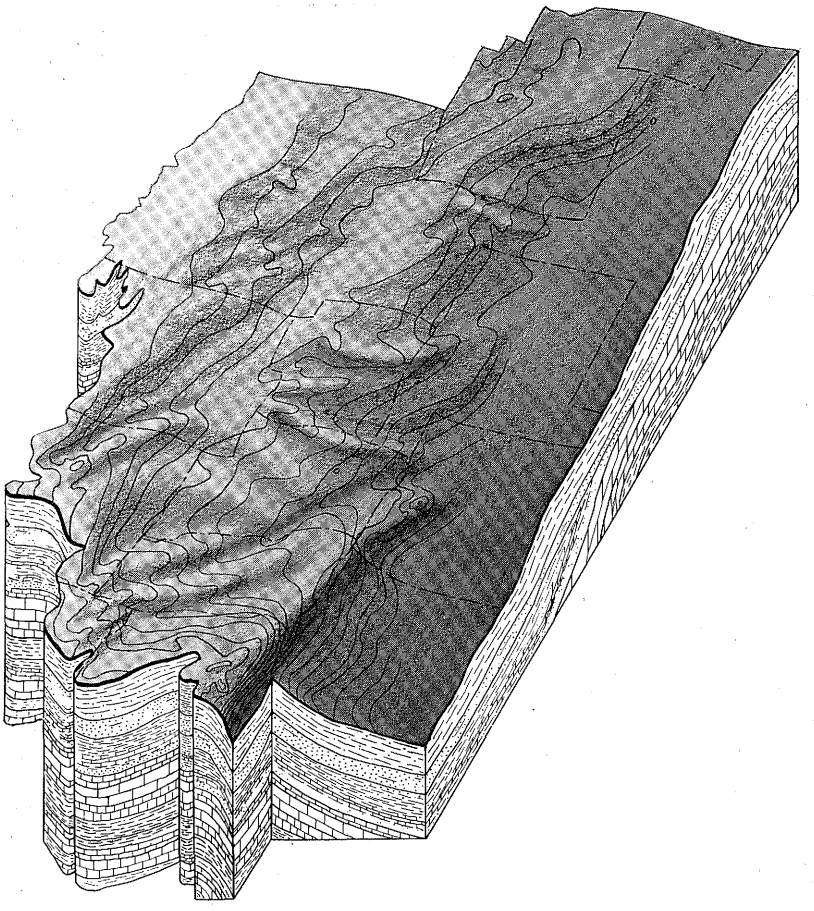


FIG. 5.—Surface of coal No. 6 as it would appear if all the overlying material were removed. The diagram shows the significance of the structural contour line. (Shading by Geo. H. Renshawe.)

(1) In a region where the drill holes are numerous and evenly distributed, the position of the contours is closely determined. It is also possible to use a small contour interval and thereby introduce great detail. The data available for District VII would not permit the use of an interval less than 50 feet. In areas furnishing meager information, doubt is expressed by the use of broken contours.

(2) Surface elevations have been determined by various methods. In the East St. Louis, Belleville, Breese, Carlyle, Okawville, and New Athens quadrangles, most of the elevations were determined with a hand level by E. W. Shaw of the U. S. Geological Survey and J. A. Udden of the Illinois Geological Survey.

In the collection of drill records an attempt is always made to secure the correct elevation of the top of the holes. This is usually done by reference to an established bench mark or to a railroad elevation which has been adjusted to sea level as a datum plane. A few operators have been able to furnish accurate levels to all of the holes drilled under their direction. For scattered wells, reference has been made to the Rolfe topographic map of Illinois made in 1892-3. These elevations have been adjusted where necessary. The writer is indebted to Messrs. Fohs and Gardner of Tulsa, Okla., for instrumental levels in parts of Montgomery and Bond counties. During the summer of 1913 stadia levels were run by J. E. McDonald of the Cooperative Mining Investigation to holes in Christian, Montgomery, Bond, Fayette, Clinton, and Jefferson counties, for which elevations were uncertain.

PRACTICAL USE OF MAP

The general base map has been compiled from the best available data. Each smallest square represents a section of approximately 640 acres. On this base is shown the areal distribution of coal No. 6, its approximate depth at any given point, and its position with reference to sea level. The locations of drill holes or outcrops from which the data have been secured are also indicated. For points located between contour lines, intermediate elevations may be assigned to the top of coal No. 6, for example: the elevation of the coal at a point halfway between the 250-foot and the 300-foot contours, would be 275 feet. Figures obtained in this way are approximately correct and are sufficient for all practical purposes.

Certain black figures on the map show surface elevations. In order to determine the depth to coal No. 6, it is necessary only to add to, or subtract from, the surface elevation the figure representing the elevation of the coal (obtained from the nearest contour line). For example: Beckemeyer, Clinton County, is about halfway between contours 0 and 50; the top of coal No. 6 is therefore 25 feet above sea level. The surface elevation at Beckemeyer is 452, and by subtracting as indicated above, the depth to coal is found to be approximately 427 feet. Where the coal is below sea level, the altitude must be added to the surface elevation to secure the depth to coal.

The absence of contours on the east part of the map does not signify the absence of coal, but merely the lack of sufficient information regarding it. Few holes have been drilled in the deeper part of the basin, because in this territory drilling and mining will be more costly and will be undertaken only when the shallower coal is no longer available.

Structure of District VII

RELATION TO GENERAL STRUCTURE OF ILLINOIS

The "Coal Measures" of Illinois occupy a spoon-shaped basin, its deepest part being in Hamilton, Wayne, and White counties. The long axis of the "spoon" passes near Olney in Richland County and Lovington in Moultrie County. The position of the basin may be seen in Plate III. The district under consideration forms the southwestern part of the "spoon," and the general dip is east or north toward the main axis of the basin. The dip is not regular but varies in direction and degree as shown in Plate III. Coal No. 6, the main bed in the region, outcrops in the Mississippi River bluffs at an elevation of about 470 feet above sea level. An average eastward dip of about 14 feet per mile carries it 300 feet below sea level 5 miles east of Centralia, Marion County.

DUQUOIN ANTICLINE

The main modification of the structure is the Duquoin anticline named from the town in Perry County near which the fold is well developed. West of town the beds lie almost flat with slight dip north and northwest; whereas for some distance east of town, the eastward dip is 300 feet per mile. Properly speaking, this one-sided fold is a monocline. The top or axis extends N. 10° E. through Duquoin to Sandoval, Marion County, north of which place it appears to lose its identity.

RELATION BETWEEN COAL NO. 6 AND OIL SANDS

A detailed explanation of oil and gas accumulation would be out of place in this report, but it is regarded advisable to mention the use of the map in determining the geological structure of beds other than the coals. In a general way the successive beds were deposited parallel to one another. This parallelism is not absolute, but for practical purposes in Illinois it may be assumed. After deposition, pressure was exerted on the strata in certain horizontal directions and all of the beds were affected similarly. If the position of one bed or formation is shown, those above and below may be regarded as having parallel structure. Since the structure of coal No. 6 as shown on the map represents almost equally well the structure of any oil or gas horizons, the map may be of use in selecting locations for drilling where the conditions are favorable.

RELATION OF OIL AND GAS ACCUMULATION TO GEOLOGIC STRUCTURE

In Illinois the accumulation of oil and gas appears to be controlled by the anticlines or arches in the beds. For the most part, the rocks

are saturated with salt water which may be original water from the sea in which the beds were deposited, or it may have been fresh water that has dissolved mineral salts while percolating through the underground rocks. It is supposed that originally the particles of oil resulted from decomposition of vegetable or animal matter, or both, which lay buried at the bottom of a sea under a variable amount of sands and clays that now cover the oil-bearing beds.

In Illinois after the deposition of the oil-bearing rocks and those overlying them, and at a time probably corresponding to the uplift of the Ozark Mountains, adjustment to pressure resulted in more or less bending of the formations into anticlines and synclines. Gravity immediately had its effect in causing the general downward movement of the water and oil where no greater opposing forces operated. In some cases, the water and occluded oil must have moved up the dip in response to a higher head of water with which it was connected.

Not only did the water move up or down according to conditions, but the oil tended to rise to the top of the water owing to its lower specific gravity. Wherever an upward fold existed in the beds, the oil and gas rose to the top of such a fold and was trapped or held there under pressure of the water below. Naturally the gas, being lighter than oil, rises above the latter and is found in the highest part of the fold. In prospecting for oil, therefore, it is best not to drill in the topmost part of a dome or anticline, but slightly down dip from the axis of the fold, since the top may contain only gas as stated above.

Some of the folds in Illinois are arches whose axes extend many miles; others ars shaped like an inverted saucer, in which case they are called domes. Between the two forms all gradations exist such as elongated domes, anticlines whose axis are not horizontal, and terraces of different shapes.

In a general way, the structural features described below indicate the areas in which conditions are favorable for oil and gas accumulation. A report[8] by Raymond S. Blatchley has covered the relationship of the areas mentioned below to petroleum, in greater detail than is desirable in the present report.

The areas regarded favorable for oil and gas in the southern part of the district have been described by R. S. Blatchley[9] and E. W. Shaw.[10]

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[8] Blatchley, Raymond S., Oil resources of Bond, Macoupin, and Montgomery counties: Ill. Geol. Survey, Bull. 28, 1914.

[9] Blatchley, Raymond S., Oil resources of Illinois: Ill. Geol. Survey, Bull. 16, 1910.

[10] Shaw, E. W., Carlyle oil field and surrounding territory: Ill. Geol. Survey, Extract Bull. 20, 1912.

STRUCTURAL FEATURES

LIST OF FEATURES

Of these structural features those designated by an asterisk are now described for the first time:

1. Ohlman anticline*
2. Hillsboro flat*
3. Sorento dome*
4. Ayers anticline*
5. Carlinville dome
6. Staunton dome*
7. Pocahontas anticline*
8. Carlyle anticline
9. Irishtown anticline
10. Bartelso dome
11. Hoffman dome
12. Nashville anticline
13. Venedy dome
14. Darmstadt anticline
15. White Oak anticline
16. O'Fallon anticline

1. OHLMAN ANTICLINE

The Ohlman anticline is a low arch whose axis extends in a northwest-southeast direction through the northeastern part of T. 10 N., R. 2 W. So far as known, the beds are highest near the NE. corner sec. 3, T. 10 N., R. 2 W., where the coal lies 76 feet above sea level. From this point, the beds dip in all directions, except northwest, in which direction there is probably a gradual rise, although details are not known. At the crest of the anticline the coal is about 35 feet higher than in wells located in sec. 10, T. 10 N., R. 2 W., and sec. 26, T. 11 N., R. 2 W. Southeast from the crest, the coal drops to a few feet above sea level in sec. 12, T. 10 N., R. 2 W., and lies almost flat over several square miles south and southwest of Ohlman as shown by the position of the 0 contour. The anticline is therefore a small structural feature.

2. HILLSBORO FLAT

For several miles in all directions from Hillsboro the coal lies practically flat. On the map the area is shown between the 150 and 200 contours. The Hillsboro flat covers parts of Tps. 7, 8, and 9 N., Rs. 3, 4, and 5 W.

It extends southward from the Christian County line to Walshville and from 4 miles east of Hillsboro to 2 miles east of Litchfield. The total area covered is about 200 square miles. Near the eastern

side of the flat in the vicinity of Hillsboro a narrow, elongate dome rises 15 to 20 feet above the surrounding structure, but not high enough to be shown by contours on the map. The axis of the narrow fold extends through Hillsboro and to a point about 3 miles southwest of that city. The fold itself averages 1 mile in width. Over the entire Hillsboro flat, coal No. 6 lies almost flat at about 175 feet above sea level.

3. SORENTO DOME

Rising above the Hillsboro flat is the Sorento dome. The area is shown on the map within the oval-shaped contour marked 200 which includes parts of southwestern Montgomery and northwestern Bond counties. The highest part of the dome is in the southwestern portion of T. 7 N., R. 5 W., where the coal reaches an altitude of 250 feet above sea level. This structural feature belongs to the type known as an elongated dome. Its long axis extends northeast-southwest, the length of the dome being almost three times its width. In the area surrounding the dome the elevation of coal No. 6 varies from 150 to 200 feet above sea level.

4. AYERS ANTICLINE

Eastward from the south end of the Sorento dome the beds are arched into an anticline named from the town of Ayers. The axis of the fold extends east across the north tier of townships in Bond County. The anticline is flanked on the south by a decided depression near Smithboro and Greenville, where the coal lies from 60 to 100 feet above sea level. Near Ayers the coal reaches an elevation of 165 feet. From this district it dips northward, but data are rather meager and the exact shape of the north side of the anticline is unknown. Toward the east it seems to lose its identity in Fayette County.

5. CARLINVILLE DOME

The Carlinville dome was described in Extracts from Bulletin 20. The large contour interval of the present map fails to show the real nature of the fold, which is a dome somewhat elongated in an east-west direction. The coal in the highest part of the fold lies 379 feet above sea level. The axis extends east and west in secs. 7 and 8, T. 9 N., R. 7 W., Macoupin County. Gas under a pressure of about 135 pounds was found in the top of the dome. Three or four wells have furnished the gas supply for Carlinville for a number of years, but the pressure had fallen to 35 pounds in 1911, and there is little prospect of any marked increase. At present 10 wells are producing about 40 barrels of oil per day from the sides of the dome. The

sands lie in the base of the "Coal Measures" next overlying the St. Louis limestone or "Big Lime" of the driller, the Chester beds being absent.

6. STAUNTON DOME

Recent levels for which the Survey is indebted to the Chicago and Northwestern R. R. indicate a doming of the beds three miles northwest of Staunton, Macoupin County. The highest part of the dome so far as known is in secs. 7 and 18, T. 7 N., R. 6 W., and secs. 13, 14, and 15, T. 7 N., R. 7 W.

7. POCAHONTAS ANTICLINE

The shape of the Pocahontas anticline is doubtful. Drill holes located in secs. 28 and 32, T. 5 N., R. 4 W., indicate that the coal is higher than it is south and north of this locality. In sec. 32, T. 5 N., R. 4 W. its elevation is 179 feet above sea level; whereas in sec. 15, three miles north, the top of the coal lies at 76, a condition which shows a dip of more than 30 feet per mile. To the south a slight depression exists in the coal in the vicinity of Pocahontas, as shown by a drill hole in sec. 8, T. 4 N., R. 4 W., in which the coal is 125 feet above the sea. This syncline appears to be a minor feature, however, since in the southeast part of the township the coal has the same elevation as in the Pocahontas anticline, in what appears to be the crest of the Irishtown arch, noted by E. W. Shaw. The Pocahontas anticline appears to lose its identity east of Shoal Creek.

The descriptions of the structural features listed below are quoted from E. W. Shaw.[11]

8. CARLYLE ANTICLINE

The Carlyle anticline or elongated dome is a very low arch, the central line of which extends from the Baltimore and Ohio Railroad about midway between Carlyle and Beckemeyer a little east of north for three or four miles. The highest part is near the middle, where the rocks are only a little higher than they are to the north. They are, however, higher than the same beds to the east, south, or west and this dip of the rocks in three directions away from the center of the dome seems to be the most important fact in the development of an oil pool.

At Carlyle and Beckemeyer and for some distance south and southwest the Herrin coal (No. 6) is 15 or 20 feet above the sea; to the east and southeast it dips to 50 or 60 feet below the sea level in the vicinity of Huey. Northwest from Carlyle the coal rises toward the center of the field where it is 50 to 60 feet above the sea. West from Carlyle the coal dips gently again almost to sea level, but northwest it does not sink so low and it is not known to lie within 25 feet of sea level anywhere

[11] Shaw, E. W., The Carlyle oil field and surrounding territory: Extracts from Bull. 20, Ill. Geol. Survey, p. 20-25, 1912.

northwest of the pool. To the north and northeast, however, it descends to an altitude of 15 to 20 feet above sea in a distance of 2 or 3 miles.

It may seem remarkable but it is a fact that the shape of the Carlyle oil pool does not correspond to the shape of the anticline as it is developed in the coal-bearing rock. The place where the coal is highest is well to the northwest of the center of the pool; but when the variable thickness of the strata is remembered, the surprising fact is that the outline of the dome in the coal-bearing rocks is so near the outline of the pool. Layers of sandstone in particular vary greatly in thickness, and it is surprising that when many such layers are piled one on top of another the uppermost is so greatly parallel to the lowest.

9. IRISHTOWN ANTICLINE OR STRUCTURAL TERRACE

In the central part of Irishtown township, 5 to 7 miles north and 2 to 3 miles east of Carlyle, the coal lies 50 to 70 feet above sea. The details of the structure in this vicinity are not known for there are few outcrops and artificial excavations which show recognizable strata, but the coal is certainly higher than it is midway between this district and the Carlyle anticline, and it is considerably higher than the same bed a few miles to the east. Apparently there is a low anticline here which plunges and fades out to the east. Two wells drilled here in the fall of 1911 obtained no showing of oil. The highest known point in the coal in Irishtown township is at the Ohio Oil Company's well on the Michel farm near the middle of section 17, but as the sands and the coal are not absolutely parallel, the highest point in the sands may be a mile or two away from the middle of section 17.

Recent drilling in sec. 26, T. 4 N., R. 4 W., shows coal No. 6 to be 163 feet above sea level and it is believed that this area is the westward continuation of the Irishtown anticline as described by Mr. Shaw, although conclusive data are lacking.

10. BARTELSO DOME

There is fairly good evidence of a low dome one to two and a half miles north and a little east of Bartelso. Five wells have been sunk in the vicinity of Bartelso and both the coal and the sands seem to be rising toward a point a short distance to the northeast of the town and indications of oil have been found. Four to seven miles north and northeast of Bartelso the strata are low and probably barren of oil; but between this place and the town there is possibility of a pool.

11. HOFFMAN DOME OR ANTICLINE

At Hoffman, about 11 miles east of Bartelso, the strata are high, the coal according to a diamond drill record being 37 feet above sea, whereas a very few miles to the northwest, north, and east, it is below sea level. It may dip to the south also, and if so, the structural feature is a dome; otherwise it is an anticline, which plunges to the northeast. In either case it is well worth a test for oil.

The structure between Hoffman and Bartelso is not known. Most likely there is a shallow syncline, but there is a possibility of a small arch.

12. NASHVILLE ANTICLINE

At Nashville the strata have a noticeable rise to the west, but a mile north of Addieville they seem to be 50 feet lower. From what is known of the "lay" of the rocks there appears to be a broad but fairly steep-sided anticline plunging slightly to the northeast but perhaps extending without a break northeast to the Hoffman dome. There is some indication that the anticline is double crested, one crest being southeast and one northwest of Nashville. To the southwest the anticline becomes less pronounced. At Oakdale it appears to be broad and low, though farther to the southwest toward the Sparta field, it may become higher and steeper. It may be however that this uplift is not an anticline but a dome. If so, its position is 2 to 4 miles west of Nashville.

13. VENEDY DOME

In a deep well near the old town of Venedy about 6 miles southwest of Okawville, the coal is reported to lie at a depth of 212 feet, or 250 feet above sea. This is higher than it lies in surrounding territory, but the details of this dome or anticline are not yet known.

14. DARMSTADT ANTICLINE

The Darmstadt anticline has a northeast-southwest trend, and is somewhat irregular. It probably extends northeast to the Venedy uplift, beyond which it appears to be double crested, one crest running nearly north to New Memphis, and the other northeast to Okawville. The anticline seems to be highest near Darmstadt, where the coal bed reaches an elevation of 298 feet above sea, whereas it is 50 to 75 feet lower to the west, north, and east. It may, or may not, be lower to the northeast, and there is a possibility that it is lower to the south and is a dome. It is at least a well-marked uplift, flanked on the northwest and southeast by synclines, and is one of the most worthy places in the region for a test well.

15. WHITE OAK ANTICLINE

A low anticline plunging gently to the northeast extends in a southwest-northeast direction through White Oak, where it is unsymmetrical, the southeast limb being rather steep and about 40 feet high, and the northwest being less than 10 feet high. It thus has somewhat the form of a terrace facing southeast, but the distinct slope to the northwest makes it an anticline. To the southwest its limits are not known. It may extend as far as Baldwin. To the northeast it appears to broaden and to extend nearly to Lively Grove. The highest known point is 6 to 7 miles east and 2 miles north of Marissa, where the coal is reported in a test hole to be 295 feet above sea. This is higher than the coal lies either to the northwest, northeast, or southeast. But, unfortunately, there is very little information on the position of the strata in this district, and hence the structure is somewhat doubtful. There may be a dome just northwest of the middle of Lively Grove township, and the anticline may be high or low, steep sided or gently sloping. But in any case, the anticline should be tested before adjacent territory. One test has already been sunk near White Oak and no oil was found. Another test on this anticline might be very well located 5 or 6 miles northeast of White Oak.

16. O'FALLON ANTICLINE

The O'Fallon anticline was pointed out by R. S. Blatchley.[12] This anticline extends from Belleville north to O'Fallon, and thence somewhat northeast, where it spreads out and loses its identity in this direction.

CHEMICAL VALUE OF COAL NO. 6 IN DISTRICT NO. VII

A detailed report on the chemical value of Illinois coals is being prepared by Prof. S. W. Parr for early publication as Bulletin 3 of this series, and in view of this fact, it is not regarded advisable to include a chemical discussion in this paper. It is the intention, therefore, to present only tabulated average analyses for the different coals of the State so that they may be easily compared.

In Plate IV the same analyses are presented in graphic form.

[12] Blatchley, R. S., Oil resources of Illinois: Bull. 16, Ill. Geol. Survey, pp. 42-177, 1910.

TABLE 1.—*Average analyses of Illinois coals by districts*

(Figures are for coal as received)

Analyses by J. M. Lindgren under general supervision of Prof. S. W. Parr

District	Coal bed	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	B. T. U.	Number of samples averaged
La Salle	2	16.18	38.83	37.89	7.08	2.89	10981	33 from 11 mines
Murphysboro	2	9.28	33.98	51.02	5.72	1.29	12488	15 from 5 mines
Rock Island and Mercer counties	1	13.46	38.16	39.75	8.63	3.59	11036	14 from 4 mines
Springfield-Peoria	5	15.10	36.79	37.59	10.53	3.52	10514	54 from 17 mines
Saline County	5	6.75	35.49	48.72	9.04	2.92	12276	27 from 7 mines
Franklin and Williamson counties	6	9.21	34.00	48.08	8.71	1.53	11825	58 from 16 mines
S. W. Illinois west of Duquoin anticline	*6*	*12.56*	*38.05*	*39.06*	*10.33*	*4.01*	*10847*	*76 from 25 mines*
Danville: Grape Creek Coal	6	14.45	35.88	40.33	9.34	2.55	10919	31 from 4 mines
Danville: Danville coal	7	12.99	38.29	38.75	9.98	2.93	11143	18 from 2 mines

PART II—COUNTY REPORTS

INTRODUCTION

It is believed that the reader can secure most satisfactory information from a report which is divided into units that can be considered separately. It is the plan, therefore, to present the facts regarding the coal resources of Illinois, not only in a general way for a district, but also for each county as a unit. Upon the completion of the separate district reports they will be combined into a volume with additional papers on features of general importance.

BOND COUNTY

Production and Mines

Production[1] in tons, year ending June 30, 1913.... 231,999
Average annual production, 1908 to 1913..... 143,358
Total production 1881 to 1913.....3,160,126

The production of coal from Bond County for the year ended June 30, 1912, was slightly more than 3/10 of 1 per cent of the total production of Illinois. Only two mines operate in the county—the Pocahontas Mining Company at Pocahontas and the Northern Coal & Supply Company at Sorento. Coal No. 6 is worked in both.

Table 2.—*List of shipping mines, Bond County, 1913*

Map No.	Company	No. or name	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production, 1913
			¼	¼	Sec.	T. N.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Pocahontas Mining Co.	1	NE	SW	3	4	4	500	380	120	7	6	139,783
2	Northern Coal & Supply Co.		SE	SW	31	7	4	609	385	212	6	....	92,216

Coal-bearing Rocks

The coal-bearing rocks of Bond County vary in thickness from 700 to 900 feet. The upper half consists largely of shales and is barren of workable coals. Bed No. 6 is reached between 370 and approximately 460 feet below the surface, and the main coals lie within

[1] Statistics from Coal Repts., Ill. State Mining Board.

a zone 200 feet in thickness, the top of which is represented by coal No. 6.

The lower part of the "Coal Measures" is more sandy, and in the vicinity of Greenville considerable salt water is reported from a sandstone of variable thickness which lies at a depth of about 700 feet. This sandstone reaches a thickness of almost 200 feet in a few of the deep holes, although the average is between 50 and 100, and in some places shales are interbedded with the sandstone.

The sandstones at the base of the coal-bearing beds are productive of oil and gas at Carlinville, and were formerly productive at Litchfield. Indication of oil and gas are reported from a well in sec. 16, T. 5 N., R. 4 W. owned by the Producers Oil Company, the log of which is given below.

Record of Producers Oil Company

Location—SW.¼ NE.¼ sec. 16, T. 5 N., R. 4 W.

Description of Strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Recent—		
Clay	89	89
Mud, blue	41	130
Carboniferous system—		
Pennsylvanian series—		
McLeansboro formation—		
Limestone	10	140
"Slate" and blue mud	110	250
Sand (hole full of water)	100	350
"Slate"	50	400
Mud, blue	35	435
Carbondale formation—		
Coal (No. 6)	8	443
"Slate"	47	490
Limestone	20	510
Shale, blue	105	615
Pottsville formation—		
Sand, gas	19	634
Shale, black, and mud	34	668
Sand (show of yellow oil, 2 quarts to 1 bbl. water)	14	682
Shale, black	8	690
Sand	20	710
Shale	20	730
Sand	10	740
Shale, black	10	750
Mud, white	28	778
Sand, pebbles (½ bailer of oil at 778 feet, 4 bailers of water second screw at 785 feet)	20	798
"Slate"	12	810
Shale	10	820

Description of Strata	Thickness *Feet*	Depth *Feet*
Mississippian series		
Chester group—		
Red rock, cave	20	840
Limestone shells	3	843
Red Rock	10	853
Sand	5	858
Shale	57	915
"Slate," white	25	940
Limestone	3	943
Red rock	17	960
Sand (hole full of water)	15	975
Red rock, cave	7	982
Sand	6	988
Red rock	10	998
Limestone	5	1003
Sand (water)	10	1013
Red rock, cave	2	1015
Sand	10	1025
Osage and Meramec ("big lime") groups—		
Limestone (hole full of water at 1,040 feet)	480	1505
"Slate"	15	1520
Limestone	8	1528
Kinderhook and Upper Devonian (?) shales—		
"Slate" and shells	490	2018
Silurian system—		
Alexandrian limestone—		
Limestone	30	2048
Ordovician system—		
Maquoketa shales—		
"Slate" and shells	70	2118
Kimmswick-Plattin (Trenton)—		
Sand and limestone, hard (no oil)	32	2150
Limestone	5	2155

Well completed February 24, 1911

The lowest beds of the "Coal Measures" overlie a series of interbedded thin limestones, sandstones, and shales, some of the latter being distinctly red. The series, known as the Chester, attains a thickness of about 300 feet in Bond County, but toward the western side of the county it thins and in places is not more than 100 feet thick.

The following logs are published to furnish detail regarding the character of the coal-bearing rocks:

Log of Bond County Gas Company Well

Location—Sec. 22, T. 5 N., R. 3 W.

Description of Strata	Thickness *Feet*	Depth *Feet*
Soil and clay, yellow, soft (water)	90	90
Sand and gravel, brown, soft (water, fresh)	70	160
Lime, white, soft	2	162

Description of Strata	Thickness *Feet*	Depth *Feet*
Sand, green, soft	8	170
Lime, blue, hard	3	173
"Slate," black, soft (fresh water)	10	183
"Slate," blue, soft	55	238
Lime, white, soft (fresh water)	10	248
"Slate," white, soft	50	298
Sand, white, soft, loose (salt water)	30	328
"Slate," white, soft	25	353
"Slate," blue, soft	30	383
Red rock, red soft	5	388
"Slate," white, soft	10	398
Mud, yellow, soft	10	408
Lime, white, hard	20	428
Coal (No. 6), black, soft	4	432
"Slate," black, soft	16	448
Lime shells, white, hard	15	463
Sand, white, soft	30	493
Coal, black, soft	4	497
"Slate," white, soft	48	545
Shale, black, soft	15	560
Shale, brown, soft	15	575
Lime, blue, very hard	8	583
Coal, black, soft	3	586
Sand, white, soft (some water)	24	610
Shale, brown, sandy and soft	30	640
Sand, white, soft (3 bad holes)	75	715
Mud, black, soft (hole full water)	20	735
Lime, blue, hard	4	739
"Slate," white, soft	10	749
Lime, white, hard	10	759
"Slate" and lime shells, white, hard	15	774
Mud, black and soft	10	784
"Slate," white, pink, soft	24	808
Red rock, soft	12	820
Coal blossom, black, soft (water)	5	825
"Slate," white, soft	5	830
"Slate," black, hard	10	840
Red rock, red, soft	12	852
"Slate," black, hard	8	860
Lime, white, hard	4	864
"Slate," white, soft	8	872
Lime, white, hard	22	894
"Slate," black, cave	20	914
Lime, white, hard	2	916
Red rock, red, soft	4	920
"Slate," black, hard	12	932
Sand (1st Lindley), white soft (gas at 935 to 940)	34	966
"Slate," black, soft (water at 950)	4	970
Sandy lime, white, hard in bottom, top soft	30	1000
"Slate," white, soft	3	1003

Description of Strata	Thickness	Depth
	Feet	*Feet*
Sand lime, brown, very hard	10	1013
"Slate," white, soft	12	1025
Red rock, red, soft (gas at 1049)	15	1040
"Slate," black, hard (gas at 1052)	8	1048
Sand (2nd Lindley), white, hard	6	1054

Record of Lumaghi Coal Co.

Location—SW.¼ SW.¼ sec. 26, T. 7 N., R. 4 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Sand, gravel, clay, lime	82	....	82	....
Fire clay	8	6	90	6
Lime, sandy	9	6	100	....
Lime, hard, brown	8	6	108	6
Shale, blue	1	6	110	....
Shale, black	1	....	111	....
Fire clay	11	....	122	....
Shale, light	15	....	137	....
Coal	2	6	139	6
Fire clay	3	6	143	....
Shale, light	27	....	170	....
Lime, sandy	4	....	174	....
Shale, sandy	8	....	182	....
Rock	4	....	186	....
Shale, light	25	....	211	....
"Slate," black	1	6	212	6
Lime	2	....	214	6
Shale, blue	12	....	226	6
"Slate," blue	9	6	236	....
Coal	2	....	238	....
Fire clay	2	....	240	....
Sandy shale	82	....	322	....
Shale, light	20	....	342	....
Lime, sandy	4	....	346	....
Shale, light	6	....	352	....
Shale, red	2	....	354	....
Shale, yellow	4	....	358	....
Shale, blue	13	....	371	....
Lime	10	....	381	....
Clay, blue	4	....	385	....
"Slate," black	2	....	387	....
Coal (No. 6)	7	9	394	9
Fire clay	....	5	395	2
Lime				

Record of H. R. Ameling, hole No. 1

Location—Center SW.¼ SE.¼ sec. 12, T. 6 N., R. 5 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Clay, yellow	7	----	7	----
Sand and clay	9	----	16	----
Shale, brown	2	----	18	----
Shale, dark	7	----	25	----
Sandstone	2	----	27	----
Shale, dark	59	----	86	----
Limestone, gray	7	6	93	6
Shale, black	31	----	124	6
Coal	1	----	125	6
Shale, dark	52	6	178	----
Limestone	4	----	182	----
Shale, dark	39	----	221	----
Sandstone, soft	13	----	234	----
Shale, dark	81	----	315	----
Shale, red	1	----	316	----
Shale, blue	8	----	324	----
Shale, mixed	11	----	335	----
Limestone	4	----	339	----
Shale, dark	15	----	354	----
Coal	1	----	355	----
Shale, dark	13	----	368	----
Limestone, decomposed	3	----	371	----
Limestone	3	----	374	----
Coal, no cores	4	6	378	6
Coal	1	----	379	6
Shale, dark	5	----	384	6
Shale, gray	7	2	391	8
Shale, dark	18	----	409	8
Shale, blue	3	4	413	----
Sandstone, gray	1	3	414	3
Shale, dark	2	----	416	3
Shale, gray	4	9	421	----
Shale, light blue	25	----	446	----
Shale, dark	36	----	482	----

Geologic Structure

The geologic structure of the beds as indicated by the position of coal No. 6 has been described in a general way on page 33. Bond County contains parts of four major structural features—Sorento dome, Ayers anticline, Stubblefield anticline, and the Irishtown anticline.

Coal No. 6 lies highest above sea level in the extreme northwestern corner of the county, where its altitude is between 200 and 250 feet above sea level. The general dip to the south and east carries the coal 20 feet below sea level in the southeast corner of the county.

Despite the dip, the depth of the coal beneath the surface does not increase regularly because the surface slopes gradually toward the south and east and counteracts the effect of the dip.

The Ayers anticline already described lies in the northern part of the county, its axis extending almost east and west through T. 6 N., Rs. 2, 3, and 4 W.

Four miles north of Greenville coal No. 6 is 165 feet above sea level or about 80 feet higher than at Greenville. The coal continues low to the west and at Old Ripley averages 75 feet above sea. From this place the beds rise toward the south, and coal No. 6 reaches an altitude of 179 feet in the NE. cor. sec. 32, T. 5 N., R. 4 W., on the Stubblefield anticline. There appears to be a depression of minor importance between the fold named immediately above and the Irishtown anticline. The axis of the latter extends northwest-southeast through the southeast part of T. 4 N., R. 4 W. and the southwest part of T. 4 N., R. 3 W.

The structure in the southeast quarter of the county is characterized by a gradual dip in this direction. The elevations of the coal in the southwest corner of the county were computed by J. A. Udden from surface outcrops of limestone and it is possible that the degree of dip to the south is somewhat exaggerated.

Coal No. 6

Coal No. 6 is commercially the most important bed in the county. So far as known, it is present under the entire county except a few sections in the eastern part of T. 6 N., R. 5 W. It appears to be absent in sec. 23, and is represented by a 1-foot bed in sec. 24. This "spotty" territory is part of a larger area shown on Plate I in Christian, Montgomery, and Bond counties, in which coal No. 6 is extremely irregular and "pockety." Many holes show it to be absent, whereas others indicate a normal thickness. It is believed that this development is the result of topographic conditions at the time the coal was being deposited. An irregular arm of land, rising here and there slightly above the level of the swamp in which the vegetal matter was growing and having the general outline indicated on the map, would cause such an irregular absence of coal.

Another and equally reasonable theory attributes the absence of the coal to erosion after deposition. In some holes which do not show coal No. 6, the normal limestone cap rock also is absent. It is probable that after the deposition of the coal of some of the overlying beds, this part of the State existed as a land surface upon which the drainage cut channels to varying depths and locally removed the coal completely. The following log illustrates such a condition.

Record of H. R. Ameling hole No. 3
Location—Sec. 23, T. 6 N., R. 5 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Clay	14	....	14	....
Sand	2	....	16	....
Clay	8	....	24	....
Shale, blue	8	....	32	....
Shale, sandy	....	10	32	10
Shale, sandy, with streaks of sandy limestone	9	2	42	....
Shale, gray, sandy	12	....	54	....
Shale, dark	17	....	71	....
Limestone, gray	6	....	77	....
Shale, blue	19	....	96	....
Limestone, gray	6	10	102	10
Shale, dark	1	2	104	....
Shale, black	1	6	105	6
Shale, gray	16	6	122	....
Shale, gray, with black streaks	14	....	136	....
Shale, sandy, gray	15	....	151	....
Shale, gray, with streaks of brown limestone	15	....	166	....
Shale, dark gray	2	2	168	2
Coal	....	10	169	....
Shale, dark gray, sandy	27	....	196	....
Sand, gray, streaked with shale	3	10	199	10
Limestone, gray	....	8	200	6
Shale, dark	30	6	231	....
Shale, dark, sandy	10	....	241	....
Sand, white	25	....	266	....
Shale, dark, sandy	7	....	273	....
Sand, white	32	....	305	....
Shale, dark	7	....	312	....
Shale, variegated	15	....	327	....
Shale, dark	2	....	329	....
Limestone, gray	5	6	334	6
Shale, dark	1	6	336	....
Shale, blue	4	....	340	....
Streaks of blue shale, gray limestone and white sand	20	....	360	....
Sand, white (place of coal No. 6)	10	....	370	....
Shale, dark, sandy	5	....	375	....
Sand, white	5	....	380	....
Shale, dark	3	....	383	....
Sand, white	32	....	415	....
Sand, white, with streaks of coal	10	....	425	....
Shale, dark, sandy	3	....	428	....
Sand, white	18	....	446	....
Shale, dark sandy	5	....	451	....

With the exception of the southeast quarter of the county and the small area mentioned above, coal No. 6 averages 7 feet in thickness, which is the average for the coal in the district. Nine holes in the eastern half of T. 5 N., R. 3 W. in the vicinity of Greenville, show an average thickness of 3 feet 2 inches for coal No. 6. At Smithboro in the next township east it is 3 feet, which is the thickness reported in two holes located in secs. 20 and 35, T. 4 N., R. 2 W.

Coals below No. 6

Most of the prospect holes are stopped in the fire clay underlying coal No. 6, hence this coal is fairly well known; whereas those below are but little explored. Tests in sec. 12, T. 6 N., R. 5 W. were continued 120 feet below coal No. 6 without passing through any other commercial coal. One log in this section shows streaks of coal 50 feet below coal No. 6, and another reports a 6-inch bed 105 feet below the same horizon. About 20 holes have been drilled for oil in Bond County, and in only 6 of these are noted coals other than No. 6. It must be remembered that the oil prospects are made by the churn drill, and measurements are not so accurate as with the diamond drill. Since the main interest is oil, the resulting coal data are probably inaccurate, but they comprise the best available information for the beds below coal No. 6.

Although all of the holes in which lower coals are reported are in the vicinity of Greenville, correlation of the different beds is a difficult matter owing to the variability of the intervals between the coals. In sec. 9, T. 5 N., R. 3 W. a 6½-foot bed is reported to lie 200 feet below coal No. 6 at a depth of 625 feet. A 6-foot bed is noted occupying the same position at the same depth in sec. 26 of this township. A similar bed is reported in sec. 22, 180 feet below coal No. 6. It is possible that this bed represents No. 2 and that the interval between coals No. 2 and No. 6 is somewhat less than to the south. In secs. 22 and 26, T. 5 N., R 3 W. a bed of coal from 3 to 4 feet thick is found from 60 to 70 feet below No. 6. This bed is probably to be correlated with coal No. 5 which is mined in the Springfield region. In sec. 23 a 5-foot bed is reported 100 feet below coal No. 6. It is not represented in any of the other logs and its correlation is doubtful.

CLINTON COUNTY

Production and Mines

Production in tons, year ending June 30, 1913....	1,036,303
Average annual production 1909 to 1913.....	1,020,373
Total production 1881 to 1913.....	16,032,809

Clinton County ranked 17 in 1913 having a production of 1.7 per cent of the entire Illinois output. Five shipping mines were in operation, all working coal No. 6.

TABLE 3.—*List of shipping mines, Clinton County, 1913*

Map No.	Company	Mine name or No.	Location					Surf. elev.	Depth of coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T. N.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Southern Coal, Coke & Mining Co.	9	NW	SW	17	1	5	454	319	135	8	....	367,619
2	Breese-Trenton Mining Co.	East	....	NE	22	2	4	450	400	50	7	6	236,885
3	North Breese Coal Mining Co.	North	SW	NE	23	2	4	442	392	50	7	6	235,096
4	Consolidated Coal Co.	West	....	NE	21	2	4	457	394	63	7	6	120,186
5	Breese-Trenton Mining Co.	Buxton	....	NE	21	2	3	458	432	26	8	....	76,517

COAL-BEARING ROCKS

The coal-bearing rocks of Clinton County, which are covered by an average thickness of 100 feet of drift, vary in thickness from 500 to 1000 feet, the larger sections lying in the eastern part where the eastward dip has been effective in carrying all of the beds deeper beneath the surface. The Shoal Creek limestone, which is described on page 25, is well exposed along Shoal Creek and its tributaries. It appears to be fairly persistent over the county east of its boundary, and lies from 250 to slightly more than 300 feet above coal No. 6.

No coals of commercial importance exist above No. 6. A thin bed from 150 to 180 feet above coal No. 6, is noted in places. This bed, which is seldom reported to be more than 15 inches thick, is probably to be correlated with coal No. 8. Scattered records show a thin bed representing coal No. 7 between 25 and 35 feet above coal No. 6. It contains bands of "slate" and sulphur amounting here and there to definite partings and separating the bed into at least two benches. In sec. 12, T. 1 N., R. 1 W. the entire bed measures 2 feet 8 inches, but its average is between 1 and 2 feet.

Most of the logs show a limestone of varying thickness immediately overlying, or slightly above, coal No. 6. In places the limestone rests on the coal, but in most places a shale of varying thickness intervenes. The Buxton mine at Beckemeyer has black shale roof which attains a thickness of 4 feet, although here and there it is absent, and

the limestone immediately overlies the coal. Typical sections in this county show a dark or black shale of variable thickness containing "niggerheads" and forming the roof of the coal. Above this is a limestone which may be separated into two or more benches, the combined thickness averaging less than 10 feet.

The following logs are from holes in different parts of Clinton County:

Well Record of Germantown Flour Mills

Farm and well—Schurman No. 1. Location—Sec. 8, T. 1 N., R. 3 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil	1	....	1	....
Clay, sandy	19	....	20	....
Sand and gravel, partly cement	30	6	50	6
Clay, blue, gravelly	30	6	81	....
Shale, blue	1	....	82	....
Limestone	6	7	88	7
Shale, blue	2	9	91	4
Shale, black	2	8	94	....
Shale, dark; one hard layer	10	2	104	2
Coal, bony	....	4	104	6
Coal	....	6	105	....
Shale, soft, light	7	....	112	....
Shale, sandy	19	....	131	....
Shale, blue	28	....	159	....
Shale, light	13	....	172	....
Shale, sandy	4	....	221	....
Sandstone	25	....	246	....
Sandstone, coal parting	5	....	251	....
Shale, blue	19	6	270	6
Sandstone	4	10	275	4
Conglomerate	6	....	281	4
Shale, blue	....	5	281	9
Shale, dark	7	....	288	9
Shale, dark blue, hard bands	5	3	294	....
Shale, gray	16	....	310	....
Shale, dark blue, hard bands	31	9	341	9
Shale, black	....	3	342	....
Clay shale	1	3	343	3
Limestone	3	....	346	3
Shale, blue	10	....	356	3
Shale, black	....	9	357	....
Clay shale	6	6	363	6
Limestone	5	6	369	....
Shale, blue	5	6	374	6
Coal, bony	....	7	375	1
Clay	4	11	380	....
Coal, bony	1	....	381	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Clay shale	4	....	385	....
Limestone	7	6	392	6
Shale, dark	3	6	396	....
Limestone	1	....	397	....
Shale, dark	1	4	398	4
Limestone	3	....	401	4
Shale, dark	3	....	404	4
Limestone	1	....	405	4
Shale, dark	3	....	408	4
Limestone	1	6	409	10
Coal	6	....	415	10
"Blue band" (No 6)	....	1	415	11
Coal	1	8	417	7
Clay	1	5	419	....

Well record of Gibson and Veitch

Farm and well—C. N. Dunn, No. 1

Location—NE.¼ NE.¼ sec. 1, T. 1 N., R. 1 W.

Description of Strata	Thickness	Depth
	Feet	*Feet*
Clay and subsoil	34	34
Gravel	6	40
"Slate"	21	61
Lime, very hard	15	76
"Slate"	49	125
Lime, very hard	15	140
"Slate" and lime shells	405	545
Lime, very hard, cap rock	31	576
Coal (No. 6)	6	582
"Slate"	63	645
Coal (No. 5)	4	649
"Slate" and thin lime shells	166	815
Upper salt water sand	40	855
"Slate" and thin lime shells	180	1035
Sand (water)	115	1150
"Slate" and lime shells	100	1250
Sand (water)	110	1360
Red Rock (cave)	10	1370
Limestone	11	1374
Oil sand	11	1385
Sand (water from 1422–1520)	135	1520
Limestone	162	1682

Record of Trenton Coal Co., well No. 1

Location—sec. 29, T. 2 N., R. 5 W.

Description of Strata	Thickness		Depth	
Pennsylvanian series—	*Ft.*	*In.*	*Ft.*	*In.*
Clay, yellow	22	....	22	....
Clay, blue	20	....	42	....
Shale, blue	1	....	43	....
Shale, sandy	2	....	45	....
Shale, sandy	55	....	100	....
Sandstone, shale partings	22	....	122	....
Sandstone	47	....	169	....
Shale, blue	2	....	171	....
Sandstone	26	....	197	....
Sand and lime mixed	2	6	199	6
Sandstone	14	8	214	2
Conglomerate	....	8	214	10
Shale, blue	15	2	230	....
Lime shale	7	....	237	....
Shale, blue	20	....	257	....
Shale, blue, and lime pebbles	3	....	260	....
Limestone	2	....	262	....
Limestone, very hard	5	4	267	4
Shale, soft, blue	6	10	274	2
Limestone	4	5	278	7
Shale, sandy	8	5	287	....
Shale, blue	34	....	321	....
Coal, shaly	2	....	323	....
Coal (No. 6)	5	3	328	3
Fire clay	2	9	331	....
Limestone	5	8	336	8
Clay, shale, lime, pebbles	2	10	339	6
Lime shale	2	....	341	6
Sandstone	4	6	346	....
Shale, blue	20	....	366	....
Limestone	1	6	367	6
Shale, black	2	6	370	....
Coal (No. 5)	2	6	372	6
Fire clay	....	6	373	....
Sand shale	13	....	386	....
Lime shale	3	4	389	4
Limestone	....	6	389	10
Shale, blue	27	2	417	....
Shale, blue	2	4	419	4
Slate, black	....	8	420	....
Coal	....	9	420	9
Shale, blue	24	3	445	....
Shale, blue	2	4	446	4
Limestone	....	8	448	....
Shale, black	....	6	448	6
Fossiliferous	....	6	449	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, black	3	3	452	3
Coal	5	....	452	8
Coal	1	7	454	3
Fire clay, soft	1	....	455	3
Clay shale	5	2	460	5
Shale, black	....	6	460	11
Coal, bony	1	9	462	8
Shale, soft	1	2	463	10
Coal, bony	9	....	464	7
Shale, soft dark	10	5	475	....
Shale, blue	68	....	543	....
Sandstone	8	2	551	2
Shale	....	10	552	....
Coal	1	....	553	....
Clay shale	3	....	556	....
Shale, blue	4	2	560	2
Sandstone	19	7	579	9
Mississippian series—				
Chester formation (upper part)—				
Limestone	....	3	580	....
Limestone	11	....	591	....
Sand shale	8	....	599	....
Sand and lime mixed	9	4	608	4
Clay shale	....	10	609	2
Limestone	....	6	609	8
Shale, red and blue, lime bands	4	4	614	....
Shale, red	....	6	614	6
Shale, blue	13	6	628	....
Limestone	9	4	637	4
Limestone shale mixed	3	8	641	....

The record just above shows no limestone or black shale near the coal. Such a condition is not rare, and is attributed to erosion after the deposition of part of the roof materials. More details will be given in the discussion of coal No. 6.

The coal-bearing rocks extend from 300 to 600 feet below coal No. 6, the variation in thickness being due to the deposition of the lowest Pennsylvanian sediments on a former land surface which was composed of hills and valleys larger than those of Illinois today. As a rule the lowest 200 feet of "Coal Measures" is more sandy than the upper part of the section. The Pottsville formation at the base averages 160 feet at Carlyle and thickens towards the south. It is composed of sandstones interbedded with shales. The sands are generally porous, and over most of the county the Pottsville is known as the "salt sand," because of the large amount of salt water contained.

The coals of commercial importance lie in a zone 250 feet thick, coal No. 6 being at the top. Most of the available logs for Clinton County are records of churn-drill holes bored in prospecting for petroleum. The data regarding the coals are rather meager, especially for those below coal No. 6, which is mined and well known. These beds will be described so far as known under the subject "Coals below No. 6."

The "Coal Measures" overlie a series of limestones, shales, and sandstones known as the Chester group, which varies in thickness in Clinton County from 300 to 600 feet, and contains the producing oil sands at Carlyle. This series is most easily recognized by the presence of red shales, or "red rock" of the driller. These shales should not be confused with those lying in some places from 20 to 50 feet above coal No. 6, mentioned earlier in this report. The Chester contains no commercially valuable coal, and prospecting for this material should be discontinued upon reaching these beds. If identification is difficult, the detailed log of the well, or better still, samples from each screw (in the case of churn drilling) should be sent to the State Geological Survey. This office will be glad to make proper correlations and to advise the operator of the position of his drill in the stratigraphic section.

The following log is typical of the relation of the "Coal Measures" to the underlying Chester.

Well record of Siva Oil Co.

Location—NW.¼ sec. 5, T. 2 N., R. 5 W.

Description of Strata	Thickness	Depth
Pennsylvanian series—	*Feet*	*Feet*
Clay	43	43
Lime	5	48
Shale, sandy	7	55
"Slate"	30	85
Lime	8	93
"Slate"	124	317
Lime	6	223
"Slate"	93	316
Red rock	4	320
"Slate"	15	335
Lime	10	345
"Slate"	5	350
Coal (No. 6)	7	357
"Slate"	39	396
Lime	2	398
"Slate"	86	485
Lime	5	490
"Slate"	70	560
Shale, sandy	87	647

Description of Strata	Thickness *Feet*	Depth *Feet*
"Slate"	13	660
Sand	12	672
"Slate"	10	682
Mississippian Series—		
Chester group (upper part)—		
Lime	18	700
"Slate"	8	708
Red rock	14	722
"Slate"	10	732
Lime	25	757
"Slate"	18	775
Lime	12	787
"Slate"	15	802
Lime	30	832
"Slate"	35	857
Sand	9	866
"Slate"	68	934
Red rock	9	943
Lime	10	953
Red rock	6	959
"Slate"	51	1010
Sand	120	1130
"Slate"	10	1140
Lime	11	1151

Geological Structure

Clinton County lies on the west side of the Illinois coal basin, and the most noticeable feature of the geologic structure is a general eastward dip of the beds as shown by the attitude of coal No. 6. Along the western side of the county this coal is 180 feet above sea level; whereas on the eastern side it is as much as 150 feet below the sea, a difference of 330 feet. The eastward dip is not regular, but is interrupted by gentle folds, at least one of which has proved to be of economic importance. The Carlyle anticline described in Part I raises coal No. 6 to an elevation of 60 feet above sea level in the northwest corner of the Carlyle oil field. The axis of this fold extends northwest-southeast and differs in this respect from the axis of the fold in the oil sands 600 feet below the coal. The condition is due to the lack of parallelism between the sands and the coal. The coal is higher along the axis than to the north, east, or south.

The axis of the Irishtown anticline enters the county about the center of the north line of T. 3 N., R. 3 W., and extends a little south of east, until the fold loses its identity in T. 3 N., R. 2 W. In sec. 17 of this township the coal is 73 feet above sea level, 50 feet higher than in holes 4 miles to the north or south.

Several holes drilled by the Siva Oil Company in secs. 13, 24, and 25, T. 2 N., R. 5 W. are difficult to correlate with other holes in the vicinity. The coals are thin and irregularly developed in the different holes, and no definite structure is suggested. It was thought by some that because the main coal was found considerably higher above sea level in these holes, a dome had been proved to exist. It is believed by the author that faulting is responsible for the discrepancies, although the exact nature of the movements has not been determined.

The coal lies 60 feet above sea level in the northwest corner of sec. 7, T. 1 N., R. 3 W., one mile northwest of Bartelso. This altitude for coal No. 6 indicates that a dome exists, since the coal is lower in all directions from this point.

At Hoffman the top of the coal is 43 feet above sea level, almost as high as at Bartelso, 11 miles west, although the regular east dip would carry the coal much deeper. The rocks here are higher than to the west, north, or east. Their position to the south is not known. A wide shallow syncline appears to exist between Bartelso and Hoffman.

With the exception of the Aviston area, the structure appears to be fairly regular and free from major faulting.[1]

Several small faults exist in mine No. 9 of the Southern Coal and Mining Company, NW. ¼ SE. ¼ sec. 17, T. 1 N., R. 5 W. A few of these dislocations have been traced almost a mile. They trend from east-west to northeast-southwest and appear to split at different points. Figure 6 represents two persistent faults on the east side of

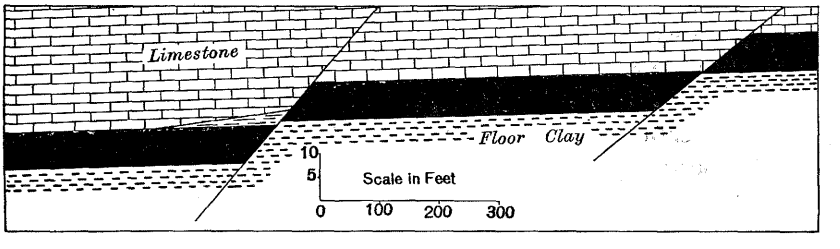

FIG. 6.—Sketch of faults on main east entry near parting, Southern Coal, Coke and Mining Co., mine No. 7, New Baden, Clinton County.

the mine. They are northeast-southwest fractures, along the northwest side of which the strata have dropped about 8 feet, practically the thickness of the coal. Other than a slight shattering of the coal near the fracture, the effect is small and consists in causing steep

[1] The term *fault* in this report signifies an actual fracture along which vertical or horizontal movement has occurred. It does not refer to erosion channels, clay veins, or "horsebacks" often called "faults" by the miner.

grades for haulage. Small faults of a similar character were found in the West mine at Trenton.

Small irregularities in the dip exist in most of the mines and are known to the miners as "sags" and "hills". They consist of dips which continue comparatively short distances, and then change to the opposite direction. Figure 7 shows the track profiles (approximately

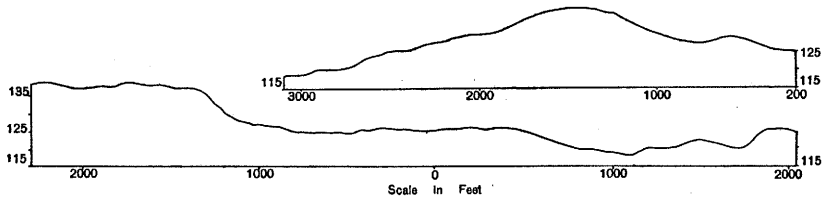

FIG. 7.—Track profiles in parts of Southern Coal, Coke and Mining Co., mine No. 9, New Baden, Clinton County.

the base of coal) in parts of the New Baden mine. Local hills and valleys give a relief of 15 feet to the coal in a distance of 400 to 800 feet and the irregularity of the dip is well illustrated in the cut. These features appear to have no definite trend and may be related to the floor upon which the original vegetal matter was deposited. It is difficult to believe that regional movements have produced features so small in extent.

The chief effect of these irregular dips is additional haulage expense. In a few mines in the State, as in the Jeffrey mine near Herrin, the bills are so steep that the maintenance of a suitable grade for the track requires more than ordinary expenditure. No serious difficulty of this kind is reported in Clinton County.

COAL NO. 6

DISTRIBUTION AND DEPTH

Coal No. 6 ("blue band") is represented throughout the entire county, although its thickness varies. It is nearest the surface on the western side of the county where it lies at a depth of 320 to 350 feet. Its gradual east dip carries it to depths between 500 and 575 feet in the eastern part of the county. The arching of the beds in the vicinity of Hoffman counteracts the effect of the regular east dip and brings the coal almost 100 feet nearer the surface than would otherwise be expected.

The deepest shaft in the county, that of the Breese-Trenton Mining Company's Buxton mine at Beckemeyer, reaches the bottom of coal No. 6 at 440 feet. Fortunately sufficient drilling has been done to enable one to outline the areas of thin coal with some success. At

present mining operations are carried on at New Baden, Breese, and Beckemeyer, the mines being located along the railroads and in areas where the coal averages 7 to 8 feet in thickness.

THICKNESS OF COAL NO. 6

In an irregularly shaped area of about 35 square miles in the vicinity of Aviston (see Plate I in pocket), coal No. 6 is either absent or much below normal thickness. In this area 8 holes give an average thickness of slightly less than 3 feet for this bed. It should be remembered that most of these holes were made by the churn drill and that the measurements are not uniformly accurate. However, it is certain that the coal does not attain its normal thickness and it is probable that this area is the southward extension of the more or less barren area at Highland, Madison County, and north in parts of Montgomery and Bond counties, described earlier in the report and more in detail in the reports for the counties named. In Clinton County, this area is roughly rectangular, its long axis extending about N. 30° W. through the town of Aviston, which is near the center of the area. Its length is about 8 miles in Clinton County and its average width about 4 miles. A drill hole located in sec. 34, T. 2 N., R. 4 W., is the only one in which coal No. 6 is absent; in the others it is merely much thinner than normal.

Another roughly rectangular area of thinner coal approximately 100 square miles in extent lies in the eastern part of the county. Its width is about 8 miles, a little greater than the distance from Carlyle to Hoffman, and its long dimension in Clinton County is about 14 miles (see Plate I). So far as known definitely from present data, the southern boundary of this area is represented by a line connecting Carlyle and Hoffman, and its long axis extends about N. 15° E. through the north line of the county. It is entirely probable that this area of thinner coal continues to the south through Washington County, into Perry, and across the line east into Jefferson County, but drill holes are too scattered to permit the safe drawing of definite boundaries for thick and thin coals in the counties just mentioned. Even in Clinton County the line is tentative and will no doubt be changed by the results of future drilling. It is probable that small areas will be found inside the boundaries indicated where coal No. 6 reaches its normal development, but available information indicates the probable irregular nature of the coal within such lines.

To the west and southwest of the "spotty" area near Aviston the coal varies in thickness from 5 to 8½ feet, the average being 6 feet 10 inches in 8 holes scattered over the western parts of Tps. 1 and 2 N., R. 5 W. In the central part of the county, between the

two areas of thinner coal, its average thickness is 7 feet. This area contains the mines at Beckemeyer and at Breese. In mine No. 10 of the Southern Coal and Mining Company at Germantown, coal No. 6 ranges in thickness from 4 feet 6 inches to 5 feet 2 inches. It is reported that a 2-foot 4-inch bed exists at a distance of 5 or 6 feet below coal No. 6 and that the two beds together represent the "blue-band" coal, the interval between being merely a parting. This information is not confirmed or disproved by logs in the Survey office, the only similar suggestion being an unsupported statement that at the mill in New Baden about 8 miles southwest of Germantown, the coal is divided into two benches by a 2-foot parting of shale. Such a division is not known at the New Baden mines, a short distance away. The extreme eastern part of the county is directly connected with the Centralia field across the line in Marion County. The few holes that have been drilled here indicate an average thickness of 6 feet for coal No. 6.

PHYSICAL CHARACTER OF COAL NO. 6

The physical character of the coal is best determined at the face in mines where a large area is exposed to view. Figure 8 shows the general characteristics of coal No. 6 in Clinton County. This coal exhibits the usual characteristics of the bed over the district. It is separated into three benches which are uniformly recognizable. At New Baden the bed averages 8 feet 4 inches in thickness. A charcoal parting about 2 feet from the roof separates the middle bench from the top coal which is generally bright and hard and contains but little dirt. In places a few small vertical streaks of pyrite cut through the upper part of the bed.

The middle bench, about 4½ feet thick, extends from the parting mentioned above, down to the "blue band", a clay containing some pyrite and averaging 1 to 1½ inches in thickness. This bench consists of alternate layers of bright and dull coal, also bands of dirt, charcoal, and pyrite. Individual bands of impurities are generally lenticular and can not be traced throughout the mine, but it is not unusual to find two more or less persistent streaks of pyrite in the middle bench. In the mine mentioned above two such bands are known each about ¼ inch thick, the upper one about 15 to 18 inches below the top coal parting and the other 12 to 18 inches lower. Because of their hardness the pyrite streaks are often called "steel" bands by the miner and where such streaks are persistent the placing of shots is governed to some extent by their position, in order to take advantage of the parting which they afford.

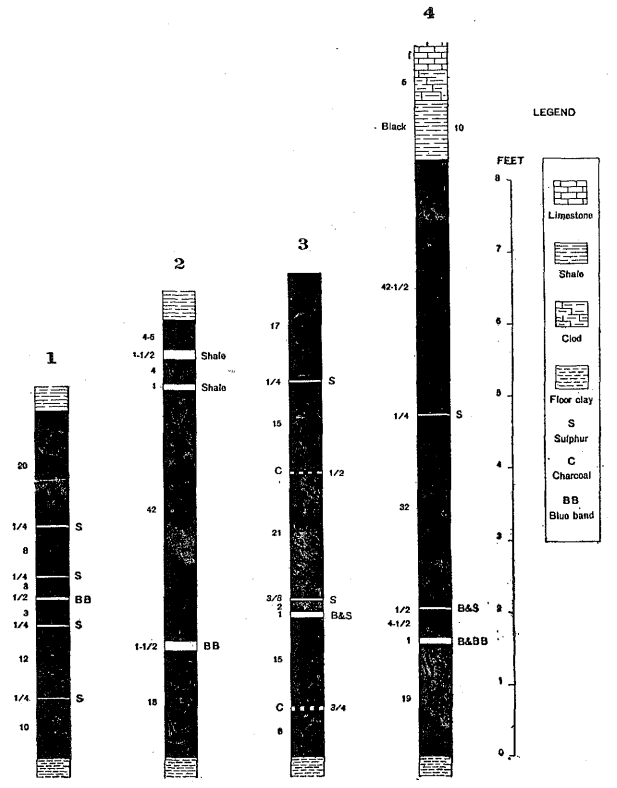

FIG. 8.—Graphic sections of coal No. 6 from measurements made in mines of Clinton County. (B indicates "bone.")

1. Southern Coal Co., mine No. 10, Germantown (abandoned). 9th W. off 1st N., 2200 feet from shaft.

2. Trenton Coal Co., mine No. 1, Trenton (abandoned). Room 1, 2d E., north side.

3. Breese-Trenton Mining Co., Beckemeyer. Face 3d E. off N.

4. Southern Coal, Coke and Mining Co., New Baden. 6th N. off main east entry.

The bottom bench measures from 17 to 24 inches. It consists in most places of harder coal than the middle and tends to contain a higher percentage of dirt. A dull appearance due to the large amount of impurities present is common.

In the fracture planes of the coal small amounts of calcium carbonate have been deposited and now appear as white scales. Irregular balls of pyrite exist in some of the mines, but not so plentifully as to cause special trouble in mining.

The general conditions at Beckemeyer agree with those just described except in measurement detail. The top coal is 18 inches thick,

and a small pyrite band commonly lies about 20 inches below the top of the middle bench. The "blue band" averages 5 or 5½ inches in thickness. In places it is in two parts separated by an inch or two of clean coal. In others the upper part consists of bone and coal and the lower part is a mixture of gray shale and pyrite.

The following table shows the measurements on coal No. 6 made at different mines in Clinton County.

TABLE 4.—*Mine measurements of the three benches composing coal No. 6 in Clinton County*

Company	Mine	Top coal		Middle bench		"Blue band"	Lowest bench
		Ft.	*In.*	*Ft.*	*In.*	*Inches*	*Inches*
Southern Coal, Coke & Mining Co.	No. 9	2	....	4	6	1 to 1½	20 to 24
Breese-Trenton Mining Co.	Buxton	1	6	4	6	3 to 5½	24
Trenton Coal Co.	No. 1 (South Mine)	....	4 to 6	4	7	1 ½	18
Cooperative Coal & Mng. Co.	1	....	....	....	....		14
Southern Coal Co.	10	1	8	....	11¼	½	26

The thin top coal of the South mine at Trenton and the 11¼-inch middle bench of Southern Coal Company No. 10 at Germantown are the principal irregularities in the mines examined in the county. Neither of these mines produced any coal during 1912-13.

ROOF AND FLOOR

Throughout most of the county a good limestone cap rock lies above the coal. It ranges from 5 to 15 feet in thickness and in places is separated into several beds by small layers of shale. This is the persistent limestone which contains the little fossil called *Fusulina cylindrica*. It is about the size of a grain of wheat, and its presence enables the geologist to identify the bed in places where coal No. 6 is absent. Here and there the limestone rests directly on the coal, but in many places a black shale, called "slate" by the miner, intervenes between the cap rock and the coal. In most of the mines both conditions are known; the mines at Trenton have a 40-foot soft shale roof and are exceptions to the general rule. Such a condition suggests that the original limestone and black shale roof was removed by erosion after having been deposited, and was later replaced by the softer shale. Absence of the limestone cap rock is indicated in some

of the drill holes of Tps. 1 and 2 N., R. 5 W. and in the southeastern part of T. 2 N., R. 3 W.

In the north part of the Germantown mine the black slate attains a thickness of 5 feet; whereas near the shaft only a thin parting of slate separates the coal from the limestone. Mine No. 9 of the Southern Coal, Coke, and Mining Company at New Baden has the limestone roof except in a limited area on the west side, where black shale overlies the coal. Throughout the mine about 3 inches of an irregularly bedded calcareous shale called "clod" directly underlies the limestone.

The black shale is sheety and requires much timbering. In places the coal adheres to the shale, and since a clean parting lies 7 inches below the top of the coal, this much of the bed is left up for roof where separation of shale and coal is not easily made. The limestone roof requires no timbering.

In the Buxton mine at Beckemeyer black shale as much as 4 feet in thickness and containing many niggerheads is the regular roof. In only a few places does the limestone come into contact with the coal. To protect the shale and to render mining conditions more satisfactory, about 18 inches of coal is left up for roof.

About 200 feet northeast of the shaft bottom, an irregularly bedded, gray, calcareous shale replaced the normal roof in a small area which appears to have been subject to erosion subsequent to the deposition of the beds some distance above the coal. Part of the coal itself was eroded and the depressions are filled with a conglomerate, some of the pebbles of which are coal. Because of the unconsolidated nature of the material, much of it falls; and in the summer of 1912 the top of the fall was 30 feet above the roof of the coal.

The normal floor material is clay, which is reported in the mines to be from 18 inches to 8 feet thick. In most places it rests on shale, but in a few places a bed of limestone is reported to lie a few feet below the coal. The clay varies greatly in character from place to place and even in the same mine. Its color varies from light gray to almost black, depending on the amount of carbonaceous matter contained. In most places the clay slacks on exposure to the air, and where considerable moisture exists the floor materials are squeezed up into the rooms and entries by the pressure of the overlying strata.

Coals below No. 6

Despite the many holes drilled in Clinton County, the coals below No. 6 cannot be regarded as thoroughly prospected. Most of the holes were made by the churn drill and were put down in search of

petroleum; hence details regarding the coals were of minor interest to the operators and drillers.

In the vicinity of Trenton a 2½-foot coal is reported 42 feet below coal No. 6 in a position corresponding to coal No. 5. Thin coals have been noted at a similar horizon in sec. 17, T. 1 N., R. 5 W., in secs. 13, 29, T. 2 N., R. 3 W. and in sec. 1, T. 1 N., R. 1 W., but most of the logs make no note of such a coal, a fact indicating a "spotty" development of this bed. A recent diamond-drill hole in sec. 12, T. 1 N., R. 1 W., shows a 3-foot 11-inch coal 110 feet below coal No. 6. The interval between the two appears to be too great to render safe the correlation of the lower bed with coal No. 5. In Saline County such an interval exists, but in Williamson and Franklin counties these coals are but 40 to 50 feet apart. Information is too meager to correlate satisfactorily the 3-foot 11-inch bed in sec. 1.

The only other bed of promising nature in the county lies from 200 to 250 feet below coal No. 6 in proper position to be correlated with coal No. 2. In sec. 25, T. 2 N., R. 5 W. this bed is 485 feet below the surface and is reported to be 4 feet thick. It is found in sec. 12, T. 1 N., R. 1 W. at a depth of 642 feet and is 10 inches thicker than in the last hole mentioned. This is apparently the bed reported by the Centralia Coal Company, NW. ¼ NW. ¼ sec. 19, T. 1 N., R. 1 E. at a depth of 774 feet. At this place the bed reaches a thickness of 6 feet 11 inches. This coal is reported only in the holes mentioned, and its existence over most of the county is extremely doubtful. It probably exists in disconnected areas or pockets which in the future may yield considerable tonnage. It is significant that this coal is reported almost exclusively in diamond-drill holes, and it is possible that its existence has been overlooked in parts of the county tested only by the churn drill.

A few thin beds are reported here and there between coals No. 2 and No. 6, but they are not persistent and appear to be lenticular deposits covering small areas and are of no commercial value.

CHRISTIAN COUNTY

Production and Mines

Production in tons year ending June 30, 1913.... 1,481,737
Average annual production 1909 to 1913..... 1,346,479
Total production 1881 to 1913..... 22,794,343

Christian County has ranked 14 in production since 1909. Its output for 1913 was 2.5 per cent of that for the entire State. The following table shows the rank of the operating mines for 1913.

TABLE 5.—*List of shipping mines, Christian County, 1913*

Map No.	Company	Mine name or number	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T.	R.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Christian County Coal Co.			NE	33	13N	2W	609	472	137	7	8	341,112
2	Springfield Coal Mining Co.	6	SW	NW	26	13N	2W	610	480	130	8	....	240,247
3	Stonington Coal Co.		SE	NE	28	14N	1W	610	478	132	7	....	239,938
4	Penwell Coal Company	1		NE	21	11N	1E	696	728	−32	7	....	197,627
5	Pana Coal Co.	1	SE	SE	16	11N	1E	695	722	−27	8	....	166,564
6	Smith Lohr Coal Mining Co.		cen	ter	15	11N	1E	681	720	−39	7	6	100,303
7	Illinois Midland Coal Co.	7	SW	NW	14	13N	3W	575	347	228	7	6	74,824
8	Assumption Coal & Mining Co.		W	SE	2	12N	1E	644	659	−15	1	6	.....
	Coal No. 2 (?)								987	−343	3	....	73,883
	Coal No. 1 (?)								1000	−356	3	....	.....
9	Pana Coal Company	2	NW	NW	15	11N	1E	681	713	−32	8	....	38,156
	C. W. Vanderver	Green-wood								365	7	....	9,083

All of the mines except that of the Assumption Coal and Mining Company operate coal No. 6. The shaft at Assumption which is the deepest in the State (1004 feet) hoists from beds Nos. 1 and 2.

Coal-bearing Rocks

Sixty logs are available for the study of the coal-bearing beds in Christian County. A large number of these are diamond-drill holes and the resulting information presents a degree of uniformity equalled in but few counties of the State. The prospect holes, however, are so situated that a large area in the south half of the county is left unexplored. The same is true of the extreme northern part of the county but this is near the edge of the basin in which coal No. 6 is developed to commercial thickness and is perhaps not so promising as parts of the south half which will be treated under the subject "Coal No. 6."

The coal-bearing rocks of Christian County vary in thickness from about 800 feet in the western part to more than 900 feet along the eastern border, and are covered by glacial drift which ranges in thickness from 15 feet to almost 150 feet. It must be remembered that the drift was deposited upon a former land surface and that its present thickness depends upon its location, whether on a former hill or in a valley.

In the western part of the county the Carlinville limestone forms the bed rock directly underlying the drift. This limestone is a prominent feature of the logs in that it is persistent and averages from 5 to 10 feet in thickness. In many places it is separated by thin beds of shale into two or more benches. Certain logs show several beds of limestone in a zone about 50 feet wide occupying the general horizon of the Carlinville. The interval between this limestone and coal No. 6 in western and central Christian County is approximately 250 feet, but increases toward the eastern boundary where it is a little more than 300 feet.

In the southeastern corner of the county the New Haven limestone underlies the drift, the dip having carried the Carlinville 300 to 400 feet below the surface. The New Haven limestone is reported to be 20 to 30 feet thick, although it is possible that these figures are somewhat large owing to the local cementation of the basal part of the drift which is likely to be included with the underlying limestone.

The 200-foot interval between the New Haven and Carlinville limestone is occupied mostly by shale. Here and there one or two thin coals are reported, although these are not distinctive features. Black and gray shales also predominate in the 250 to 300-foot interval between the Carlinville limestone and coal No. 6. A persistent bed

of thin coal which has been called No. 8 lies 150 to 180 feet above coal No. 6. Within 50 feet above the last mentioned coal a bed of red or pink shale is commonly noted which, although it rarely reaches a thickness of 10 feet, is so distinctive in color that it is useful in determining the position of the coal beds. This shale is present not only in Christian County, but also over most of southern Illinois. A thin bed of coals, ordinarily less than 1 foot thick, but in one place reported 4 feet 11 inches, commonly lies 30 feet or less above coal No. 6. This coal has been called No. 7.

The usual immediate roof of coal No. 6 is black shale which varies in thickness from less than 1 foot to 10 feet or more. Above this shale, or "slate" as it is called by the miners, is the usual limestone cap rock which ranges in thickness from 1 to more than 20 feet and is almost everywhere present.

Coal No. 6 is persistent and over most of the county is easily recognized. The northern part of the area is near the edge of the basin in which this coal was deposited to its normal thickness. Furthermore, the interval between coals No. 5 and No. 6 decreases toward the north, and the lower coal attains greater thickness, the three conditions combining to render identification of the coals somewhat difficult. Fortunately the character of the beds above coal No. 6 remains constant and serves as an aid to correlation. Coal No. 6 lies at a depth of about 300 feet on the western side of the county, and its eastward dip carries it a little more than 700 feet below the surface along the eastern boundary.

Most of the drill holes have been stopped in the floor of coal No. 6; a few, however, penetrate the entire section of coal-bearing strata. Of the records mentioned, the log presented on page 69 is typical. It shows a zone of 250 feet thick consisting of shales, a very small amount of sandstone, and a still smaller amount of limestone. Although 7 coal beds are recorded in this hole, only three are commercially important. A 2-foot 4-inch bed 81 feet below coal No. 6 probably represents coal No. 5. A 2-foot 5-inch bed divided into two equal parts by a 3-inch layer of shale lies 156 feet below coal No. 6 and 100 feet lower, the 2-foot 4-inch bed probably represents coal No. 2. Near Taylorville this horizon shows two beds 12 feet apart, the top bench being 3 feet 11 inches and the lower bench 3 feet 8 inches in thickness. A lenticular bed 2 feet 5 inches thick which may represent coal No. 1 mined at Assumption and in the northwestern part of the Illinois coal field lies 27 feet below the lower bench of No. 2 (?). The other beds are not traceable over any considerable areas; and their thicknesses ranging from a few inches to only slightly more than one foot, class them as commercially unimportant.

Below the coal beds mentioned the strata are more sandy, as is to be expected in the lowermost coal-bearing rocks. The available records show about 200 feet of these sandy shales and sandstones.

At Palmer 220 feet of pink shales, limestone, and sandstone belonging to the Chester group underlie the coal-bearing rocks, and the Chester rests on the massive St. Louis limestone or "Big Lime" of the driller. In the eastern part of the county the Chester beds appear to be considerably thicker, but the only hole that penetrates this group of beds stops at 1335 feet without reaching the "Big Lime."

The following logs show the character of the underlying strata at Taylorville, Assumption, and Pana.

Record of Byrd-Willey drill hole near Taylorville

Hole—No. 13. Location—NW. cor. NW.¼ SE.¼ sec. 13, T. 13 N., R. 2 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Clay	14	....	14	....
Sand	8	....	22	....
Clay and rocks	11	....	33	....
Sand, coarse	7	....	40	....
Sand, fine	4	....	44	....
Clay and sand	37	....	81	....
Sand	23	....	104	....
Clay	17	....	121	....
Sand	8	....	129	....
Clay	7	....	136	....
Sand	11	....	147	....
Gravel	2	....	149	....
Clay, sandy	2	....	151	....
Loose boulders	1	6	152	6
Sandstone	9	6	162	....
Shale, blue	3	....	165	....
Shale, soft, light	19	....	184	....
Limestone (Carlinville)	9	6	193	6
Shale, light	1	....	194	6
Shale, black	2	6	197	....
Shale, blue	15	....	212	....
Shale, soft, with hard lumps	7	....	219	....
Limestone and shale mixed	6	....	225	....
Shale, light	3	6	228	6
Limestone	4	....	232	6
Shale, black	1	6	234	....
Shale, light, soft	6	....	240	....
Lime shale	3	6	243	6
Shale, light	9	2	252	8
Coal	....	10	253	6
Shale, light	1	6	255	....

Description of Strata		Thickness		Depth	
		Ft.	*In.*	*Ft.*	*In.*
Shale, sandy		9	----	264	----
Sandstone		9	----	273	----
Shale, sandy		9	----	282	----
Shale, blue		39	2	321	2
Coal		1	3	322	5
Shale, soft		1	7	324	----
Shale, blue		4	----	328	----
Shale, sandy		4	----	332	----
Sandstone, soft, with a few shale streaks		40	----	372	----
Shale, blue		18	----	390	----
Shale, tough, blue		29	----	419	----
Coal		----	3	419	3
Shale, soft		4	9	424	----
Shale, tough, blue		5	----	429	----
Shale, soft		4	----	433	----
Shale, dark		2	----	435	----
Limestone, blue		----	6	435	6
Shale, soft, variegated		10	6	446	----
Shale, dark blue		2	7	448	7
Coal (No. 7)		----	7	449	3
Shale, dark		----	10	450	----
Lime shale		3	----	453	----
Limestone		4	----	457	----
Limestone and shale		2	----	459	----
Sandstone		6	6	465	6
Limestone		1	6	467	----
Shale, black		6	2	473	2
Coal	No. 6	5	4	478	6
Sulphur band	No. 6	----	½	478	6½
Coal	No. 6	----	6	479	½
"Blue band"	No. 6	----	1¼	479	1¾
Coal	No. 6	1	7	480	8¾
Sulphur band	No. 6	----	¼	480	9
Coal	No. 6	----	4	481	1
Light shale		7	11	489	----
Shale, soft		4	----	493	----
Limestone mixed with shale		7	----	500	----
Shale, soft		4	----	504	----
Shale, light		5	----	509	----
Shale with sand streaks		5	----	514	----
Shale, gray		6	----	520	----
Shale, blue		34	----	554	----
Rock, hard blue		1	----	555	----
Shale, black		6	6	561	6
Limestone, blue		----	11	562	5
Shale, black		----	2	562	7
Coal (No. 5?)		2	4	564	11
Shale, soft		4	1	569	----
Shale with sand streaks		6	----	575	----

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, gray	17	----	592	----
Shale, black	4	----	596	----
Coal	1	----	597	----
Shale, black	----	6	597	6
Sandstone	5	----	602	6
Shale, blue	26	6	629	----
Shale, soft	7	----	636	----
Shale, dark	1	----	637	----
Coal	1	3	638	3
Shale, parting	----	3	638	6
Coal	1	2	639	8
Shale, soft	1	10	641	6
Sandstone	7	----	648	6
Sandy shale	8	6	657	----
Blue shale	8	----	665	----
Shale, black	3	8	668	8
Coal	1	2	669	10
Shale, light, sandy	1	2	671	----
Shale, light	6	----	677	----
Shale, sandy	4	----	681	----
Sandstone	4	6	685	6
Shale, blue	1	----	686	6
Coal, bony	----	4	686	10
Shale, soft	3	2	690	----
Shale, light	2	----	692	----
Shale, dark	2	5	694	5
Coal	----	5	694	10
Shale, dark	1	2	696	----
Shale, soft	5	----	701	----
Limestone	2	9	703	9
Coal	----	7	704	4
Shale, blue	15	2	719	6
Shale, black	2	----	721	6
Shale, gray	4	6	726	----
Shale, blue	2	----	728	----
Shale, dark, blue	9	3	737	3
Coal (No. 2?)	2	4	739	7
Sandstone, soft	17	5	757	----
Shale, light	3	----	760	----
Shale, dark	2	----	762	----
Shale, blue with sandstone streaks	36	----	798	----
Sandstone	34	----	832	----
Sandstone and shale mixed	15	----	847	----
Shale, blue with sand streaks	19	----	866	----
Sandstone and shale mixed	23	----	889	----
Sandstone	4	----	893	----
Shale, dark blue	27	----	919	----
Limestone	31	----	950	----

Record of Byrd & Taylor Hole—No. 8

Location—NE. cor. SE.¼ NE.¼ sec. 35, T. 13 N., R. 1 E.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil	9	----	9	----
Cement, sand and gravel	13	----	22	----
Clay, blue, gravelly	21	----	43	----
Sand	4	----	47	----
Clay, sandy	43	----	90	----
Sand and gravel	25	----	115	----
Shale, soft, blue	11	6	126	6
Shale, dark	20	----	150	6
Sandstone	21	6	172	----
Shale, rotten, gray	6	6	178	6
Lime shale with pebbles	2	6	181	----
Limestone	----	7	181	7
Lime shale	8	5	190	----
Limestone (Shoal Creek)	10	9	200	9
Lime shale	----	3	201	----
Shale, dark	2	----	203	----
Shale, tough, blue	13	----	216	----
Shale, soft clay	4	----	220	----
Limestone, shaly	3	6	223	6
Shale, sandy	32	----	255	6
Shale, dark	3	----	258	6
Shale, gray	11	6	270	----
Shale, sandy	22	----	292	----
Shale, tough, blue	35	6	327	8
Shale, fossil	1	----	328	6
Coal (No. 8?)	----	6	329	----
Clay shale	3	----	332	----
Lime shale	19	----	354	----
Shale, tough, blue	62	5	416	5
Coal	----	3	418	8
Clay shale	4	4	421	----
Lime shale	8	----	429	----
Shale, black	1	----	430	----
Clay shale, soft	4	----	434	----
Shale, soft, red, gray	3	----	437	----
Shale, red	1	----	438	----
Limestone	1	6	439	6
Shale, red and blue	10	----	449	6
Clay shale, soft, rotten	5	6	455	----
Limestone shale mixed	----	6	455	6
Clay shale, soft	----	6	456	----
Clay shale	6	----	462	----
Lime shale	12	----	474	----
Shale, sandy	20	----	494	----
Shale, blue, brown bands	9	----	503	----
S ale, tough, blue, brown band	17	----	520	----

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, blue, brown bands	13	10	533	10
Coal, shale streaks	....	6	534	4
Coal	3	2¼	537	6¼
"Blue band" shale } No. 6	....	¾	537	7
Coal	2	3	539	10
Fire clay	1	10	541	8
Shale, gray	7	4	549	....
Shale, black	2	....	551	....
Lime shale	5	6	556	6
Coal, bony	....	3	556	9
Shale, dark	....	3	557	....
Shale, dark blue	1	4	558	4
Limestone	1	8	560	....
Sand and lime mixed	4	6	564	6
Shale, gray	3	....	567	6
Limestone, shaly	8	6	576	....
Shale, sandy	15	....	591	....
Shale, tough, blue	27	....	618	....
Limestone	3	....	621	....
Shale, black	6	8	627	8
Coal	....	6	628	2
Fire clay	1	....	629	2
Limestone	....	6	629	8
Clay shale, soft, rotten	2	2	631	10
Shale, gray	1	....	632	10
Sandstone	1	2	634	....
Shale, sandy	18	....	652	....
Shale, blue	4	....	656	....
Coal	2	....	658	....
Shale, sandy	9	....	667	....
Shale, tough, blue	25	....	692	....
Shale, black	1	6	693	6
Coal	2	2	695	8
Fire clay	....	4	696	....
Shale, gray	6	8	702	8
Shale, dark	2	2	704	10
Coal	....	1	704	11
Shale, blue	....	7	705	6
Coal	....	10	708	4
Shale, gray	5	7	714	....
Sandstone	4	....	718	....
Shale, sandy	7	....	725	....
Shale, blue, brown bands	16	3	741	3
Coal	1	1	742	4
Fire clay	8	....	743	....
Shale, gray	24	....	767	....
Shale, sandy	4	....	771	....
Sandstone	3	5	774	5
Shale	....	3	775	8

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Coal	----	3	775	11
Shale, fossiliferous	1	6	778	5
Coal, bony	----	3	778	8
Coal	1	2	779	10
Shale, blue	1	10	785	----
Coal	----	5	785	5
Shale, dark	3	7	789	----
Shale, sandy	14	8	803	8
Coal	3	11	807	7
Shale, sandy } No. 2	3	5	811	----
Sandstone	8	4	819	4
Coal	3	4	819	4
Shale, sandy	9	3	832	8
Coal	----	7	832	10
Sandstone	5	2	838	----
Sandstone shale streaks	21	2	859	2
Coal	2	5	861	7
Dark shale	3	5	865	----
Sandstone, shale partings	25	----	890	----
Shale, sandy	19	----	909	----
Shale, tough, blue	19	----	928	----
Shale, rotten, blue	16	----	944	----
Shale, gray	3	----	947	----
Shale, rotten, blue	17	----	964	----

Shaft record of Assumption Coal Mining Co.

Location—NW.¼ SE. ¼ sec. 2, T. 12 N., R. 1 E.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil	1	6	1	6
Subsoil	1	----	2	6
Clay, yellow	8	----	10	6
Clay, yellow, and sand	8	6	19	----
Gravel, hard, and clay	5	----	24	----
Clay, brown	3	----	27	----
"Soapstone," soft	18	----	45	----
Coal	----	4	45	4
Fire clay	2	----	47	4
Limestone, blue	5	----	52	4
Fire clay	1	6	53	10
Clay shale	5	6	59	4
Limestone, gray } New Haven limestone	6	8	66	----
Limestone, gray, and gray shale	1	----	67	----
Limestone, gray	38	----	105	----
Sand shale	52	4	157	4
Clay shale	14	----	171	4

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Coal	2	6	173	10
Fire clay	6	....	179	10
Sand shale, gray	10	....	189	10
Clay shale	22	8	212	6
Shale, blue	8	....	220	6
Conglomerate lime rock	2	6	223	....
"Slate," black	1	....	224	....
Coal	....	6	224	6
Fire clay	10	6	235	....
Sand rock	40	....	275	....
Sand, porous (salt water)	14	....	289	....
Limestone	1	6	290	6
Fire clay	10	....	300	6
Limestone (Carlinville or Shoal Creek?)	9	....	309	6
Shale, black	1	6	311	....
Coal	....	6	311	6
Sandstone	4	....	315	6
Limestone and boulders	21	....	336	6
Sand shale, blue	20	....	356	....
Clay shale	2	....	358	6
Shale, blue	5	....	363	6
Coal and shale	2	....	365	6
Fire clay and boulders	8	....	373	6
Sandstone	15	....	388	6
Sand rock	50	....	438	6
Shale, black	....	3	438	9
Coal	....	6	439	3
Fire clay	2	....	441	3
Limestone	4	....	445	3
Sandstone	13	9	459	....
Sand shale	52	....	511	....
Fire clay	2	....	513	....
"Slate," black	2	....	515	....
Fire clay, red	12	4	527	4
Lime rock and fire clay	5	....	532	4
Shale, chocolate	6	....	538	4
Shale, blue	25	6	563	10
Shale, black	2	....	565	10
Coal and slate	....	6	566	4
Conglomerate lime and clay	12	....	578	4
Limestone	3	....	581	4
Sandstone	20	....	601	4
Sand shale, blue	23	....	624	4
Sand shale, brown	4	....	628	4
Limestone	1	....	629	4
Coal (No. 6?)	1	8	631	....
Fire clay and boulders	6	....	637	....
Sandstone	10	....	647	....
Fire clay and rock	7	....	654	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, black	2	....	656	....
Coal	....	2	656	2
Fire clay and rock	10	....	666	2
Limestone, sandy	8	....	674	2
Sandstone and sand shale	8	....	682	2
Sandstone	10	....	692	2
Sand shale, blue	21	....	713	2
Sandstone	1	....	714	2
Shale, blue	32	....	746	2
Fire clay	....	6	746	6
Limestone	....	6	747	2
Fire clay	2	....	749	2
Lime rock and fire clay	5	....	754	2
Limestone	1	....	755	2
Coal	1	....	756	2
Fire clay	4	....	760	2
Sand shale	22	....	782	2
Shale, black	1	6	783	8
Coal	1	6	785	2
Fire clay	....	4	785	6
Sand shale	25	....	810	6
Shale, black	6	....	816	6
Coal	1	....	817	6
Fire clay	3	....	820	6
Limestone	1	....	821	6
Shale, black	5	....	826	6
Coal	1	8	828	2
Fire clay	1	....	829	2
Limestone	1	4	830	6
Sand shale	18	....	848	6
Lime rock, sandy, and small boulders	1	6	850	....
Hard fire clay and boulders	15	....	865	....
Sandstone	16	4	881	4
Sand shale	18	2	899	6
Shale, black	1	....	900	6
Coal	....	2	900	8
Fire clay	2	....	902	8
Limestone	5	....	907	8
Sand shale, blue	7	....	914	8
Shale, black	1	....	915	8
Coal	....	5	916	1
Fire clay	5	6	921	7
Fire clay and boulders	7	6	929	1
Sand shale	25	8	954	9
Shale, black	5	....	959	9
Coal[2]	2	2	961	11
Fire clay	....	3	962	2
Lime and sandstone	1	6	963	8

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Sand shale, dark	14	....	977	8
Conglomerated rock	1	6	979	2
Coal[2]	3	6	982	8

Geologic Structure

Christian County is on the western side of the Illinois coal basin. Throughout the county, so far as known, the geologic structure consists of a uniform dip toward the southeast into the lower part of the basin. Near the county line west of Kincaid, coal No. 6 lies 280 feet above sea level; whereas south of Pana in the southeast corner of the county this bed is 70 feet below the sea or 720 feet beneath the surface, conditions which show an average dip of 11 feet per mile.

Unfortunately a large part of the south half of the county is unexplored by the drill and the structure is not known. In view of the regularity displayed by the beds in the central part of the county, and along the southern border, it is believed that no pronounced irregularities in the dip exist anywhere in the county. Minor folds are known, as in sec. 19, T. 13 N., R. 2 W., from where the coal dips to the north and south. A small arching of the beds is shown by the drill holes located south of the county line in secs. 2 and 3, T. 10 N., R. 2 W. At the SW. cor. sec. 35, T. 11 N., R. 2 W. the coal is 76 feet above sea level, or 35 feet higher than it is 1 mile north or south.

Coal No. 6

Distribution and Thickness

Of the coal produced in Christian County, 95 per cent is mined from coal No. 6. The remainder comes from two beds in the lower part of the "Coal Measures" at Assumption which may represent coals No. 1 and No. 2, or possibly the upper and lower benches of coal No. 2 or No. 1. Definite correlations have not been made.

Coal No. 6 is best known in the vicinity of the present mines at Taylorville, Kincaid, Edinburg, and Pana. Diamond drill holes have proved the presence of the bed north of the south line of T. 13 N. and south of the north side of T. 14 N. It is commercially developed at Pana and the drill has shown coal No. 6 to underlie at least the south half of the two townships west of Pana.

Doubtless the area in which the coal is thin or absent in Montgomery, Bond, and Clinton counties, extends northeast at least into the

[2]Definite correlations of these coals have not been made. They probably represent coals No. 1 and 2, but they may be the upper and lower benches of either No. 1 or No. 2.

southwestern part of Christian County. One boundary of this area is fairly definite in the southern half of T. 11 N., R. 2 W., where a drill hole in the SE. cor. sec. 31, and another a quarter of a mile south failed to penetrate any coal at the horizon of coal No. 6. At Palmer, 8 miles northwest, the churn drill penetrated no coal. The area between has not been tested, but it is believed that it will prove to be unfavorable so far as coal No. 6 is concerned. The general direction of the barren area is northeast-southwest, but its shape in Christian County is extremely uncertain, owing to the scarcity of drill records in the possible "pockety" area. At the Assumption mine, sec. 2, T. 12 N., R. 1 E., only 1 foot 8 inches of coal is found at the horizon of coal No. 6. Absence of this coal is noted in a hole at Dunkel 3 miles south of Assumption.

At Pana, 6 miles farther south, the coal attains a thickness of 8 feet; therefore the south boundary of the barren area is located between Dunkel and Pana. Normal coal is found 6 miles west of Assumption and has been traced north from this point. Whether or not the area of thin coal No. 6 is in the vicinity of Assumption is part of the area referred to above is not determined, but it is believed that the two are connected. Even if this is true, there seems no doubt that a considerable body of good coal exists outside the borders of the area. In Christian County T. 12 N., Rs. 3 and 4 W. offers favorable territory for the drill. North and west of this area coal No. 6 appears to be developed to its normal thickness and it is believed that by drilling first in the northwest and later toward the southeast, the possible "spotty" territory, a considerable acreage of commercial coal may be found.

The extreme northern part of the county in Tps. 15 and 16 N., Rs. 1, 2, and 3 W. has not been explored by the drill. This is near the line north of which No. 6 is too thin to be commercial. The border is not a definite line, but rather a zone several miles in width, in which coal No. 6 is developed to normal thickness in one place and deposited nearby to a thickness of but a foot or two. At Mechanicsburg a few miles north of the county line where coal No. 6 was mined formerly, the coal was about 6 feet thick at the shaft, but thinned to 2 inches in a distance of 800 feet north. At Chatham, 8 miles southwest of Springfield, coal No. 6 is between 5 and 6 feet thick. Future prospecting will probably show that considerably acreage of coal No. 6 exists in Tps. 15 and 16 N., Christian County, but drill holes must be placed closer to each other than is customary in the Illinois fields, in order to secure correct knowledge of the area.

In T. 13 N., Rs. 1 E., 1, 2, and 3 W. coal No. 6 averages 7 feet in 21 drill holes and mines distributed over the area. The tier of townships

to the north is underlain by coal No. 6 ranging from 4 feet 3 inches to 7 feet 8 inches, the average being 5 feet 11 inches in 13 measurements. At Pana in the southeast corner of the county the coal varies in thickness from 7 to 8 feet; and the same figures represent its thickness in the drill holes indicated on the map in T. 11 N., Rs. 1 and 2 W.

Sections measured at the face in 7 mines now operating or formerly active show coal No. 6 including all bands to vary in thickness from 80 to 109 inches.

PHYSICAL CHARACTER OF COAL NO. 6

The so-called "blue band" is the most persistent of the impurities in the bed and occupies a position 10 to 20 inches above the floor. This layer is variable in thickness and character. It is generally not less than 1 inch thick, and in places a double band occurs at this horizon, each part ranging from ½ inch to 3 inches, the two being separated by about 2 inches of coal.

Pyrite bands are present especially in the middle bench. They are in most places less than 1 inch thick, and can be excluded by reasonable care in mining. This is not true, of course, with the sulphides which are disseminated throughout the coal mass.

As a whole, the bed shows a dull luster. At Taylorville the bottom bench contains the hardest, brightest coal and breaks up into cubical blocks. It is customary to mine the entire bed and to make use of the shale and rock roof rather than to leave the top coal as is done in parts of southern Illinois. Figure 9 shows graphically the characteristics of coal No. 6 in Christian County.

The bed is not affected by any major irregularities in the mines thus far exploited. A few small faults having a throw of only a foot or two were noted at Stonington, but as a rule conditions are uniform.

ROOF AND FLOOR

The regular roof of coal No. 6 in Christian County is a black shale overlain by a limestone which ranges in thickness from 1 foot to more than 20 feet. The black, laminated shale below the limestone is reported as thick as 8 feet in the mines of the county. In places the shale is absent, and the limestone immediately overlies the coal and forms an excellent roof which requires much less timbering than does the more easily broken shale. Here and there 3 or 4 inches of loosely consolidated, lighter-colored shale, called "clod" by the miner, rests on the coal, and must be "drawn" when the coal is removed.

The floor is generally clay of variable thickness. From 4 to 6 feet of this material is not uncommon and more is reported in some of the mines. Its thickness is somewhat uncertain owing to the few

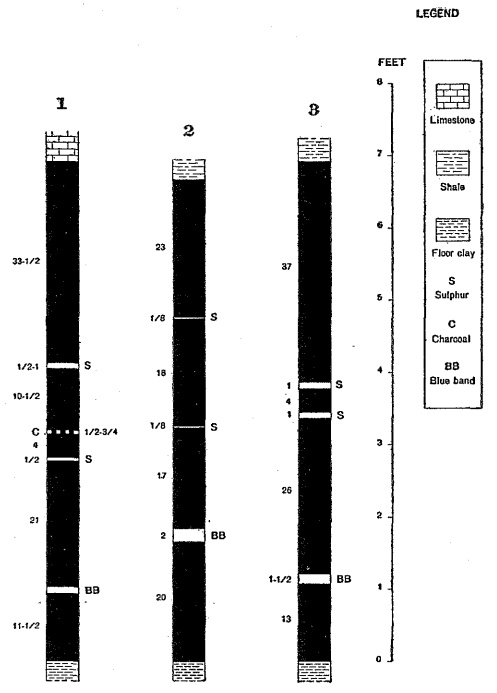

FIG 9.—Graphic sections of coal No. 6 from measurements made in mines of Christian County.

1. Stonington Coal Co., Stonington. Room 4, 4th NW. off main entry.
2. C. W. Vanderver, Edinburg. 1st S. off main west entry.
3. Penwell Coal Co., No. 1, Pana. Room 1, straight N., main east entry.

places in which it is penetrated in mining. It is commonly underlain by dark-gray or light-colored shales, and in places thin limestones lie a short distance below the clay, although they are more or less impure and can not be traced throughout the county.

In one of the mines at Pana, the floor squeezes where the roof is hardest, and as a result the lower part of the coal bed is fractured.

COALS BELOW NO. 6

The coals below No. 6 are lenticular and hence less easily traceable. Moreover, the interval between the beds, especially between coals No. 5 and 6, varies considerably in short distances, thus adding to the difficulty of correlation. For example, the interval between coal No. 6 and the next lower important coal varies from 20 feet in the vicinity of sec. 34, T. 14 N., R. 2 W. to about 75 feet in sec. 13, T. 13 N., R. 2 W. The lower bed ranges in thickness from 1 foot to 5 feet and averages 3½ feet in 8 diamond drill holes in the townships mentioned.

It is probable that it should be called coal No. 5 since the larger interval is not uncommon in the counties south of Christian, and the smaller one is well known to the north as in the mine at Mechanicsburg. Even at Springfield the average interval between coals No. 5 and No. 6 is but 39 feet. This bed tends to become thicker toward the north, and in secs. 13, 22, 32, and 34, T. 14 N., R. 2 W. coals No. 5 and No. 6 are of about equal importance. In a majority of the holes the roof of coal No. 5 is composed of a few feet of black shale capped by a thin limestone, this succession of beds being the normal one in the Springfield district where coal No. 5 is mined. Near Edinburg and Sharps the cap rock is absent.

Only a few holes have been drilled through the lowest bed of the "Coal Measures", and it is possible to draw only general conclusions regarding the distribution of the earlier coals. Three main horizons appear to exist below coal No. 5. Owing to the lenticular nature of the coal it is not believed that all three horizons contain commercial coals throughout the county. In places a bed of coal separated into 2 benches by shale varying from a few inches to 6 or 8 feet in thickness, is reported to lie 70 feet below coal No. 5. The aggregate thickness of the coal is reported to reach as much as 5 feet, although neither bench is known to be more than 2 feet 10 inches.

About 250 feet below coal No. 6 is an horizon which should be tested in any attempt to explore the coal resources of the county. This coal occupies the general position of coal No. 2 and may have been deposited contemporaneously with the Murphysboro bed. Some coal generally exists at this horizon but the determination of its thickness and character must be left to the drill. In places it exists as a single bed; whereas in others it is separated into two benches by a variable amount of shale or sandstone. A combined thickness of 6 feet is not unknown.

About 36 feet below the lower bench of the coal mentioned above, there is developed in places a bed known as coal No. 1, probably equivalent to at least one of the beds mined at Assumption. In sec. 35, T. 13 N., R. 1 W. a 2-foot 5-inch coal lies 318 feet below coal No. 6 and probably corresponds in position to the upper bed at Assumption. Three typical logs are graphically compared in figure 10.

The lenticular character of the coal beds in the lower part of the "Coal Measures" renders predictions unsafe, but the existence of coals that may prove to be commercial, as at Assumption, is highly probable. With this in mind it seems reasonable to suggest that in drilling, most of the holes should be extended at least through the horizon of coal No. 5 which in most places is not more than 70 feet below coal No. 6.

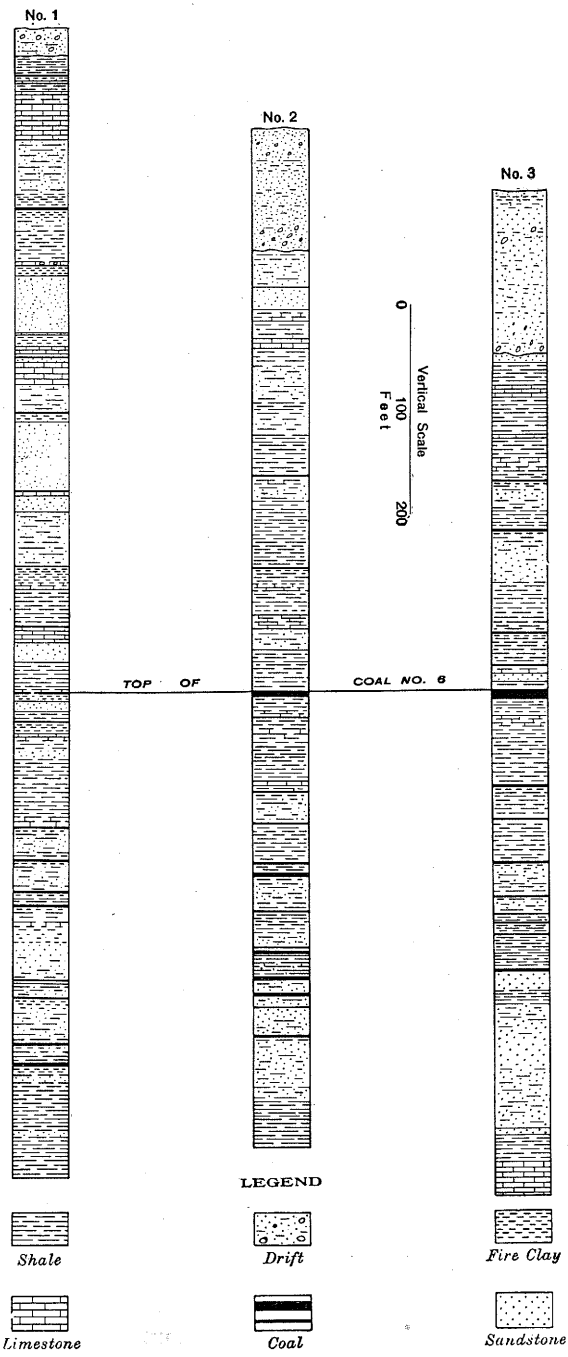

FIG 10.—Graphic sections of drill holes in Christian County.
1. Shaft at Assumption.
2. Byrd & Taylor, hole No. 8 in SE.¼ NE.¼ sec. 35, T. 13 N., R. 1 W.
3. Byrd & Taylor, hole No. 13 in NW.¼ SE.¼ sec. 13, T. 13 N., R. 1 W.

A few holes should be continued from 250 to 300 feet below coal No. 6 in order to test all of the possibilities of the area.

Coal No. 7

About 30 feet above coal No. 6 is a bed which rarely attains a thickness of more than a few inches. Earlier in this report it has been designated as coal No. 7. Diamond-drill records in the southwestern part of T. 14 N., R. 2 W. seem to indicate a somewhat abnormal development of this bed to a thickness which, if affecting a considerable area, might lend to it commercial value. Records show thicknesses ranging from 3 feet to 4 feet 11 inches, but it is believed that such a development of coal No. 7 is restricted to a small area and is not to be expected outside.

FAYETTE COUNTY

Production

No coal production is reported from Fayette County. In 1874 a shaft at Vandalia was sunk to a depth of 377 feet, and from the bottom of the shaft a hole was drilled to a depth of 574 feet without finding a workable coal bed. From data at hand, it appears that the hole was continued just far enough to reach the horizon of coal No. 6, and that this bed is absent at this point.

A few of the thin coals in the upper "Coal Measures" outcrop at several places in the county east of a general north-south line through the middle of R. 2 E. Here and there one of these lenticular beds attains a thickness of 2 feet, and formerly coal was mined for local consumption at a number of places in the county.[3]

Coal No. 6 is mined north of the county at Pana, south at Centralia, and west in Montgomery County. Prospecting has been extended into Fayette County eastward, and doubtless shafts will be sunk there in the future, especially after the more easily accessible coal has been extracted.

Coal-bearing Rocks

The coal-bearing beds of Fayette County have been explored by about 20 drill holes and by the shaft mentioned above. About half of the holes were discontinued in the fire clay underlying coal No. 6, a few penetrate the lower coals, and two put down in search of petroleum reach depths of 2825 and 2960 feet. All except 2 of the holes of which the records are available for study, are located in the two west tiers of townships. The well of the Producers Oil Company

[3] Ill. Geol. Survey, vol. 6, p. 143, 1875.

in the NE. ¼ NW. ¼ sec. 22, T. 9 N., R. 1 W. shows 1140 feet of coal-bearing rocks. Their nature is best known above coal No. 6 which lies from 490 feet beneath the surface in sec. 4, T. 6 N., R. 1 W. to about 730 feet near Farina in T. 5 N., R. 5 W.

These beds are overlain by the glacial drift which varies in thickness from 30 or 40 feet to about 150 feet. Where erosion prior to the deposition of the drift did not cut down too deeply, a thick limestone is found a short distance below the drift. This limestone occupies the position of the New Haven which has been described previously. Where the limestone is present, it forms in most places a conspicuous bed which in places attains a thickness of 25 feet, although its average is considerably less. From 200 to 250 feet below the New Haven is the Carlinville limestone which can be recognized in most of the holes.

A few thin coals lie between the two limestones mentioned but they are lenticular and unimportant. Shales and a few minor beds of sandstone constitute the interval. Between the Carlinville lime and coal No. 6 which lies about 310 feet below, the records show a larger amount of sandstone than is common in this part of Illinois. Several logs show a thick bed of sandstone including beds of shales or limestones about half way between the Carlinville limestone and coal No. 6.

The thin bed of coal which is generally found about 180 feet above coal No. 6 is not reported in the holes of Fayette County. Coal No. 7 which is shown in most of the holes, lies from 20 to 30 feet above No. 6 and appears to be thicker here than in the counties to the west. Half of the logs record this bed and show a thickness ranging from a few inches to 2 feet 7 inches, the average being 2 feet where the bed is present.

Most of the records show the usual limestone cap rock above coal No. 6 with a thin intervening bed of black shale, but holes in sec. 22, T. 9 N., R. 1 W.; sec. 15, T. 6 N., R. 1 E., and sec. 24, T. 6 N., R. 2 E., show only a shale roof, the limestone probably having been eroded subsequent to deposition.

Nine churn-drill holes penetrate the lower part of the "Coal Measures," but the logs are unsatisfactory. As much as 550 feet of coal-bearing rocks are known below coal No. 6, but aside from the fact that more sandy beds exist near the base and a few coal beds are noted, little definite information is available.

The following logs are typical of the coal-bearing strata in Fayette County.

Drill record of F. S. Peabody hole

Location—NE.¼ SW.¼ sec. 16, T. 8 N., R. 1 E.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil	1	....	1	....
Clay	11	....	12	....
"Hardpan"	15	....	27	....
Sand	14	....	41	....
Clay, yellow	12	....	53	....
Bowlders	1	....	54	....
Clay and gravel	4	....	58	....
Clay, yellow	5	....	63	....
Sand	3	....	66	....
Clay	9	....	75	....
Clay and gravel	9	....	84	....
Limestone, broken	14	....	98	....
Limestone, hard, blue (New Haven)	9	....	107	....
Sand shale	3	....	110	....
Sandstone	2	....	112	....
Sand shale	7	....	119	....
Sandstone	1	6	120	6
Sand shale	21	6	142	....
Sandstone	1	....	143	....
Sand shale	9	....	152	....
Sandstone	2	....	154	....
Sand shale	12	....	166	....
Shale, soapy, lime spots	4	....	170	....
Shale, dark, soapy	1	6	171	6
Coal	....	6	172	....
Fire clay, soft	6	6	178	6
Sandy shale	22	6	201	....
Shale, dark, soapy	28	6	229	6
Shale, dark, limy	1	6	231	....
"Slate," black	2	....	233	....
Coal	1	....	234	....
Fire clay	6	....	240	....
Shale, blue	2	....	242	....
Sand shale, lime spots	11	....	253	....
Limestone	....	8	253	8
Sand shale	6	4	260	....
Shale, soapy	20	....	280	....
Sand shale, lime band	15	....	295	....
Shale, soapy	10	....	305	....
Lime shale	3	6	308	6
Shale, soapy	1	2	309	8
Coal	....	4	310	....
Fire clay	3	9	313	....
Shale, soapy	13	3	327	....
Lime shale	2	....	329	....
Sand shale	3	....	332	....
Sandy shale	21	....	353	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Limestone (Shoal Creek?)	5	....	358	....
Shale, tough, blue	1	....	359	....
"Slate," black	4	6	363	6
Chert	....	6	364	....
Sand shale	13	4	377	4
Shale, soapy	6	....	383	4
Shale, soapy, hard sand partings	4	6	387	10
Sand shale, hard	8	8	396	6
Shale, tough, dark	17	6	414	....
Shale and bands, soapy	6	7	420	7
Sand shale	9	5	430	....
Shale, dark, sand bands	11	....	441	....
Shale, dark	6	....	447	....
Sandstone, hard	3	....	450	....
Sand shale	9	....	459	....
Sandstone, hard	2	....	461	....
Sand shale	7	....	468	....
Sand shale, hard	26	....	494	....
Sandstone	1	....	495	....
Sand shale, hard	9	....	504	....
Sand shale, hard	24	....	528	....
Sandstone	1	....	529	....
Sand shale	2	....	531	....
Sandstone	49	....	580	....
Lime shale, sandy	1	6	581	6
Shale, tough, dark	2	....	583	6
Shale, sandy	10	6	594	....
Shale, tough, dark	25	6	619	6
Shale, red	1	6	621	....
Sand shale, hard	5	....	626	....
Shale, red	2	....	628	....
Shale, dark	3	....	631	....
Lime shale, hard, sandy	9	6	640	6
Shale, dark, tough	2	5	643	....
Shale, dark	1	....	644	....
Chert	....	10	644	10
Shale, dark, tough	7	2	652	....
Shale, soapy	3	....	655	....
Shale, soft, black	2	6	657	6
Limestone, hard	....	6	658	....
Shale, soft, black	....	6	658	6
Lime shale, hard	1	6	660	....
Shale, dark	1	....	661	....
Shale, soapy	4	11	665	11
Coal	....	8	666	7
Slate	....	3	666	10
Coal	....	2	667	....
Slate, limy	....	5	667	5
Slate, black	2	7	670	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Coal (No. 6)	6	7	676	7
Sandstone	6	11	683	6
Sandstone, shale partings	4	6	688	....
Shale, soapy	5	....	693	....
Sandstone, limy	3	10	696	10
Slate, black	1	2	698	....
Coal (No. 5?)	4	....	702	....
Fire clay, soft	2	....	704	....
Shale, hard, blue	2	....	706	....

Geologic Structure

A small number of holes in the county renders a determination of detailed structure impossible. The strike of the beds in the western part of the county is almost north-south and the dip is eastward into the Illinois coal basin. The only holes in the eastern part of the county, one in sec. 24, T. 6 N., R. 2 E., and the other in sec. 32, T. 5 N., R. 4 E. show coal No. 6 at 40 and 140 feet below sea level, respectively. In the latter hole at Farina the coal is 130 feet higher than at Kinmundy, six miles southwest. It is possible that the deepest part of the basin is not regular in shape, but that a syncline having a north-south axis connecting with the main basin at the south extends through the eastern part of Marion County and into the southern part of Fayette County. That this syncline does not extend through Fayette County is shown by the position of coal No. 6 in sec. 24, T. 6 N., R. 2 E., where it stands higher than at Vandalia, 10 miles west.

Coal No. 6

Distribution and Thickness

Coal No. 6, which ranges in depth from 490 feet in sec. 4, T. 6 N., R. 1 W. to 720 feet at Farina in the southeast corner of the county, is commercially the most important bed. Its presence has been demonstrated throughout the greater part of the western half of the county, although its thickness is not in all places sufficient to encourage mining. The northwest quarter of the county has been better explored by the drill than have the remaining areas, and in this quarter, comprising Tps. 7, 8, and 9 N., Rs. 1 E. and 1 W., coal No. 6 averages 6½ feet in thickness. In the vicinity of Vandalia this coal appears to be thin or absent. To the north in sec. 16, T. 7 N., R. 1 E. no coal is reported at this horizon, and it is possible that a considerable area in this part of the county will prove to be barren of coal No. 6 in commercial

thickness, but any attempt to outline such an area with the meager information available would be futile.

A churn-drill hole in sec. 24, T. 6 N., R. 2 E. 10 miles east of Vandalia reports 7 feet of coal No. 6; at Farina in the southeast corner of the county the same bed is said to be 6 feet thick. The fact that in the southeastern part of Bond County and in the northern part of Marion County the coal is below normal thickness, lends support to the belief that this bed will show similar characteristics in southern and southwestern Fayette County, although the drill alone will determine the facts.

ROOF AND FLOOR

Knowledge of the characteristics of roof and floor is limited to drillings and is necessarily unsatisfactory in comparison with examinations in the mine. A limestone cap rock is present over most of the prospected area, but in sec. 22, T. 9 N., R. 1 W.; sec. 15, T. 6 N., R. 1 E.; and in sec. 24, T. 6 N., R. 2 E. only shale is found over the coal, the limestone probably having been eroded after deposition. In places the cap rock is reported to lie in contact with the coal, but generally a few feet of black shale intervene as is usual in the Belleville district. In practically every hole the material under the coal is reported as clay or shale.

Coals below No. 6

The coals below coal No. 6 in part of Fayette County appear to be extremely lenticular. The diamond-drill hole in NE. ¼ SW. ¼ sec. 16, T. 8 N., R. 1 E. shows a 4-foot coal 28 feet below the top of coal No. 6. The interval here appears to be too small for No. 5, but such a figure would not be unusual farther north in Christian County. No coal is found in a similar position in any of the other Fayette County logs. A 1-foot bed is noted in sec. 15, T. 6 N., R. 1 E. 85 feet below coal No. 6, and 45 feet lower is another bed said to be 5 feet thick. A hole drilled in the same section by another company shows the same coal horizons, but the log reverses the thicknesses of the two lower coals, and it is thought that the records are not reliable as to the coal. Three records show coal ranging in thickness from 1 to 5 feet about 250 feet below coal No. 6; whereas other holes passing through the same horizon fail to penetrate any coal. The data available do not permit a safe conjecture as to the existence of a coal below No. 6 which might be commercially developed in the future.

MACOUPIN COUNTY

Production and Mines

Production in tons, year ended June 30, 1913....	5,208,682
Average annual production 1908 to 1913.....	4,504,632
Total production 1881 to 1913.....	73,459,119

The 15 mines of Macoupin County produced 8.6 per cent of the total output for the State in 1913. Four of these mines: Superior Coal Company Nos. 1, 2, and 3 at Gillespie, and Consolidated Coal Company No. 14 at Staunton, averaged more than 3000 tons per day. Table 6 is a list of the shipping mines and data concerning them. The production is for the year ended June 30, 1913.

Coal-bearing Rocks

The character of the coal-bearing beds is best known in the eastern half of the area where about 100 holes and shafts have been sunk at least as deep as coal No. 6, which lies 300 to 400 feet below the surface in this part of the county. The beds rise gently toward the west, and coal No. 6 reaches the surface near the western border. It outcrops and was formerly mined in the bluffs of Hodges Creek in sec. 29, T. 10 N., R. 9 W. Coal No. 5, about 50 feet below coal No. 6, is said to be visible at this place during low water. No accurate measurements have been made, but its thickness is reported to be about 2 feet.

The "Coal Measures" are thinnest along the western boundary of the county, where about 300 feet of strata overlie the Mississippian limestones. From 5 to 10 miles farther west in Greene and Jersey counties, the lowermost coal-bearing rocks appear at the surface. At Carlinville more than 500 feet of these beds are known, and at the extreme eastern side of the county they attain a thickness of about 700 feet.

The surface deposits range in thickness from 20 to 200 feet or more showing a former relief even greater than that of the present.

The Carlinville limestone 220 to 250 feet above Coal No. 6 reaches its western limit a short distance west of the town of the same name, and its outcrop can be traced southeast toward Staunton and into the southern counties. This limestone outcrops in many of the streams near Carlinville and may be recognized without difficulty. It forms the bed rock over an extensive area in this part of the State and lies immediately under the glacial drift. Although its average thickness is but 9 feet, its persistency lends to it considerable usefulness in the proper correlation of beds. In the eastern part of the county this limestone is found as far as 150 feet below the surface.

TABLE 6.—*List of shipping mines, Macoupin County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T. N.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Superior Coal Co.	3	NW	NW	36	8	7	641	346	295	7	....	837,834
2	Superior Coal Co.	2	NW	SW	6	7	6	620	317	303	7	6	828,288
3	Superior Coal Co.	1	SE	NW	29	8	6	630	340	290	7	6	681,852
4	Consolidated Coal Co.	14	....	NE	30	7	6	605	285	320	7	....	651,229
5	Consolidated Coal Co.	15	north	cen.	9	7	6	645	362	283	7	....	460,201
6	Royal Colliery Co.	1	SW	SW	8	12	6	673	314	359	6	6	395,652
7	Girard Colliery Co.	5	SE	SE	32	12	6	676	345	331	7	....	353,002
8	Madison Coal Corporation	....	....	NW	1	7	6	680	417	263	8	....	279,290
9	Glenridge Coal Co.	1	....	NE	9	12	6	674	320	354	7	....	242,122
10	Vivian Collieries Co.	....	SW	SW	5	11	6	674	352	322	6	6	209,213
11	Consolidated Coal Co.	8	....	SW	11	7	6	680	393	287	7	9	185,541
12	Carlinville Coal Co.	....	....	NW	28	10	7	627	258	369	7	....	77,790

A few thin coals lie between the Carlinville limestone and coal No. 6 below, but they do not appear to be so persistent as in Christian County. However, the discovery of the persistent nature in the latter area may be due to the use of the diamond drill. A few inches of coal No. 7 is generally found as usual about 30 feet above coal No. 6. In many places it has a limestone roof whose thickness is regularly less than that of coal No. 6. A few logs show a 2-foot coal about 150 feet above coal No. 6. This bed is probably to be correlated with coal No. 8 which has been described in other counties, but its lack of persistency in Macoupin County renders it almost useless in correlation.

Coal No. 6 and its limestone cap rock are the most widely developed in the county. In but few holes is one or the other absent. In the Griffell well, NW. ¼ SE. ¼ sec. 15, T. 9 N., R. 7 W., the absence of both is due to pre-glacial erosion which extended to a depth of 235 feet.

Underlying coal No. 6 are 300 to 500 feet of coal-bearing rocks, but little is known of their nature except that they consist largely of shales, a few sandy beds especially in the lower parts, and lenticular beds of coal. The deeper holes were drilled in search of oil, and little attention was given to the lower coals. Coal No. 5 was noted by Worthen in a few outcrops along the western side of the county where it is 30 to 40 feet below coal No. 6. In the logs available for study its absence is conspicuous. Scattered records show a thin coal from 80 to 100 feet below coal No. 6, which may represent coal No. 5, but the interval appears to be too large for such a correlation. From 200 to 250 feet below coal No. 6 in the general position of coal No. 2, a few records show from 3 to 4 feet of coal. This, the lowest bed in the county, is but a short distance above the thick Mississippian limestones upon which the "Coal Measures" lie.

The following logs represent typical borings in various parts of the county:

Well record submitted by Thos. Rinaker

Farm—Dews

Location—NE. cor. NW.¼ NW.¼ sec. 2, T. 9 N., R. 9 W.

Description of Strata	Thickness *Feet*	Depth *Feet*
Pennsylvanian Strata—		
Clay, yellow	65	65
Mud, white	41	106
Quick sand and gravel	4	110
Mud, yellow	10	120
Lime (good flow fresh water)	8	128
"Slate," white	22	150

Description of Strata	Thickness	Depth
	Feet	*Feet*
Coal (No. 6)	4	154
"Slate", white	11	165
"Slate", brown	10	175
Mud, white	35	210
Sand, black (?)	20	230
"Slate", white	15	245
"Slate", brown	15	260
Coal	4	264
"Slate", brown	4	268
Mud, white	5	273
"Slate", white	7	280
Sand, broken, dark	20	300
Sand, white	10	310
Mississippian strata (upper beds)—		
Lime, sandy	10	320
Mud, white	10	330
Limestone (brackish water)	200	530
"Slate", black	10	540
Lime, dark	10½	550½

Well record of Haake well, Impromptu Exploration Co.

Location—SW.¼ NW.¼ sec. 17, T. 9 N., R. 7 W.

Description of Strata	Thickness	Depth
	Feet	*Feet*
Top soil	30	30
Quick sand and gravel	25	55
Blue gumbo clay	25	80
"Slate", white	50	130
"Slate", black	5	135
Lime, white	3	138
"Slate", white	12	150
Lime, white	5	155
"Slate", white	5	160
Limestone and slate	5	165
"Slate", black	2	167
Limestone, gray	1	168
"Slate", white	4	172
Coal (No. 6)	5	177
"Slate", white	73	250
"Shale", brown	20	270
"Slate", white	10	280
Shale, brown	5	285
"Slate", white	15	300
"Slate", black	13	313
"Slate", white	6	319
Limestone shells	6	325
"Slate", white	21	346
"Slate", black	10	356
"Slate", white	12	368

Description of Strata—	Thickness	Depth
	Feet	*Feet*
Shale, black, and coal	2	370
"Slate", white	5	375
Shale, black	12	387
"Slate", black (show of oil 392 to 410 feet)	2	389
Sand (oil 417)	24	413
Salt water (421)	37	450

Record of F. S. Peabody hole

Farm and hole—Davis No. 7

Location—NW.¼ NW.¼ sec. 11, T. 10 N., R. 6 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil	2	....	2	....
Clay, yellow	14	....	16	....
"Hardpan"	2	....	18	....
Clay, yellow	20	....	38	....
"Hardpan" and gravel	10	....	48	....
Clay, blue	26	....	74	....
Gravel	3	....	77	....
Limestone, broken (Carlinville)	11	6	88	6
"Slate," black	8	6	97	....
Shale, soft, soapy	9	....	106	....
Limestone	1	6	107	6
Lime shale	1	6	109	....
Shale, soft, soapy	9	6	118	6
Lime shale	2	....	120	6
"Slate," black	2	6	123	....
Coal	....	8	123	8
Fire clay	6	4	129	....
Lime shale	7	....	136	....
Sand shale, hard bands	9	....	145	....
Shale, tough, lime bands	11	....	156	....
Limestone	4	....	160	....
"Slate," black	....	6	160	6
Lime shale	1	....	161	6
Sandstone	1	6	163	....
Shale, gray	26	10	189	10
Coal	....	9	190	7
Fire clay	2	5	193	....
Lime shale	6	....	199	....
Sand shale	41	....	240	....
Shale, tough, gray	14	....	254	....
"Slate," hard, gray	11	....	265	....
Shale, soft, dark	4	....	269	....
Clay shale, soft	3	....	272	....
Sand shale	6	....	278	....
Sand shale, hard	19	6	297	6
"Slate," black	2	3	299	9

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Coal	1	....	300	9
Fire clay	3	3	304	....
Sand shale	8	....	312	....
Shale, soft, blue	3	....	315	....
Limestone	6	....	321	....
Shale, soft	1	....	322	....
Clay shale	1	....	323	....
"Slate," black	2	3	325	3
Coal	....	3	325	6
Clay shale	7	4	332	10
Limestone	5	10	338	8
Clay shale	1	....	339	8
Limestone	8	10	348	6
"Slate," black	1	....	349	6
Coal (No. 6)	5	8	355	2
Fire clay	....	10	356	....

Geologic Structure

The lowest beds that outcrop in Macoupin County are near coal No. 6, which reaches the surface in the extreme western part at an altitude of about 600 feet above sea level. The glacial drift covers most of the surface and the outcrops are confined to the stream channels that have been cut into the bed rock.

All the beds dip eastward at the rate of about 14 feet per mile. Data are too meager in the western half of the county to permit the drawing of detailed structure contours. In the eastern half of the area, although the general dip is eastward, in places slight modifications and even reversals of this dip have been noted. In secs. 7 and 8, T. 9 N., R. 7 W. the beds occupy the position of a small dome, the center of the arch being about 50 feet higher than the surrounding areas. This structural feature has proved to be of some economic importance, because of its effect on the accumulation of oil and gas. For details regarding the Carlinville dome, the reader is referred to Extracts from Bulletin 20.[4] The 50-foot contour interval used on the large map in the present report, is too large to show properly the shape of the dome.

The doming of the strata two miles northwest of Staunton is another variation in the general eastward dip. Inside of the closed contour shown on the map the coal is from 20 to 30 feet higher than in the surrounding area. This Staunton dome has not been tested by holes sufficiently deep to reach the Pottsville beds which produce some oil at Carlinville.

[4] Kay, Fred H., The Carlinville Oil and Gas Field: Ill. State Geol. Survey, Extracts Bull. 20, p. 38, 1912.

No large faults are known in the county. Here and there in the mines a small slip is noted, but the beds appear to be free from troublesome displacements.

Coal No. 6

DISTRIBUTION AND THICKNESS

Coal No. 6 underlies practically the entire county. A small area in the northwest is probably beyond the outcrop, and it is also likely that in the shallow area in the western half of the county the coal has been eroded by streams which were active on the old surface before glacial times. A hole in sec. 1, T. 9 N., R. 9 W., probably passed through such an ancient channel; whereas another hole one and one quarter miles northwest of the former shows coal No. 6 although it is somewhat thinner than normal. Beside the absence of the coal due to erosion immediately preceding glacial times, other irregularities are known to be the result of channels which existed during, or shortly after, coal deposition. The Griffell well mentioned above is an example of the former type in which glacial drift extends downward below the horizon of coal No. 6; whereas other wells showing no coal contain a considerable thickness of sedimentary rocks above the position of the coal. This is true especially in the vicinity of the Carlinville oil field. In this general locality a drainage channel probably existed shortly after the coal was deposited. The V. Hall well No. 5 and McClure wells Nos. 1, 2, 3, and 6 in the central part of sec. 8, T. 9 N., R. 7 W., show no coal; whereas V. Hall well No. 3, SW. ¼ SE. ¼ NW. ¼ sec. 8 penetrates 5 feet of coal No. 6. From the information at hand it is not possible to outline the course or extent of the ancient channels. To the north and south uniformly thick coal is found, although but little prospecting has been done between the area underlain by thin coal southwest of Carlinville and the similar area in western Montgomery County to the east. It is possible that the two are connected and that on the map the western border of the barren area in Montgomery County should by the westward extension of the line be made irregular to include the area described in Macoupin County.

In the eastern half of the county excluding the area mentioned above the coal averages 7 feet in thickness, the maximum being about 9 feet. At Bunker Hill, sec. 14, T. 7 N., R. 8 W., and at Chesterfield, sec. 2, T. 9 N., R. 9 W., the same coal averages 5 to 5½ feet and the few prospect holes in this part of the county seem to indicate that the coal is somewhat thinner near the edge of its area of deposition. It is commercially important, however, and will be mined when the thicker coal to the east has been extracted.

Present prospecting and mining are dependent largely upon the location of the principal transportation lines, and future roads will no doubt cause the exploitation of valuable coal resources west of the present mines.

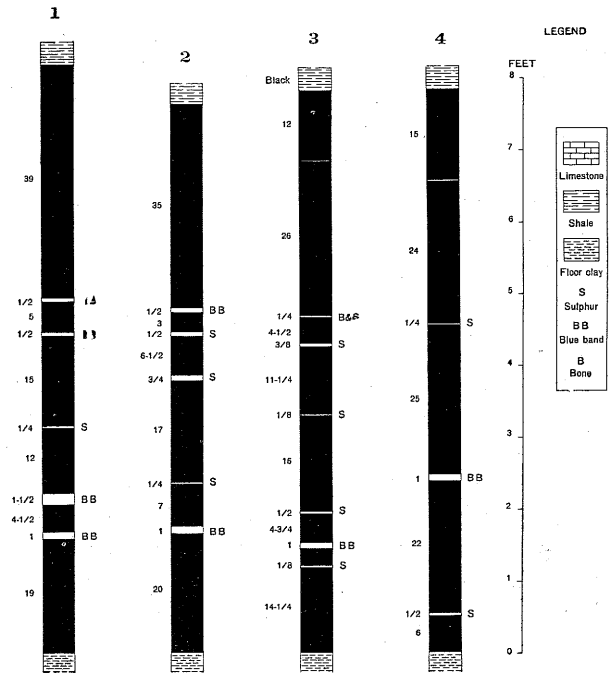

FIG. 11.—Graphic sections of coal No. 6 from measurements made in mines of Macoupin County.

1. Superior Coal Co., No. 3, Gillespie. Face main east, 4700 feet from shaft.

2. Carlinville Coal Co., Carlinville. Main south face, 5000 feet from shaft.

3. Consolidated Coal Co., No. 15, Mt. Olive. Room 20, off 3rd east, north.

4. Glenridge Coal Co., North mine, Virden. 1st W. off 15th S. off main east.

PHYSICAL CHARACTERISTICS

Coal No. 6 is in Macoupin County physically similar to that in other parts of the district, and the natural division of the bed into three benches prevails (see figure 11). The top coal which is generally separated from the middle bench by a parting of pyrite, or in other places by charcoal, is composed of hard, bright coal usually free from impurities. Contrary to practice in the southern part of the State, the top coal is generally removed in mining. At the North

mine of the Illinois Collieries Company at Virden, 15 to 18 inches of top coal is left wherever this is possible. In places flakes of calcium carbonate or calcium sulphate have been deposited in the cleavage faces, more especially near the top of the bed, probably from descending waters. The top coal is variable in thickness, but in most places it is less than 2 feet.

The middle bench contains the largest amount of impurities which consist of horizontal bands of pyrite, dirt, and bone. In many places the luster of the coal in the middle bench is duller than that of the top and bottom. The banded impurities are more or less irregular in position, but in some mines certain bands are persistent and are employed in placing shots to best advantage, especially if the band acts as a clean parting in the bed. Pyrite streaks of this type are often called "steel" bands by the miner. In Superior Coal Company's No. 3 mine at Benld, the so called "steel" band is about 5½ inches above the "blue band" and makes a clean parting at its horizon. Another characteristic parting lies from 15 to 30 inches below the top of the coal and may consist of pyrite, dirt, or charcoal.

Besides the persistent impurities mentioned above, the middle bench is characterized by a number of irregular bands of these materials, ranging in thickness from a knife edge to 2 inches. The larger ones are rejected in mining. The "blue band" is characteristic here as in other counties of the district. It averages about 1⅓ inches in thickness and is composed largely of fine-grained, gray shale, including horizontal streaks of sulphur. It is the lowest third of the bed and its position averages about 20 inches from the bottom.

The bottom coal is generally somewhat harder than the middle, and it contains fewer dirt bands. In places near the contact with the floor black jack or bone is present to a thickness of several inches.

The following detailed sections were measured at the face in typical mines of Macoupin County:

Superior Coal Company, mine No. 3
Section of coal No. 6, face 5th E., 1st S.

	Thickness *Inches*
Shale, black, roof	
Coal, bright, with gypsum flakes in cleavage planes toward top, a few charcoal bands; one small sulphur streak	30
Sulphur, in places dirt only, characteristic band	½
Coal, dull, laminated, ¾-inch charcoal band 6 inches from top; one or two irregular sulphur streaks	24
Sulphur, not continuous	¾
Coal, alternating bright and dull layers	12½
Sulphur, "steel-band" of miner; persistent, makes clean parting in coal	¼ to ½

	Thickness *Inches*
Coal, bright, clean	5½
"Blue band," sulphur, and gray shale	1½
Coal, bright, clean and hard	24
Clay floor *Total thickness coal*	99½

Illinois Collieries Company, North mine, Virden
Section of coal No. 6, room 18, 5th right, off 15 S.

	Thickness *Inches*
Shale, black, 1 to 6 feet.	
Coal, clean, bright, one small sulphur band not regular; at bottom thin sulphur band which acts as parting for top coal	15
Coal, fairly clean, bright with one band of charcoal	11
Dirt, regular, called "drift band"	1
Coal, clean	9
Dirt, persistent in mines	1
All coal above, contains many small dirt and sulphur layers.	
Coal, clean, bright	14½
Sulphur, persistent, "steel band"	⅛
Coal, clean, bright	8
"Blue band", shale and sulphur, 2 to 3 inches in places	¾
Coal, cleaner, brighter. In places bottom part is replaced by bone or black jack	29
Clay floor *Total thickness coal*	89⅜

ROOF OF COAL NO. 6

The normal roof materials of coal No. 6 in Macoupin County are black shale next overlying the coal, followed by limestone cap rock. The shale is almost everywhere present, although in places it is scarcely more than "a draw slate". In the same mine the black, laminated shale may be 6 feet thick or it may be absent, in which latter case the limestone rests on the coal. When this is the condition, there are here and there a few inches of soft, limy, gray shale exhibiting but little cohesion, which underlies the regular cap rock. This so-called "clod" requires removal in mining. Where the shale is but 12 to 15 inches thick, it is generally removed sooner or later, and the cap rock left as the roof.

Small "slip" planes are present in the shale in most of the mines and "falls" are frequent. Figure 12 shows such a "slip", and the resultant "fall" in mine No. 5, Madison Coal Corporation, Mt. Olive.

In places part of the black shale appears to have been replaced by "white top," a light gray, clay shale, which seems to be definitely related to natural heating and in some places to gob fires. After "falls" including this material, if it is not removed, chemical action

involving liberation of heat takes place in the loose mass, especially if the air is partly excluded by the plastic outer surface which results from exposure to the moist air of the mine. Heating continues, and if combustible material such as coal is mixed with the gob or if the mass rests against the rib, ignition is liable to occur. The constituents which cause the heating are not now known, but chemists of the cooperation are analyzing the shale and will no doubt be able to determine the chemical reactions involved.

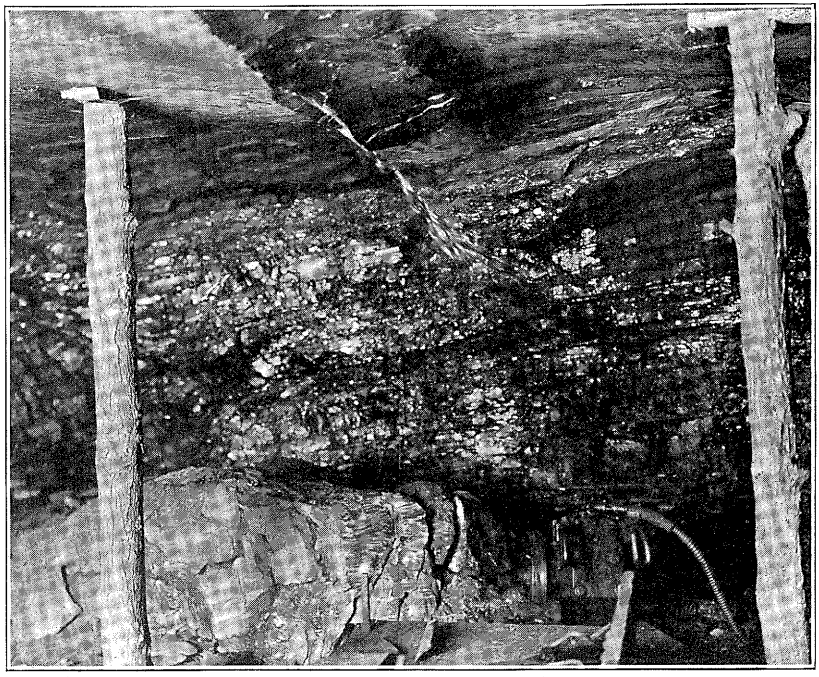

FIG. 12.—Photo showing "slip" in roof and coal, and the "fall" resulting therefrom. Madison Coal Corporation, mine No. 5, Mt. Olive. (Courtesy Madison Coal Corporation.)

The limestone cap rock is almost everywhere present. Its thickness is extremely variable, and it is made up of several beds of limestone with partings of shale. The combined thickness of these beds is as much as 30 feet in places, but averages about 10 feet for the county. The quality of the limestone roof is dependent largely upon the nature of its bedding. Where it lies in regular layers and the parting between it and the coal is clean, it possesses a high degree of efficiency; where it is nodular and lacks uniform bedding planes, difficulty is experienced in supporting it. Both types are present in mine No. 5 of the Madison Coal Corporation at Mt. Olive.

In many places the black shale contains limy concretions or "niggerheads" which protrude into the coal. The irregularities produced by these concretions are not so large as the "rolls" which are kettle-shaped protuberances of the limestone into the coal. Generally the rolls affect only the upper part of the bed and give to the roof a decidedly rough and nodular appearance. In places, however, their size and number is so great as to interfere with mining operations, and in a few mines they have caused the abandonment of the parts most affected. Such was the result on the west side of the North mine, Illinois Collieries Company, at Virden. In places immediately adjacent to the rolls slickensides are found in the coal and the laminations are but slightly downward. It is generally apparent that the material forming the roll was deposited in an actual depression in the mass of vegetal matter before it began to undergo pressure. As the overlying beds accumulated, the material now constituting the roll was depressed along with the coal and the small slip planes present are the result of adjustments incidental to the settling process.

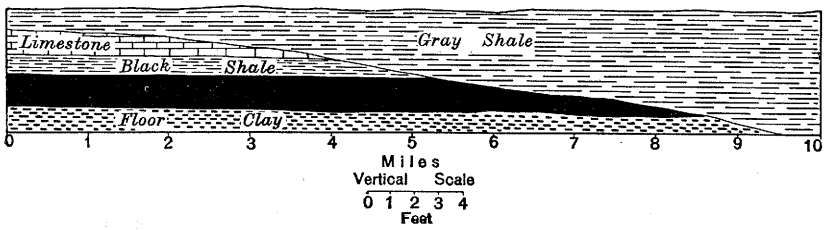

FIG. 13.—Sketch showing probable relation of erosion to the absence of roof limestone and coal in parts of Macoupin County.

An extensive area east and southwest of Carlinville has no limestone over the coal. Holes in sec. 10, T. 8 N., R. 7 W.; sec. 22, T. 9 N., R. 7 W.; and sec. 36, T. 10 N., R. 7 W. all show limestone near the coal. These holes lie in a general north-south direction. Two or three miles east, three others were drilled in secs. 18 and 32, T. 9 N., R. 6 W. and in sec. 32, T. 10 N., R. 6 W., and in all of these only shale from 40 to 50 feet thick forms the roof. Somewhere between these last holes mentioned and the Montgomery County line the coal, as well as the limestone, is absent. This barren area is part of the similar, but larger, region in western Montgomery County, described in the report on that county. The position of the western boundary of the barren area can not be drawn accurately with the available drill records, but its approximate location is indicated on the large map. It is believed that the absence of the coal and limestone is due to erosion which was active at some time after the roof limestone had been deposited. The general relations are illustrated in figure 13.

FLOOR OF COAL NO. 6

The clay underlying the coal in Macoupin county is relatively thin. In 16 mines which have been examined it varies in thickness from a knife edge to about 3 feet, the average being about 1 foot. Below the clay in most places a limestone of variable thickness and character is reported. Many of the drill holes do not penetrate this horizon, but it is known in most of the mines in the county. About three feet of dove-colored, compact, non-crystalline limestone is visible under the clay in part of mine No. 15, Consolidated Coal Company at Mt. Olive. Most of the clay is impure, especially where it is thin, and it is not promising from a commercial standpoint.

COALS BELOW NO. 6

Most of the holes that penetrate the principal coal horizons were drilled in search of oil and are located in the vicinity of Carlinville in Tps. 9 and 10 N., R. 7 W. Even in these townships no coal below No. 6 can be traced for any distance. No. 5 coal, said by Worthen to outcrop on Hedges Creek 30 to 40 feet below No. 6, does not appear to exist to the east. A coal ranging in thickness from 2 to 4 feet was noted from 90 to 110 feet below No. 6 in sec. 24, T. 10 N., R. 7 W., sec. 29, T. 9 N., R. 7 W., in sec. 2, T. 9 N., R. 9 W., and in sec. 14, T. 10 N., R. 7 W. The interval between this bed and coal No. 6 makes its correlation as coal No. 5 almost impossible. The only other horizon that shows any promise is from 200 to 250 feet below coal No. 6. Six of the deeper records note a coal in this, the position of coal No. 2 (Murphysboro). Its thickness varies from 3 to 5 feet, but the measurements are from the churn drill and are not regarded as authoritative. A complete test of any part of the county for the determination of its entire coal resources would involve the drilling of holes to a depth of 250 feet below coal No. 6 the main coal of the region. Until the supply of this latter bed is reduced however, it is doubtful if many tests will be continued below its horizon.

MADISON COUNTY

PRODUCTION AND MINES

Production in tons, year ending June 30, 1913.... 3,890,639
Average annual production, 1908 to 1913..... 3,615,309
Total production, 1881 to 1913.....56,005,118

Madison County produced 6.1 per cent of the total output for Illinois during the year ended June 30, 1913. Twenty-seven mines were operating, eleven of which produced more than 100,000 tons each, and one, New Staunton Coal Company No. 1, at Livingston, had the largest

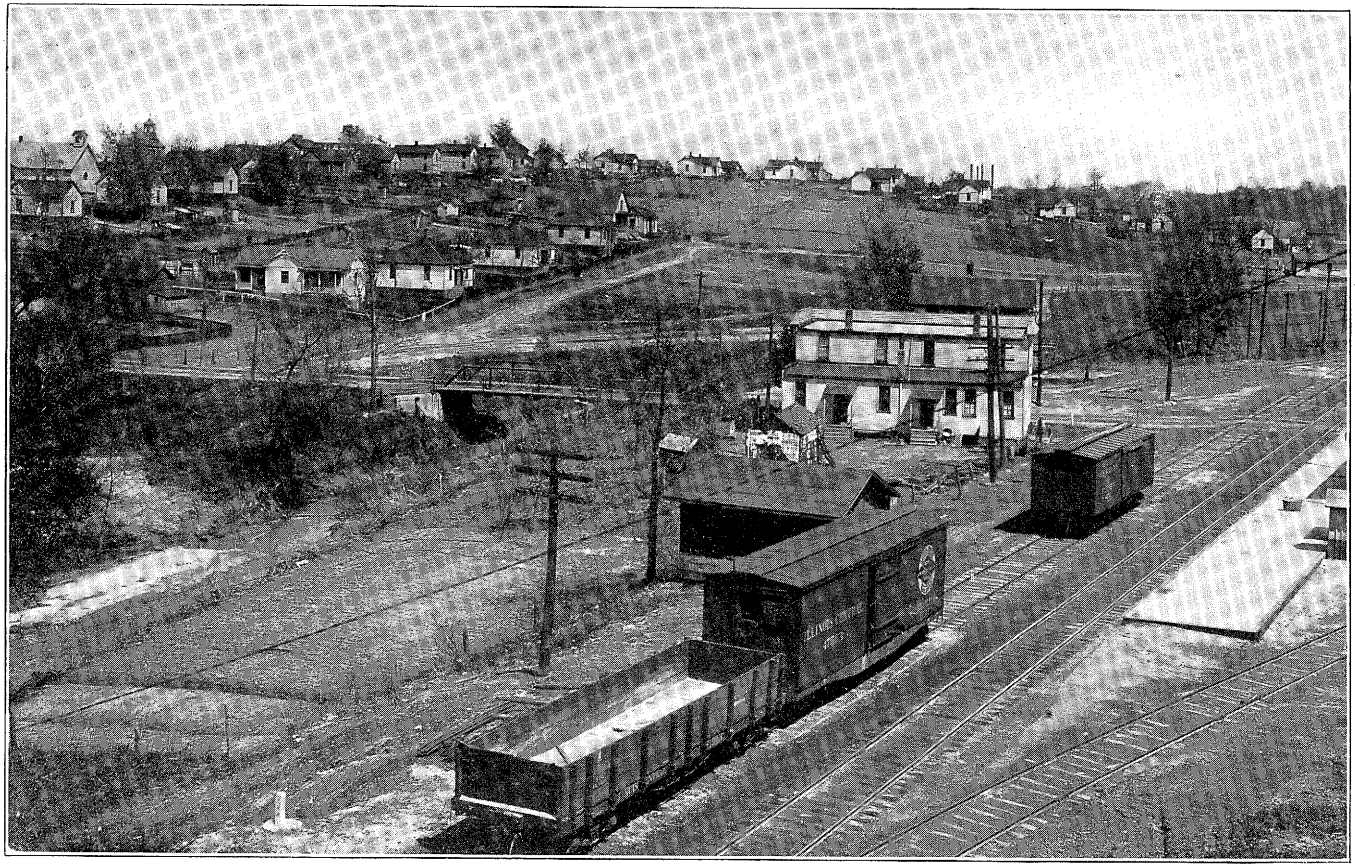

FIG. 14.—View of Glen Carbon, a typical mining town in Madison County. (Courtesy Madison Coal Corporation.)

TABEL 7.—*List of shipping mines, Madison County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T. N.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	New Staunton Coal Co.	1	NE	SE	16	6	6	586	277	309	6	....	848,715
2	Mt. Olive & Staunton Coal Co.	2	NW	NW	10	6	6	599	293	306	7	....	518,610
3	Lumaghi Coal Co	2	SW	SW	25	3	8	500	188	312	8	....	377,798
4	Donk Bros. Coal & Coke Co.	2	cen.	E½	11	3	8	573	238	335	7	....	361,169
5	Donk Bros. Coal & Coke Co.	1	....	NW	22	3	8	525	133	392	7	....	309,832
6	Madison Coal Corporation	2	SW	SE	34	4	8	476	93	383	6	6	265,504
7	De Camp Coal Mining Co.	1	SW	NE	18	6	6	622	274	348	5	4	232,974
8	Donk Bros. Coal & Coke Co.	3	NE	NE	8	3	7	568	268	300	5	....	187,125
9	Kerns-Donnewald Coal Co.	Worden	SW	SW	25	6	7	590	263	327	7	....	185,092
10	Madison Coal Corporation	4	....	NW	35	4	8	480	174	306	6	....	167,813
11	Mt. Olive & Staunton Coal Co.	1	NE	NW	8	6	6	612	280	332	6	2	144,981
12	Lumaghi Coal Co.	3	SE	SW	26	3	8	495	165	330	7	6	80,151
13	W. S. Walker	Henrietta	NE	SW	1	4	8	590	174	416	6	....	63,000
	City Coal Co.	Edwards-ville	....	....	....	....	....	....	216	....	6	5	47,636
	Edwardsville Home Trade Coal Co.	Edwards-ville	....	....	....	....	....	....	130	....	5	....	32,582
	Brookside Coal Co.	Troy	....	....	....	....	....	....	285	....	5	....	10,570

output of any single mine in the State, the average being 4,003 tons per day or a total of 848,715 tons for the year.

The mines are located in two areas, one at the southern side of the county and the other in the northeast corner. All are working bed No. 6 or the "Belleville" coal. Figure 14 is a photograph of Glen Carbon, Madison County, one of the better-class mining towns. Table 7 is a list of mines active during 1913 and data concerning them.

Coal-bearing Rocks

Madison County is located on the western boundary of the Illinois coal basin. The outcrop of the basal "Coal Measures" extends north and south through the western part of the county. Its position is obscured by the alluvial filling of American Bottom which extends from Alton south to the mouth of the Okaw in Randolph County. Its width in Madison County varies from one to six miles.

The rocks in the flood plain of the Mississippi were eroded to a depth varying from 50 to 150 feet before the alluvium was deposited; consequently the veneer of "Coal Measures" rocks was largely washed away. Figure 15 shows the relation of the valley filling to the underlying rocks along a line from Monks Mound N. 70° E. to the bluffs of the Mississippi.

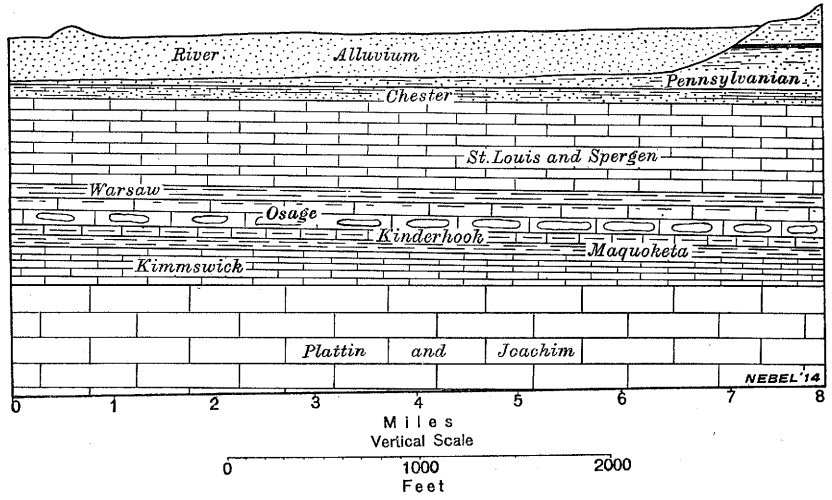

FIG. 15.—Sketch showing relation of coal No. 6 to river alluvium and to underlying beds in Madison County. (After Fenneman.)

Coal No. 6, which outcrops in the base of the bluffs south of Caseyville, is covered by alluvium, north of the southern boundary of Madison County and extends a short distance west of the bluffs. Its

line of outcrop parallels the bluffs, but sufficient drilling has not penetrated the alluvium to determine its exact position.

The coal-bearing beds, which form but a veneer in the western part of the county, increase rapidly in thickness to the east, because of the pronounced dip in that direction. The increase in the thickness is gradual and these beds measure about 700 feet along the eastern boundary of the county. Coal No. 6, which comes to the surface at the base of the Mississippi bluffs, is 230 feet below the surface at Edwardsville, and about 400 feet deep in the eastern part of the county.

The glacial covering is variable in thickness but reaches more than 100 feet in places. In the eastern part it extends down to the Carlinville limestone which forms the bed rock in parts of R. 5 W.

The beds above coal No. 6 consist largely of shale. The limestone overlying the coal is persistent, and the thin coal from 20 to 40 feet above is noted in several of the logs. The red or variegated shales described in an earlier part of the report lie a short distance above the coal just mentioned. The Carlinville limestone, averaging about 9 feet in thickness, is from 250 to 280 feet above coal No. 6. It is present only in the eastern part of the county since it rises to the west and would outcrop in a general north-south line were it not covered by glacial drift except where the latter has been eroded. From 30 to 40 feet below the Carlinville limestone, and separated from it by shale, there is present in many places a bed of coal averaging about 18 inches in thickness, and a few drillers report a thin bed 150 to 180 feet above coal No. 6, corresponding to that mentioned in the report on Christian County as coal No. 8. None of the beds above coal No. 6 are commercial.

Sandy shales and sandstones predominate below the Belleville coal. Six holes which penetrate most of the coal-bearing strate fail to show a persistent coal below No. 6. At Highland two coals separated by 10 feet of fire clay and 5 feet of sandstone lie 200 feet below the horizon of coal No. 6, the latter coal being absent at this place. The upper bed is 1 foot 10 inches thick; the lower, 1 foot 2 inches. Their position and occurrence correlate them as the two benches of coal No. 2 (Murphysboro). The other test holes do not record such beds.

At Cantine a 2-foot coal lies 105 feet below coal No. 6, and at Livingston several thin beds are reported in a zone 125 to 150 feet below the Belleville coal. The coals at both these horizons appear to be lenticular and will probably not prove to be commercial.

The following is the record of a diamond-drill hole put down at Livingston by the New Staunton Coal Company.

Record of New Staunton Coal Co. drill hole

Location—NE.¼ SE.¼ sec. 16, T. 6 N., R. 6 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil	2	....	2	....
Clay, yellow	16	....	18	....
Sand and gravel	7	....	25	....
Clay, blue	53	....	78	....
Clay, yellow	30	....	108	....
Limestone	1	....	109	....
Shale, soft, yellow	22	....	131	....
Sandstone	3	....	134	....
Shale, sandy	54	....	188	....
Shale, blue	15	....	203	....
Shale, clay, soft	11	....	214	....
Shale, soft lime	6	....	220	....
Shale, pebbles	9	....	229	....
Shale, sandy	2	....	231	....
Shale, clay	2	....	233	....
Shale, red, soft	4	....	237	....
Limestone	4	....	241	....
Shale, blue	13	....	254	....
Limestone	1	6	255	6
Coal	....	8	256	2
Shale, clay	7	4	263	6
Limestone	2	....	265	6
Lime shale	2	....	267	6
Limestone	7	....	274	6
Shale, black	2	....	276	6
Coal	6	....	282	6
"Blue band" (No. 6)	2	1	282	7
Coal	1	....	283	7
Fire clay	2	5	286	....
Limestone	7	....	293	....
Shale, blue, soft	6	....	299	....
Shale, blue	10	....	309	....
Shale, black	1	....	310	6
Shale, clay	4	....	314	6
Shale, blue	4	....	318	6
Lime shale	1	6	320	....
Shale, sandy	15	....	335	....
Shale, blue	37	4	372	4
Coal	....	8	373	....
Shale, gray	....	4	373	4
Coal	....	8	374	....
Shale, blue	34	....	408	....
Shale, sandy	....	6	408	6
Shale, black	....	6	409	....
Coal	....	5	409	5
Shale, black	....	7	410	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Coal	2	8	412	8
Shale, dark blue	1	4	414	....
Clay, shale	3	....	417	....
Limestone	2	6	419	6
Coal	....	9	420	3
Blue band	....	1	420	4
Coal	1	3	421	7
Coal, shaly	....	5	422	....
Shale, black	....	6	422	6
Limestone	3	....	425	6
Shale, clay	5	6	431	....
Limestone	1	....	432	....
Coal	1	2	433	....
Shale, clay	8	10	442	....
Shale, dark, with sandstone partings	15	....	457	....
Limestone	....	6	457	6
Shale, dark, with sandstone partings	1	....	458	6
Limestone	1	6	460	....
Shale, blue	6	2	466	2
Coal	....	6	466	8
Sandstone	....	1	466	9
Coal	....	6	467	3
Lime shale	3	9	471	....
Shale, soft, brown	19	....	490	....
Shale, black	11	....	501	....
Sandstone	34	....	535	....

Gas at 535 feet, 100 lb. pressure for one month.

The record below is from a well drilled in 1889 for the Helvetia Milk Condensing Company at Highland. The absence of coal No. 6, which should be about 310 feet from the surface, is explained under the subject "Distribution and depth" in this chapter.

Record of Helvetia Milk Condensing Co. drill hole

Location—SW.¼ SE.¼ sec. 32, T. 4 N., R. 5 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pennsylvanian strata—				
Drift	66	....	66	....
Limestone (Carlinville?)	4	....	70	....
Black shale	3	....	73	....
Fire clay	7	....	80	....
Shale	16	....	97	....
Shale, black	6	....	103	....
Limestone, brown	28	....	131	....
Shale	55	....	186	....
Sand (water)	73	....	259	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale	10	....	269	....
Fire clay?	10	....	279	....
Sand, red	2	....	281	....
Limestone	22	....	303	....
"Slate"?	5	....	308	....
Sand (horizon of coal No. 6)	12	....	320	....
"Slate"?	12	....	332	....
Sand	6	....	338	....
Shale	20	....	358	....
Sand (water)	39	....	397	....
"Slate"	20	....	417	....
Sand (water)	40	....	457	....
"Slate," black	25	....	504	....
Coal (No. 2?)	1	10	506	....
Fire clay	10	....	516	....
Shell sand	5	....	521	....
Coal	1	....	522	....
Fire clay	4	....	526	....
"Slate," black	55	....	582	....
Sand (water)	25	....	607	....
"Slate," black	25	....	632	....
Shale	75	....	707	....
Limestone	4	....	711	....
"Slate"	30	....	741	....
Sand (water)	29	....	770	....
Shale	27	....	797	....
Mississippian strata—				
Chester group—				
Limestone, brown	6	....	803	....
"Slate"	4	....	807	....
Limestone	8	....	815	....
Sand, red	2	....	817	....
"Slate," red	4	....	821	....
Sand (water)	8	....	829	....
"Slate"	3	....	832	....
Sand, brown (water)	20	....	852	....
Sand, red	12	....	864	....
Shale	6	....	870	....
Sand, brown (water)	19	....	889	....
Sand, green, shaly	15	....	904	....
Sand, green	18	....	922	....
Sand, white (water)	72	....	994	....
Sand, white	22	....	1014	....
St. Louis formation—				
Limestone	75	....	1089	....

In the Highland well the Chester beds consisting of interbedded shales, some of which are red sandstones and limestones, measure 213

feet. The top of the Chester is 797 feet below the surface and the "Big Lime" which underlies the Chester is found at 1010 feet.

Geological Structure

In common with the beds of adjacent counties, the rocks of Madison County dip eastward at an average rate of about 13 feet per mile. A slight reversal of this dip is apparent in the south-central part of the county where the axis of the Bellevillle anticline crosses the boundary and extends northeast for a few miles. Its exact shape and size in Madison County are not well known owing to a lack of drilling data, but it has not proved to be commercially important. The beds in the eastern tier of townships are almost horizontal.

Although many small slips affect the coal beds, no major faults have been found in the mines of the county. The roof irregularities known as "faults" by the miners will be discussed under the proper heading in this chapter.

Coal No. 6

DISTRIBUTION AND DEPTH

Coal No. 6 underlies approximately three-quarters of the county. Its western boundary is indicated on the large map accompanying this report. As has been mentioned, it outcrops near the base of the bluffs bordering American Bottoms, and dips to the east at a rate sufficient to carry it 400 feet below the surface along the eastern boundary.

The area in which coal No. 6 is thin or absent in Montgomery and Christian counties extends southward probably through the eastern tier of townships in Madison County. The bed is known to be absent in sec. 3, T. 6 N., R. 5 W., and for some distance east and south as shown on the map. It is also absent at Highland, and it is thin inside of the area shown near Aviston in Clinton County. Between Highland and the northeast corner of the county no drilling has been done, but the alignment of the barren and thin areas in this part of the State, leaves small room for doubt that they are all connected. The tentative boundaries are drawn on the map according to the best information available at this time. They are in no way final but will be revised from time to time as new data are available. Although it is believed that this barren zone is continuous through the eastern part of the county, its size and shape are not known. It is reasonable to suppose that between Highland and the northeast part of the county its width is about 2 or 3 miles, which is the average for the places mentioned.

THICKNESS AND CHARACTER

Coal No. 6 averages slightly more than 6 feet in thickness in the mines of the county. At Collinsville the average is about 7 feet, but the bed thins somewhat towards the northeast. No information is available as to the thickness of the bed northwest of Edwardsville, but it is likely that near the outcrop it has been considerably affected by erosion prior to the deposition of the glacial drift.

Figure 16 shows the physical character of coal No. 6 in some of the mines of Madison County.

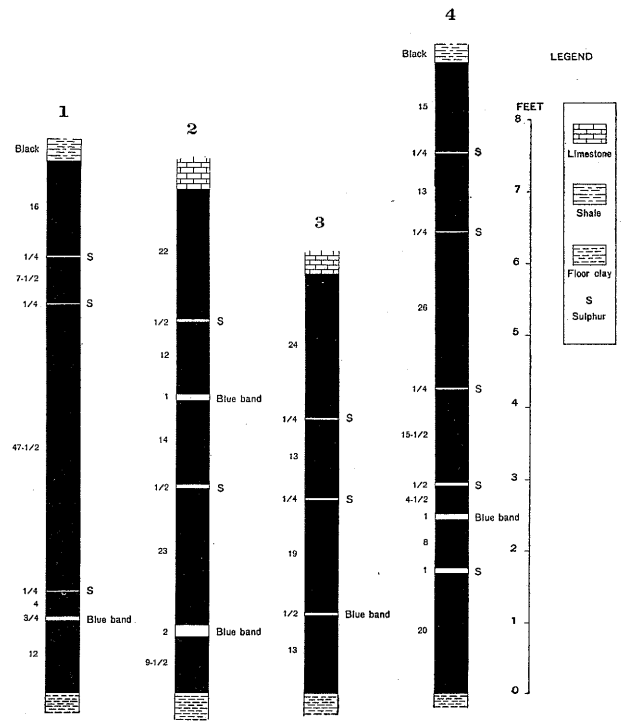

FIG 16.—Graphic sections of coal No. 6 from measurements made in the mines of Madison County.

1. Mt. Olive and Staunton Coal Co., No. 2, Williamson. Entry face, main north, 3500 feet from shaft.

2. New Staunton Coal Co., Livingston. 1st right off main west, face 4000 feet from shaft.

3. Madison Coal Corporation, No. 2, Glen Carbon. Face 8th N. off 3rd E., 3500 feet from shaft.

4. Lumaghi Coal Co., No. 2, Collinsville. 1st E. off main S., 5700 feet from shaft.

Over most of the county coal No. 6 compares favorably with that of the entire Belleville district. The usual three benches are recog-

nized (see figure 16), but the top coal is seldom left for roof. The middle bench especially is characterized by a number of pyrite bands.

The following section was measured in mine No. 2, Lumaghi Coal Company, Collinsville.

Section of coal No. 6; main east face; August, 1912

	Ft.	In.
Top coal, bright, clean	1	8
Sulphur streak	----	----
Coal, fairly clean, bright, soft, brown streak	----	1½
Coal, soft, with few dirt bands	3	8½
"Blue band," shale	----	1½
Coal, harder than above	1	10½
	8	5

About 23 inches above the "blue band" there is a streak of sulphur which is more or less continuous and reaches a thickness of ½ inch in places. In the mine it has been observed that the coal below this sulphur contains a larger number of dirt bands than does the upper part of the bed. The persistent nature of the sulphur band makes it possible to place shots above it, and to use it as a parting in the bed. The face of the coal is streaked with a large number of pyrite bands, most of which are small lenses traceable for only short distances.

The following section was measured in the mine of the New Staunton Coal Company, Livingston:

Section of coal No. 6; room 1, 11 south entry off main east

	Ft.	In.
Top coal, bright, clean, impurities mostly facings of gypsum and calcite	1	½
Coal with small sulphur streaks	2	1
Sulphur band, persistent	----	½
Coal with many dirt streaks	----	22
Sulphur band, persistent, variable in thickness	----	----
Coal, clean	----	7
"Blue band," gray shale and sulphur	----	1½
Coal, bright and clean	----	10
	6	5½

ROOF AND FLOOR

The regular roof of coal No. 6 consists of gray or black shale of variable thickness overlain by limestone ranging in thickness from a few feet to as much as 30 feet. In many places the immediate roof is so thin that it is really a "draw slate," and in others the limestone rests on the coal itself. In the latter case the contact between the coal and the limestone is generally irregular, and the bottom of the cap

rock consists in places of poorly bedded, impure limestone known as "clod." The black shale does not ordinarily exceed 8 feet in thickness, but in mine No. 3, Donk Brothers, the soapstone roof is reported to be 50 feet thick. The black shale tends to fall easily, especially after exposure to the air.

Figures 17 and 18 are from photographs by the Madison Coal Corporation. They show the character of the shale-limestone roof not only for Madison County but in a general way for district VII.

The limestone generally exhibits sufficient cohesion to form a strong roof, but in places, as in New Staunton Coal Company's mine No. 1 at Livingston, both the limestone and shale cause trouble by falling in large masses, one of which was 50 feet long and 30 feet high. Slip planes in the roof are responsible for dangerous falls and are especially feared because no evidence of their existence is known until the fall has taken place.

Besides unevenness of the contact between the limestone and the underlying shale, it is not unusual to find the limestone protruding down into the coal as a roll, actually replacing a large amount of the coal itself. Such features affect the coal for only short distances. In a few places it seems to be clear that the limestone was deposited on an eroded surface and that the accumulating pressure was responsible for the slickensides present. In other cases, the black shale forms the lowest part of the roll and its bedding is parallel with that of the coal. Slickensides in both the coal and the roll give evidence of considerable pressure.

Small faults having a throw of half the thickness of the bed are not uncommon throughout the county, but the limestone rolls are more numerous in the northeastern mines.

Coals below No. 6

The few holes in Madison County that have penetrated the entire thickness of coal-bearing beds furnish only a small amount of information regarding coals below No. 6. At Highland, coal No. 2 is probably represented by two coals separated by 15 feet of fire clay and sand, the upper bed being 1 foot 10 inches thick and the lower measuring 1 foot 2 inches. At Livingston in the northeastern part of the county five coal horizons were penetrated below coal No. 6, the beds ranging in thickness from 1 foot 2 inches to 3 feet 1 inch; but all show numerous partings of shale. It is not possible to correlate them with other beds in the county, and it is probable that they are lenticular. At Cantine a bed 2 feet 6 inches thick was found 105 feet below coal No. 6. Coal No. 5 is not developed in the area tested up to the present time.

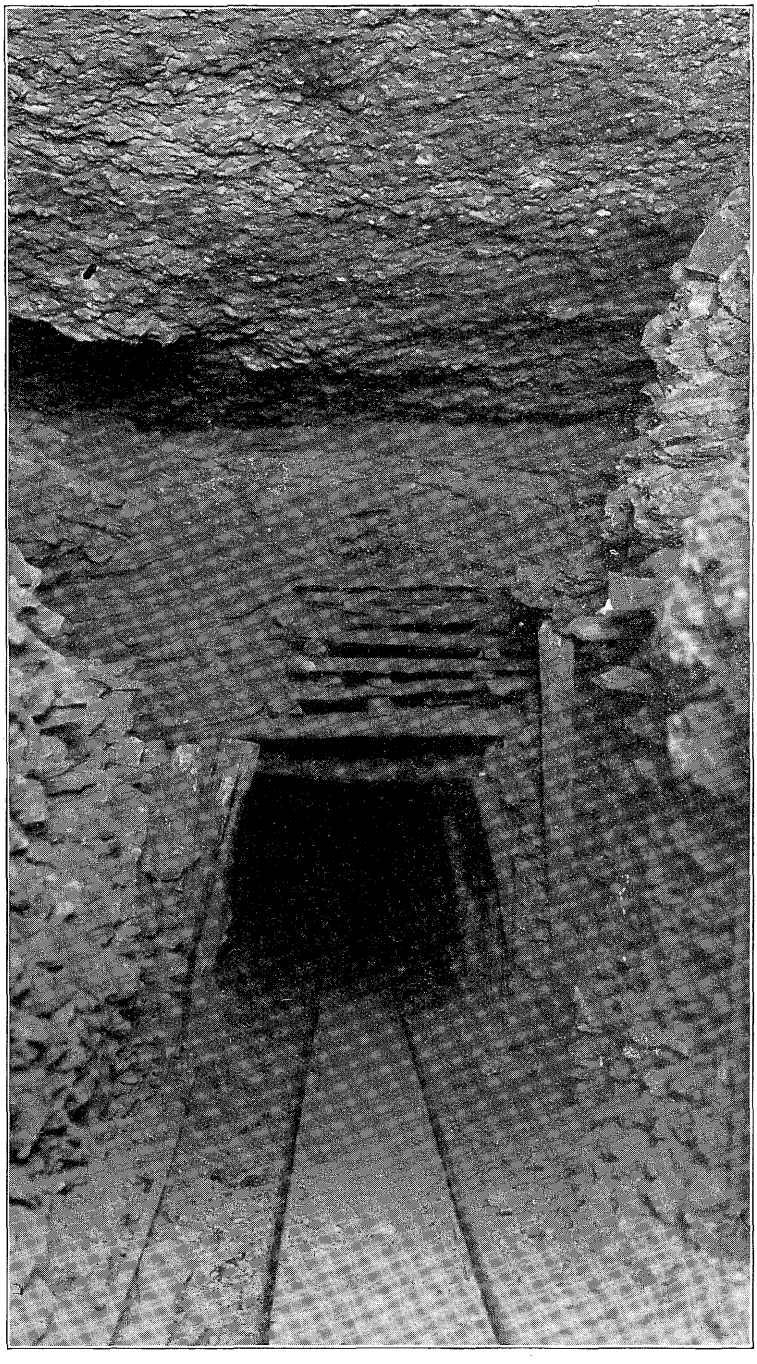

FIG. 17.—Photo showing clod-limestone roof, Madison Coal Corporation, mine No. 4, Glen Carbon. (Courtesy Madison Coal Corporation.) Note difficulty experienced in holding up clod.

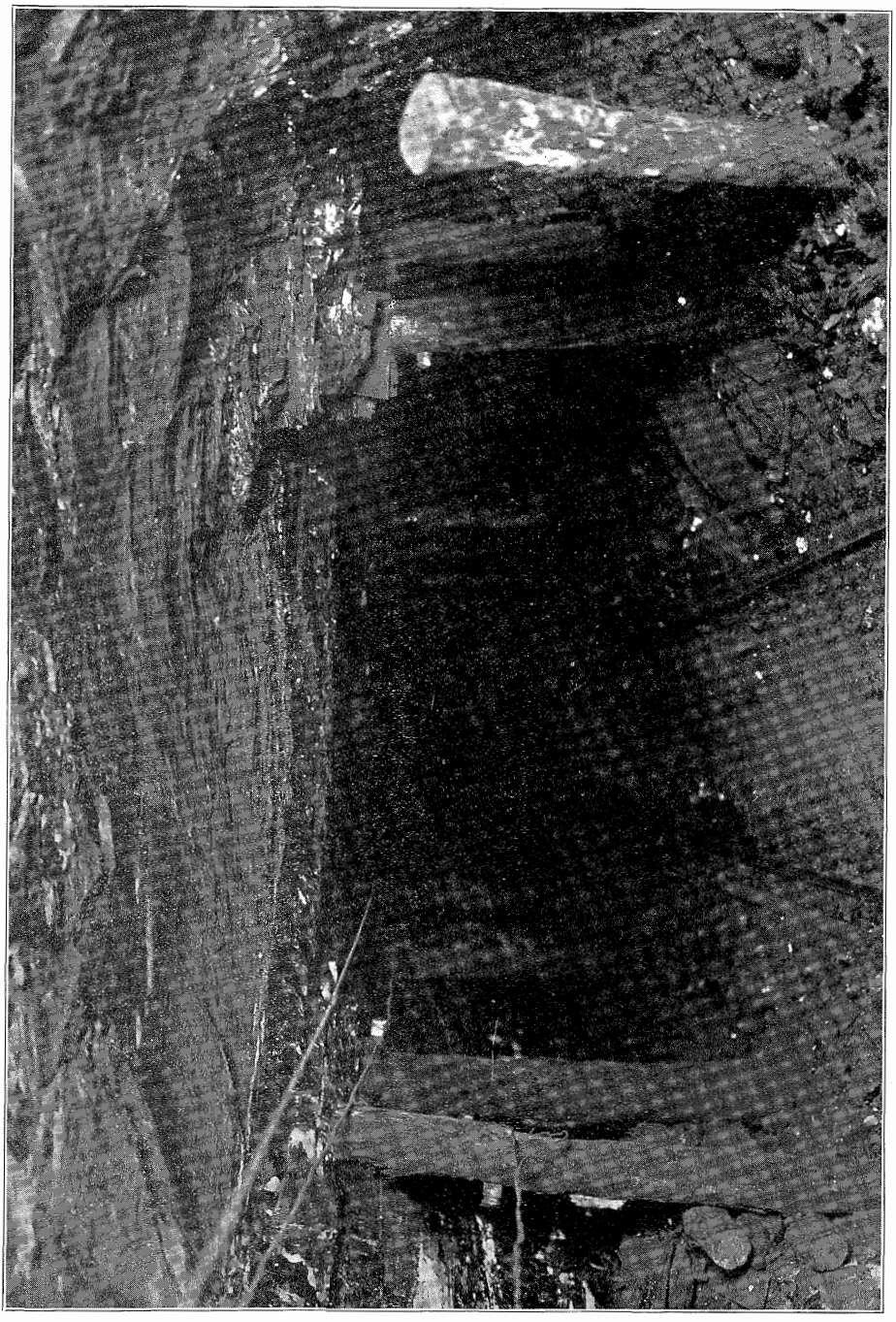

FIG. 18.—Photo showing nature of bedding in black shale roof. (Courtesy Madison Coal Corporation.)

MARION COUNTY

Production and Mines

Production in tons, year ended June 30, 1913..... 1,188,551
Average annual production, 1909 to 1913..... 1,107,319
Total production, 1881 to 1913..... 20,228,469

During the year ended June 30, 1913, Marion County produced 1,188,551 tons of coal or 1.92 per cent of the State's total output. Six mines were in operation, all in coal No. 6, and the annual production ranged from 390,106 tons down to 84,614 tons.

Table 8.—*List of shipping mines, Marion County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production, 1913
			¼	¼	Sec.	T. N.	R. E.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Marion County Coal Co.	....	NE	NE	31	2	1	490	600	–110	6	3	390,106
2	Chicago Sandoval Coal Co.	2	SW	SW	17	2	1	503	634	–131	6	....	201,567
3	Odin Coal Co.	Odin	NW	NW	13	2	1	532	708	–176	6	....	197,058
4	Centralia Coal Co.	2	NW	NW	19	1	1	496	570	– 74	6	6	167,516
5	Centralia Coal Co.	4	SW	NE	7	1	1	490	670	–180	6	6	147,689
6	Chicago Sandoval Coal Co.	1	SW	NE	17	2	1	503	604	–101	5	6	84,615

Coal-bearing Rocks

The coal-bearing beds in the western part of Marion County are well known, since most of the drill holes penetrate all of the Pennsylvanian and part of the underlying Mississippian rocks. In drilling for oil, little attention is given coals other than No. 6, and it is believed that the diamond drill will prove the existence of the beds not yet reported. The Pennsylvanian formations underlie all of the county below the glacial drift, which averages less than 100 feet in thickness, although thicknesses of 150 feet are not uncommon.

Coal No. 6, the most important bed in the county, varies in depth from 500 feet in the western side to almost 900 feet in the eastern part. The limestone cap rock is generally present, and another more

or less persistent limestone probably the Carlinville, lies about 350 feet above the coal. Other thin limestones are reported at various horizons, but these cannot be successfully correlated from one hole to another. The greater part of the section is composed of shales and minor beds of sandstone. Two beds of coal above coal No. 6 may be recognized in most of the shaft logs and diamond-drill records. The first of these lies about 35 feet above coal No. 6, and probably represents coal No. 7. A few of the logs show another thin bed 10 to 15 feet above coal No. 7, attaining a thickness of 1 foot 4 inches. About 200 feet above coal No. 6 a thin coal is reported in scattered prospect holes and shaft logs, but it is not noted in any of the oil holes. This bed is in most places thin, but its commercial utilization was attempted by the Centralia Coal Company at their mine No. 2, where it is locally developed to an unusual thickness. The shaft was later sunk to coal No. 6 and the upper levels were abandoned.

The coal-bearing formations were deposited on an eroded surface of Chester rocks, and as a result the base of the Pennsylvanian is extremely irregular, being from 400 to 700 feet below coal No. 6, the greater thicknesses representing beds deposited in former valleys. The lower part of the coal-bearing rocks is composed largely of sandstone, no bed being traceable for any considerable distance. Shales are present but not so abundantly as in the section above coal No. 6. The coals below No. 6 are insufficiently prospected since most of the deep holes have been drilled for petroleum, little or no attention having been given to the position or thickness of the coals. For a thorough investigation of the coal beds it is necessary to drill carefully through the beds for a distance of 300 feet below coal No. 6, in order to determine the existence of coals No. 5 and No 2 which are undoubtedly the most persistent. In prospecting for coal in Marion County, holes should be discontinued at a depth of 325 feet below coal No. 6. Bed No. 5 whose horizon averages 50 feet below coal No. 6 would be penetrated in all coal tests.

The following logs are representative of the beds in various parts of Marion County.

Record of Centralia Coal Co., shaft No. 2

Location—NW.¼ NW.¼ sec. 19, T. 1 N., R. 1 E.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
"Hardpan"	2	6	2	6
Clay, yellow	9	6	12	----
"Soapstone"	11	----	23	----
"Slate," blue	47	----	70	----
Shale	----	8	70	8

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Limestone	1	6	72	2
Coal	....	8	72	10
"Slate," blue	24	6	97	4
"Soapstone"	2	....	99	4
Limestone rock	5	6	104	10
Sandstone, hard	5	....	109	10
Coal	....	2	110	....
Sandstone, soft	6	....	116	....
Coal	....	6	116	....
Sandstone	2	6	119	....
Coal	....	2	119	2
"Soapstone"	4	....	123	2
Limestone rock	2	....	125	2
Sandstone	12	2	137	4
Rock, blue	1	6	138	10
Fire clay	2	....	140	10
"Soapstone"	15	6	156	4
Slate, blue	....	29	185	4
Lime rock	11	....	196	4
Shale	5	6	201	10
Coal	....	5	202	2
"Soapstone"	4	....	206	2
Sandstone	10	....	216	2
"Slate"	50	....	266	2
Limestone	1	....	267	2
Shale	2	....	269	2
"Soapstone"	3	....	272	2
Sandstone	24	....	296	2
"Slate," blue	79	....	375	2
Coal	1	2	376	4
"Soapstone"	3	....	379	4
Conglomerate of limestone	8	....	387	4
"Slate," light colored	10	....	397	4
Sandstone	56	....	453	4
"Slate," dark colored	43	....	496	4
"Slate," black, with carbonate of iron	6	....	496	10
Coal	1	½	496	½
"Soapstone" with sulphide of iron, soft, stratified rock, a mixture of kidney ore and fire clay	11	....	510	11½
Sandstone and sulphide of iron	1	....	511	11½
"Slate," deep black	1	....	512	11½
Fire clay	1	6	514	5½
Limestone, gray	2	....	516	5½
Shale, variegated	8	....	524	5½
Coal	2	....	526	5½
Marble limestone	8	....	534	5½
Shale, blue	2	....	536	5½
Limestone, gray	4	6	540	11½

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, black	2	6	543	5½
Limestone, gray	4	....	547	5½
Shale, black	12	....	559	5½
Limestone, blue	7	....	566	5½
Shale, bituminous	2	6½	569	....
Coal (continuation with diamond drill in bottom of shaft)	7	....	576	....
Lump fire clay	10	....	586	....
Sand, shale, and lime (mixed)	3	....	589	....
Lime shale	1	2	590	2
Coal and slate	....	4	590	6
Clay shale	62	6	653	....
"Slate," black	5	....	658	....
Coal	2	2	660	2
Clay shale, dark	2	10	663	....
Limestone	1	4	664	....
Clay shale	11	8	676	....
"Slate," gray	7	....	683	....
Sand shale	14	....	698	....
Clay shale	2	3	700	3
"Slate," black	....	9	701	....
Coal	1	3	702	3
Fire clay, soft brown	3	9	706	....
Conglomerate, lime, and shale	1	....	707	....
Sand shale	9	....	716	....
Shale, dark gray	4	....	720	....
"Slate," black	....	8	720	8
Coal	....	4	721	....
Shale, gray	1	....	722	....
Coal	....	1	722	1
Sand shale	5	11	728	....
Shale dark	2	....	730	....
"Slate," black	1	2	731	2
Coal	1	3	732	5
Shale, gray	1	7	734	....
Sand shale	4	....	738	....
Shale, gray, 2 partings	3	6	741	6
Coal	....	6	742	....
Sandstone, gray	5	....	747	....
Sand shale	2	....	749	....
Clay shale	3	6	752	6
Coal	....	6	753	....
Fire Clay	3	....	756	....
Clay shale	2	....	758	....
"Slate," black	1	3	759	3
Coal	1	3	760	6
Clay, shale, brown	4	6	765	....
Fire clay, white	1	....	766	....
Fire clay	3	6	769	6

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Limestone	1	6	771	....
Clay shale	2	....	773	....
"Slate," black	1	7	774	7
Coal (No. 6)	6	11	781	6
Shale, dark	1	6	783	....
Sand shale	1	4	797	....
Sandstone	16	....	813	....
Shale, gray	4	....	817	....
Clay shale	25	6	842	6
Conglomerate, sand and boulders	6	6	849	....
Sand shale	2	....	851	....
Clay shale	12	8	863	....
Coal	....	4	864	....
Fire clay	....	2	864	2
Clay shale	3	7	867	9
Sandstone	18	3	886	....

Record of shaft No. 1, Odin Coal Company

Location—NW.¼ NW.¼ sec. 13, T. 2 N., R 1 E.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Surface soil	1	10	1	10
"Hardpan"	....	10	2	8
Clay, yellow	7	....	9	8
Clay, sand, yellow	4	6	14	2
Clay, blue, gravel	20	....	34	2
Clay, blue	78	....	112	2
Clay, brown	2	6	114	8
Clay, blue, mud and sand	6	....	120	8
Quick sand	6	....	126	8
Gravel, cemented	1	....	127	8
Lime rock	1	....	128	8
"Soapstone"	....	6	129	2
Lime rock	1	....	130	2
"Soapstone"	2	6	132	8
Lime rock	7	....	139	8
"Soapstone"	7	6	147	2
Sandstone	10	....	157	2
Shale	6	....	163	2
Coal	....	4	163	6
"Soapstone"	4	....	167	6
"Slate," blue	19	....	186	6
"Soapstone"	4	....	190	6
Shale	3	....	193	6
Fire clay	4	....	197	6
Lime rock, blue	8	1	205	7
"Slate," blue	3	....	208	7
Coal	....	2	208	9

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Fire clay	....	6	209	3
Sand shale	14	2	223	5
Coal	....	7	224	....
Sand shale	11	....	235	....
Sand, rock, and shale	4	....	239	....
Sand shale	5	....	244	....
"Slate," blue	9	....	253	....
Rock and gravel	1	6	254	6
Fire clay	2	6	257	....
Fire clay and boulders	2	....	259	....
Slate, dark blue	58	....	287	....
Limestone (Shoal Creek)	10	....	297	....
"Slate," black	3	....	300	....
Coal	....	2	300	2
Fire clay	5	....	305	2
Sand rock	4	6	309	8
Sand shale	52	....	361	8
"Slate," blue	10	....	371	8
Rock and gravel	1	4	373	....
Lime rock	....	6	373	6
Fire clay	5	....	378	6
Conglomerate slate and lime rock	8	....	386	6
"Soapstone"	10	....	396	6
Sand rock	63	....	459	6
"Slate," blue	28	....	487	6
"Slate," blue, and boulders	7	....	494	6
Coal	....	10	495	4
Fire clay	2	6	497	10
Conglomerate sand and lime rock	8	....	505	10
Sand rock	5	....	510	10
"Slate," gray	13	....	523	10
Sand, shale, and lime rock	46	....	569	10
"Slate," blue	44	....	613	10
Clay shale, light	1	6	615	4
Conglomerate clay and gravel	5	....	620	4
Fire clay	6	....	626	4
Lime rock, hard	9	6	635	10
Lime rock, soft	4	6	640	4
Shale, blue	10	6	650	10
Coal	1	4	652	2
Fire clay	1	8	653	10
Conglomerate	2	....	655	10
Shale, dark blue	7	....	662	10
Coal (No. 7)	3	2	666	....
Fire clay	2	....	668	....
Clay, pebbly	2	....	670	....
Lime rock, light	1	....	671	....
Clay shale	1	....	672	....
Lime rock	5	....	677	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, blue	....	4	677	4
Limestone	....	4	677	8
Shale, blue	....	9	678	5
Limestone	1	3	679	8
Shale, blue	1	3	680	1
Lime rock, white	6	....	686	11
Lime rock, mottled	3	....	694	11
Lime rock, dark gray	....	10	695	9
Shale, black	14	....	709	9
Coal (No. 6)	7	6	717	3

Record of Ohio Oil Co. well

Well—Guthrie No. 1.

Location—SW.¼ SW.¼ sec. 28, T. 2 N., R. 1 E.

(Descriptions by J. A. Udden)

Description of Strata	Thickness *Feet*	Depth *Feet*
Pennsylvanian strata—		
Surface material	20	20
Boulder clay	6	26
Boulder clay, blue	4	30
Boulder clay, washed	10	40
Drift	10	50
Shale, micaceous, sandy	5	55
Sandstone	5	60
Shale	10	70
Shale, unctuous, light bluish	15	85
Shale, gray, micaceous	5	90
Shale, gray, micaceous, sandy	5	95
Shale, unctuous, blue	5	100
Shale, dark gray, micaceous	5	105
Shale, bluish gray, unctuous	25	130
Sandstone, sandy, fossiliferous, and shale with gray sandstone with infiltrated lime	5	135
Shale, dark gray, unctuous	5	140
Shale, dark gray, stiff	10	150
Lacking	20	170
Coal, impure, and fire clay	5	175
Fire clay, greenish gray	5	180
Limestone, brecciated, gray and black shale	5	185
Limestone, gray, sandy, with fragments of shells	5	190
Sandstone, gray, micaceous and sandy shale	5	195
Shale, sandy	5	200
Shale, dark gray	5	205
Shale, micaceous, sandy	25	230
Sandstone, sandy, showing shreds of carbonaceous material	10	240
Shale, dark gray	10	250

Description of Strata	Thickness *Feet*	Depth *Feet*
Shale, black, coaly	5	255
Another sample with same number, but probably coming from below this, consists of gray shale and sandy calcareous rock.		
Shale, gray, sandy, micaceous, and shale sandstone filled with interstitial lime	5	260
Shale, gray, clay, some limestone and black shale	5	265
Shale, micaceous, sandy	5	270
Sand, gray and white laminated	5	275
Shale, dark, stiff	15	290
Shale, dark, micaceous	10	300
Shale, dark, stiff	15	315
Shale, dark, stony, like the preceding	25	340
Shale, gray, stiff	5	345
Shale, gray	15	360
Limestone, gray and white, with coal and fire clay	5	355
Fire clay, coal, limestone, etc	5	60
Fire clay, shale, and siderite concretions	5	365
Sandstone and fire clay	5	370
Shale, gray, sandy	5	375
Shale, sandy, and sand	5	380
Sand containing carbonaceous material	5	385
Shale, gray, micaceous sand	20	405
Shale, gray	5	410
Shale, gray, sandy	35	445
Shale, dark gray	15	460
Shale, black, "clod" with a small gasteropod, small *Athyris* umbo, a crinoid stem and coal	5	465
Sandstone, nodular, calcareous, and impure sandstone	5	470
Shale, dark and siderite	10	480
No sample	5	485
Shale, black	5	490
No sample	5	495
Shale, black, calcareous rock and some white limestone	5	500
Shale, gray, sandy material, some white limestone and some black shaly calcareous rock. *Fusulina*, *Chonetes punctatus*, and crinoid stems noted	5	505
Sandstone, gray, and dark shale—a few bits of limestone	5	510
Shale, dark, and some coal. A few pieces of white limestone	10	520
Shale, gray, sandy, some black shale, and bits of yellowish-white limestone. Pyrite noted	5	525
Shale, black	5	530
No sample	5	535
Shale	5	540
Shale, dark gray and black	5	545
No sample	5	550

Description of Strata	Thickness *Feet*	Depth *Feet*
Shale, gray	5	555
Shale, gray, micaceous	5	560
Sandstone, gray, micaceous, and a few pieces of coal	5	565
Shale, gray, micaceous and bits of siderite. (Second sample with this label)		
Shale, black, and coal, with a few pieces of white and dark limestone and pyrite	10	575
Shale, black, and a few pieces of coal	5	580
Sandstone, gray, some yellow limestone, and a little shale and pyrite	5	585
Sandstone, gray, micaceous, and a little shale	5	590
Shale, black	5	595
Missing	5	600
(Second sample with this label). Dark shale, a few pieces of yellow limestone and coal	5	605
Shale, gray, micaceous, and some coal	5	610
Shale, dark	5	615
Shale, gray, micaceous	5	620
Shale, gray, and yellow, slowly effervescing limestone. Bits of olive-green sandstone	5	625
Shale, dark gray	5	630
Shale, gray	10	640
Shale, gray, and some black shale	10	650
Shale, gray	5	655
Shale, gray, micaceous	5	660
Shale, gray, sandy, micaceous, some gray micaceous shale, and a few pieces of pyrite	10	670
No sample	5	675
Shale, gray	5	680
Shale, gray, a little gray sandstone, and concretionary siderite	5	685
Shale, gray, micaceous, and a few pieces of concretionary siderite	5	690
Shale, gray, micaceous	5	695
Shale, dark	5	700
Shale, gray	5	705
Shale, gray, some imprints of leaves	5	710
Shale, gray, micaceous, and a little sandstone	5	715
Shale, gray	5	720
Shale, gray, and some siderite concretions	5	725
Shale, dark gray, and some siderite	5	730
Shale, gray	10	740
Shale, dark gray	5	745
Shale, dark gray, and some siderite	5	750
Shale, gray, sandy, and a few small pieces of white limestone	5	755
Shale, gray, sandy	5	760
Shale, dark	5	765
Shale, gray, micaceous	5	770
Shale, gray, sandy	5	775

Description of Strata	Thickness *Feet*	Depth *Feet*
Shale, gray, micaceous, sandy	5	780
Shale, gray, micaceous, some siderite and black sandy shale	5	785
Shale, gray, micaceous	5	790
Sandstone, gray, some coal, some white limestone, pyrites and siderite	5	795
Coal, some gray sandstone, some limestone, and siderite	5	800
Shale, gray, and fire clay, and small pieces of coal and siderite	5	805
Shale, black, and some coal	5	810
Shale, black, micaceous	5	815
Shale, gray, and coal, with some siderite and pyrite	5	820
Shale, gray, some coal, concretionary yellow limestone and white limestone. Pyrite also noted	5	825
Fire clay, concretions of siderite, white limestone, black limestone, and black shale	5	830
Clay shale, green, pure limestone. The shale is filled with spherules of siderite up to 12 mm. in diameter	10	840
Shale, green, filled with spherulitic siderite concretions, some sandy, pyritiferous shale and some fragments of limestone	5	845
Shale, green, much concretionary limestone. Some of the limestone is white and pure, some is in the form of black concretions with centers of calcite, some is a gray rock filled with spherules of siderite, and other small grains of siderite, while some is brownish red, and brecciated and contains organic fragments	5	850
Sandstone, white, some shale and a few fragments of limestone	5	855
Shale, gray, and shaly sand	5	860
Like the preceding	5	865
Shale, sandy, some black shale, and some coal	5	870
Sandstone, very micaceous, white	5	875
Shale, micaceous, sandy	5	880
Sandstone, gray, micaceous	5	885
Sand, shaly, gray	5	890
Like the preceding	5	895
Sand, gray, micaceous, with much pyrite, some of which is interstitial in the sand	5	900
Sand (sample very small)	5	905
Sandy, light gray, shaly rock	5	910
Like the preceding	5	915
Samples wanting	15	930
Shale, dark, stony, micaceous	5	935
Like the preceding	5	940
Sandstone, gray	5	945

Description of Strata	Thickness *Feet*	Depth *Feet*
Sand and black laminated stiff shale. Sample marked: "Salt water in this sand or Bridgeport sand"	10	960
Sand, coarse, rounded, with brownish-black grains which effervesce very slowly in acid. Many crinoid stems were noted, which did not effervesce in acid, and which had the appearance of being siliceous	15	975
Sand, coarse, gray, mixed with siderite fragments, pyrite, and some fire clay	5	980
Sandstone, gray, siderite, and fire clay	5	985
Sand, gray, fairly clean, showing secondary crystalline enlargements	5	990
Sand, gray, showing secondary enlargement of grains	10	1000
Sandstone, yellowish gray, micaceous	5	1005
Sand, gray, some limy material	5	1010
Sand, white, micaceous with some limy material	5	1015
Sand, white, micaceous	5	1020
Sand, coarse, white	5	1025
Sand, coarse, white, showing secondary enlargement of some grains	5	1030
Sand, gray, showing secondary enlargement of some grains	5	1035
Sand, coarse, gray (two samples)	5	1040
Sand, gray	5	1045
Sand, fine gray, micaceous	10	1055
Sand, gray, some pieces showing lamination, some dark shale	5	1060
Sandstone, gray, some dark greenish, micaceous shale, pyrite present	5	1065
Sand, coarse, gray, some gray shale, a little coal, pyrite and concretionary limestone of obscurely spherulitic concretionary structure	5	1070
Shale, dark, some white sandstone, a little coal, and bits of siderite. Two samples	5	1075
Sandstone, white, concretionary siderite, some pyrite, and dark shale. A few red, conchoidally splitting fragments were noted which were hard and did not effervesce. This sample was labeled "dark sand" by the driller	5	1080
Fire clay, gray, of fine texture	20	1100
Shale, dark gray, fine in texture, and comparatively soft	10	1110
Shale, dark gray and black	5	1115
Shale, greenish, dark, micaceous	15	1130
Shale, greenish black, of fine texture	5	1135
Shale, dark, micaceous, stiff	10	1145
Shale, dark, with siderite concretions	5	1150
Shale, dark	5	1155

Description of Strata	Thickness	Depth
	Feet	*Feet*
Shale, dark greenish, with a few minute and iridescent mica scales	20	1175
Shale, dark, gray fire clay, and coarse sand	5	1180
Sand, gray, showing secondary crystalline faces on some grains	5	1195
Shale, dark greenish gray, micaceous, speckled with minute, black fragments, probably carbonaceous	5	1200
Shale, gray, concretionary siderite	5	1205
Sandstone, gray, coarse, with a white siliceous interstitial cement, and some gray shale and siderite	5	1210
Shale, gray, concretionary siderite, with some small pieces of sandstone	10	1215
Shale, black, micaceous, some siderite	10	1220
Shale, gray, sandy, some sandy shale and a little black shale	5	1225
Shale, gray, micaceous	5	1230
Shale, gray, micaceous	5	1235
Shale, greenish gray, sandy micaceous	5	1240
Mostly a brown, apparently fragmental siderite, having the texture of an organic breccia, with white, coarse sandstone and gray shale	5	1245
Siderite, fragmental and granular, white sandstone and gray shale	5	1250
Sandstone, white, and granular siderite	5	1255
Sand, laminated, white, pure, with granular brown siderite	10	1265
Sandstone, yellowish gray, of fine texture	5	1270
Sand, yellowish gray, of fine texture, clean	5	1275
Shale greenish black, of very fine texture	15	1290
Shale, greenish, dark, and fine sand	10	1300
Sandstone, white, with infiltrated matrix of partly calcareous material, and some shale. Driller's note: "Sandy lime"	10	1310
Shale, dark, and white sandstone with infiltrated lime. Driller's note: "Sandy lime"	10	1320
Shale, dark, and a little sandstone with infiltrated lime, bits of pyrite	10	1330
Sand, white, somewhat coarse, and a little dark shale, Pennsylvanian in aspect. A carbonaceous film or shred was seen adhering to a small piece of sandstone	15	1345
Sand, yellow, with a few flakes of mica and some dark shale. Driller's note: "Salt sand." Pennsylvanian in aspect	15	1360
Mississippian strata—		
No sample	5	1365
Sand, yellow, and some gray oolitic limestone	5	1370
No sample	15	1385

Description of Strata	Thickness *Feet*	Depth *Feet*
Limestone, gray, oolitic. Driller's note: "Lime"	10	1395
Limestone, gray, oolitic	5	1400
Shale, gray, with a few bits of pyrite	10	1410
Shale, dark, and white sandstone with infiltrated lime. Driller's note: "Sandy lime"	30	1440
Shale, black, and some white sandstone, with a little infiltrated lime	5	1445
Shale, black, and some white sandstone with infiltrated lime	5	1450
Shale, dark, some white limestone and red shale. Driller's note: "Sandy lime, and top of red rock for 30 feet past"	5	1455
Shale, gray, and organic, white fragmental limestone. In this limestone are pieces of *Fenestella*, *Polypora* (?), echinoid spines, flutes and tuberculated, some spicules (?) and fragments of brachiopod shells, and crinoid stems. Some red shale noted	5	1460
Like the preceding with echinoid spines	5	1465
Limestone, organic, fragmental, and dark gray shale	10	1475
Shale, black, and organic, fragmental limestone	10	1485
Limestone, organic, fragmental, and some green shale	5	1490
Limestone, organic, fragmental, and black shale. Some gray sandstone and an *Athyris* noted	5	1495
Shale, dark. Some limestone and crinoid stems noted	5	1500
Shale, dark red, with some calcareous material	5	1505
Shale, dark green	5	1510
Shale, bluish black	5	1515
Shale, gray, and reddish-yellow shale with considerable calcareous material	10	1525
Shale, greenish black and brownish black, of fine texture	5	1530
Shale, brownish red, with a yellowish streak	5	1535
Shale, brownish red, and dark greenish-gray shale	5	1540
Shale, brownish and greenish gray. Driller's note: "Red rock in all 1530 to 1547 feet"	10	1550
Shale, greenish gray	10	1560
On the cover of this sample is written: "Top of lime 1560 feet. Cased here." The sample is a grayish-white shell breccia, which consists of small and thin shell fragments lying more or less flat in the same plane, showing small *Athyris* shells, and shells of other brachiopods, and crinoid stems		1560
Shale, greenish, sandy, or shaly sand, with some red shale and some white sandstone of fine texture. Brachiopod spines noted	10	1570
Sand, dark greenish, of fine texture with some white fine sand. Pyrite noted. On cover of sample is the note: "Top of Benoist or oil sand"	5	1575

Description of Strata	Thickness *Feet*	Depth *Feet*
Sand, dark green, of very fine texture, with some shale of the same color. Pyrite, white sandstone, white limestone and spines and shells of brachiopods noted. Labeled: "Benoist sand"	5	1580
Sand, white, with grains of about ⅛ mm. in diameter. Driller's note: "Oil sand"	5	1585
Sand, greenish gray, and sandy shale, some of which shows incipient fissures along which oxidation has taken place, and the material has assumed a red color. Some of the shale is red. Crinoid stems and fragments of brachiopod shells noted. Sample marked: "Benoist or oil sand"	15	1600
Sandstone, siliceous, white, gray, and green, of very fine texture. Size of grains in this, as in previous two samples, about 1/16 mm. in diameter. Some dark gray, greenish gray, and red shale. Some sandy shale was noted with joints of oxidized, red material intersecting the green. This rock shows thin laminations	5	1605
Sandstone, greenish gray, and dark brown of very fine texture. This rock is laminated, showing quite intensely green layers alternating with gray, brown, and red layers. The laminae are from 1/16 to ½ mm. in thickness and more, and quite straight. On the cover of the sample is the note: "Bottom of oil or Benoist sand"	5	1610
Sand, light gray, slightly micaceous, and apparently slightly coarser than the preceding, some dark sandy shale, and some dark brown shale	5	1615
Sand, gray, coarser than the above and ground up into separate grains. These average about 1/16 mm. in diameter. On cover of sample is the note: "Salt water sand"	10	1625

Log of Kinmundy mine shaft

Location—Kinmundy, Illinois

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Drift clay	12	....	12	....
Sandstone and shale	134	5	146	5
Limestone, pebbly	1	4	147	9
"Slate," black	9	7	157	4
Coal	1	2	158	6
Fire clay	7	....	165	6

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, gray	19	7	185	1
"Slate," black	11	....	196	1
Coal	1	6	197	7
Fire clay	2	....	199	7
Shale	37	10	237	5
"Slate," black	5	....	242	5
Limestone, bituminous	2	....	244	5
Coal	....	6	244	11
Limestone and black shale	6	....	250	11
Coal	....	2	251	1
Clay shale	5	6	256	7
Shale, gray and black with bands of lime	51	....	307	7
"Slate," black	1	6	309	1
Coal	1	....	310	....
Fire clay	1	6	311	6
Limestone	3	....	314	6
Shale, gray	15	9	330	3
"Slate," black	3	....	333	3
Coal	2	....	333	5
Fire clay	2	10	336	3
Shale and sandstone	65	6	401	9
Coal	....	4	402	1
Fire clay	4	....	406	1
Limestone	3	....	409	1
Shale	71	....	480	1
Limestone	9	10	492	....
Shale, bituminous, and 2 inches coal	2	....	494	....
Shale, pebbly	5	....	499	....
Sandstone and shale	76	....	575	....
Limestone, pebbly	1	6	576	....
Shale, bituminous, and ½ inch coal	2	6	579	....
Fire clay	5	....	584	....
Sandstone and shale	69	....	653	....
Shale, black	....	10	653	10
Coal	....	7	654	5
Fire clay	2	....	656	5
Limestone, sandstone and fire clay	8	6	664	11
Shale, blue	14	2	689	1
Limestone	21	6	710	7
Fire clay	2	....	712	7
Shale, green	1	6	714	1
Limestone, pebbly	6	....	720	1
Sandstone and shale	84	2	804	3
Coal No. 7	2	....	806	3
Fire clay	11	....	817	3
Sandstone and shale	30	....	847	3
Coal	2	2	849	5
Shale, black	3	....	852	5
Hard rock, gray limestone (No. 6)	4	....	856	5
Coal	4	2	860	7

Geologic Structure

The geologic structure is best known in the southwestern part of Marion County where most of the mines and oil wells are located. In other parts of the county the holes are scattered and data on the coals are so meager that correlation of beds is difficult and the structure therefore uncertain.

Marion County lies a short distance west of the deepest part of the Illinois coal basin, and in a general way the dip of all the beds is eastward. The most pronounced feature is the northward extension of the Duquoin anticline along the western edge of the county as far as Sandoval, where the axis begins to plunge toward the northeast. The axis of the fold passes near Centralia and Sandoval. The anticline is symmetrical, having its steeper dip to the east.

The axis of the fold undulates, the higher areas possessing the characteristics of domes, as in secs. 29 and 31, T. 2 N., R. 1 E. and in sec. 8, T. 2 N., R. 1 E. These features possess more than ordinary interest because they have been responsible for oil and gas accumulation, the largest field being located on the dome north of Sandoval. A detailed report on the Marion County oil fields by R. S. Blatchley, was published in Bulletin 16 of the Illinois State Geological Survey. From the top of the dome at Sandoval, where coal No. 6 is 32 feet below sea level, the bed dips eastward to Salem at the rate of about 36 feet per mile, although the dip is not uniform throughout the distance of 9 miles. In fact, from sec. 9, T. 2 N., R. 1 E. to Odin, the coal lies practically flat.

In the southwest corner of the county, the coal shows a dip of 200 feet in 1½ miles, as indicated by its position in mine No. 5, Centralia Coal Company, sec. 25, T. 1 N., R. 1 W., Washington County, and in the drill hole, sec. 20, T. 1 N., R. 1 E. It is probable that faulting is responsible for some of the irregularities of structure along the anticline. In Marion Coal Company's mine, NW. ¼ NE. ¼, NE. ¼ sec. 21, T. 2 N., R. 1 E., a northeast-southwest fault of approximately 30 feet displacement having a downthrow to the west, was found 200 to 300 feet east of the shaft. More than usual interest is attached to this fault, since a small oil seep in the mine along the plane of fracture was responsible for the discovery of the Marion County oil fields. The latter feature is described more fully under the subject "Roof."

In mines 3 and 4 of the Centralia Coal Company in sec. 7, T. 1 N., R. 1 E. a fault, probably the southward continuation of the one mentioned above, shows a displacement of 110 feet, the coal being higher on the east side. The fault is located 1800 feet east of the shaft in mine

No. 3, SW. ¼ NE. ¼ sec. 7, and 1500 feet east of the shaft in No. 4 NW. ¼ SE. ¼ sec. 7, the direction of the fault being slightly east of south at this place. Its location south of Centralia is uncertain, but it is believed to lie east of mines No. 2 and No. 5, and it is entirely probable that the break is east of the Miller Oil Company's well, SW. ¼ NW. ¼ sec. 20, T. 1 N., R. 1 E. The fault has limited operations on the east side of the mines mentioned. The steep east dip in the southwest corner of the county is no doubt complicated by faulting, but no details can be predicted at present. Such a condition would be in harmony with the geologic structure farther southwest along the Duquoin anticline in Perry County.

The structure of eastern Marion County is uncertain. At Kinmundy coal No. 6 lies about 273 feet below sea level; but at Farina in T. 5 N., R. 4 E. the same bed is nearly 130 feet higher, although the latter hole is 6 miles northeast of the Kinmundy shaft and would be expected to reach the coal at a lower altitude if the regular east dip affected this area. Some uncertainty exists in this case, since no written log was kept for the Farina hole.

In the extreme eastern part of the county, SE. cor. sec. 25, T. 3 N., R. 4 E., a 6-foot bed of coal overlain by limestone was found at a depth of 1050 feet, about 520 feet below sea level. Its correlation as coal No. 6 is strengthened by the existence of a thinner bed 89 feet lower, apparently No. 5. The east dip of 12 feet per mile from Salem to this hole, is regular for the district.

The 2-foot beds in sec. 4, T. 2 N., R. 4 E. and sec. 24, T. 2 N., R. 3 E. lying 273 and 350 feet below sea level are probably above coal No. 6 and the latter bed has not been recorded. Figure 19 shows the position of coal No. 6 along a line from Central City east through Salem to the edge of the county.

Coal No. 6

DISTRIBUTION AND THICKNESS

In Marion County coal No. 6 is best known in the southwestern part where it has been mined, and in the same region much information has been gained in drilling for oil and gas, although coal data secured in the latter operation are more or less unreliable. The Survey has no drill records for the following townships: T. 4 N., R. 4 E., T. 3 N., Rs. 2 and 3 E., T. 1 N., Rs. 2, 3, and 4 E. With the exception of Tps. 1, 2, and 3 N., R. 1 E., the holes are scattered, and the coal records were not carefully kept. It is believed that the bed is represented by at least a few feet of coal throughout the entire county; but predictions as to its commercial possibilities must necessarily be stated with caution, since such data as are available outside the prin-

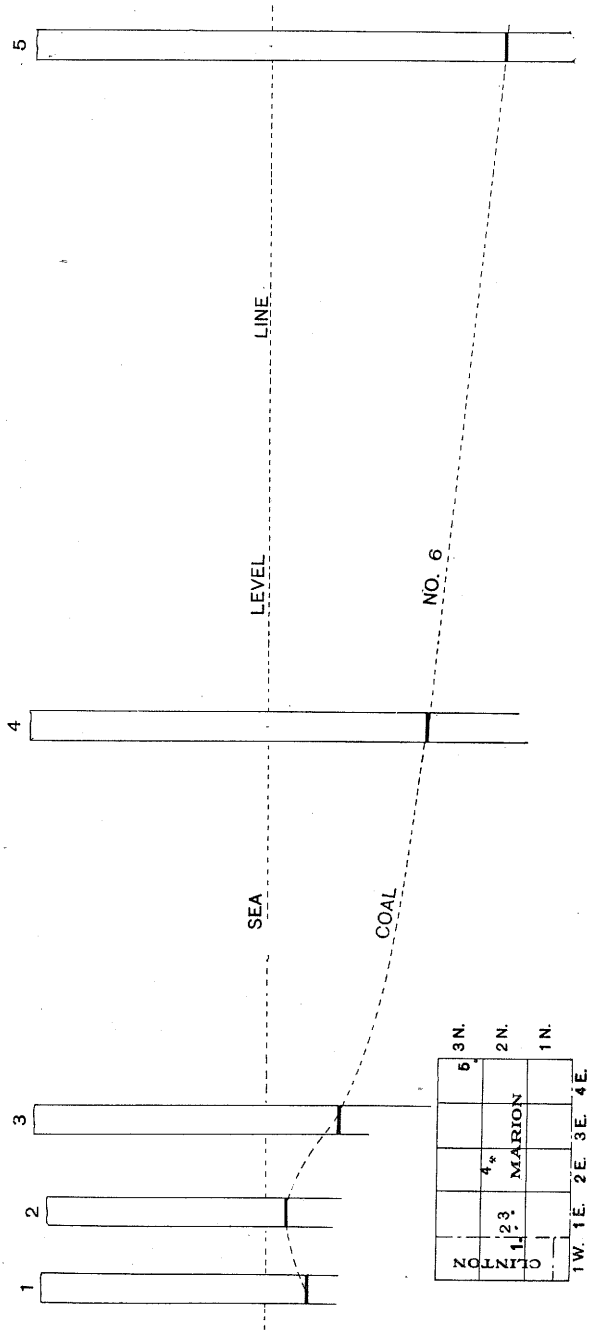

FIG. 19.—Sections showing position of coal No. 6 along a line from Central City to Salem, Marion County.

cipal mining area indicate that even where the bed is identifiable its thickness and general character are decidedly variable. Mining was formerly done at Kinmundy and at Salem, but operations were abandoned because of abnormal conditions.

The average thickness of coal No. 6 from measured sections in the mines of Marion County is 6 feet, the range being from 5 feet 6 inches to about 6 feet 10 inches. At Kinmundy the bed is represented by two benches separated by 3 feet of shale underlain by 5 feet of limestone. The upper coal varies in thickness from 28 to 36 inches and the lower averages 43 inches. At Salem it is 4½ feet thick, and the mine was abandoned several years ago. In the future when the areas of thicker coal in the Centralia district are mined out, capital will be interested in the development of the eastern part of the county, and the thinner coal will be extracted. The Centralia district is surrounded by areas of thinner coal (see Pl. I). Tps. 1 and 2 N., R. 1 E., have the advantage of uniform thickness and quality of coal and good transportation facilities.

It is probable that other areas in the county contain coal of equal thickness and character, but careful work with the diamond drill will be necessary in order properly to outline them.

PHYSICAL CHARACTER

The coal in the Centralia area resembles that of the entire Belleville district, although its average thickness is 6 feet, or 1 foot less than the average for the district.

Figure 20 is a graphic representation of coal No. 6 from measurements made in some of the Marion County mines. The physical and chemical differences in coal No. 6 east and west of the Duquoin anticline, as shown farther south, are not apparent in Marion County. As stated above, the anticline loses its identity north of Sandoval, and it is probable that general conditions were much the same on either side of the known fold during deposition of the coal.

In mine No. 5, Centralia Coal Company, the usual 3 benches are present, and the entire bed varies in thickness from 5 feet 4 inches to 8 feet, the average being about 6 feet. The top coal is irregular in thickness but persists throughout the mine. It consists mostly of glance coal which is extremely brittle and breaks into tarry, conchoidal pieces.

The prominent "blue band" 3 to 12 inches above the floor separates the middle from the bottom coal. The fracture of the middle and lower benches is blocky, and the bottom coal is the hardest of all. Gypsum and calcite are deposited in fracture planes in considerable

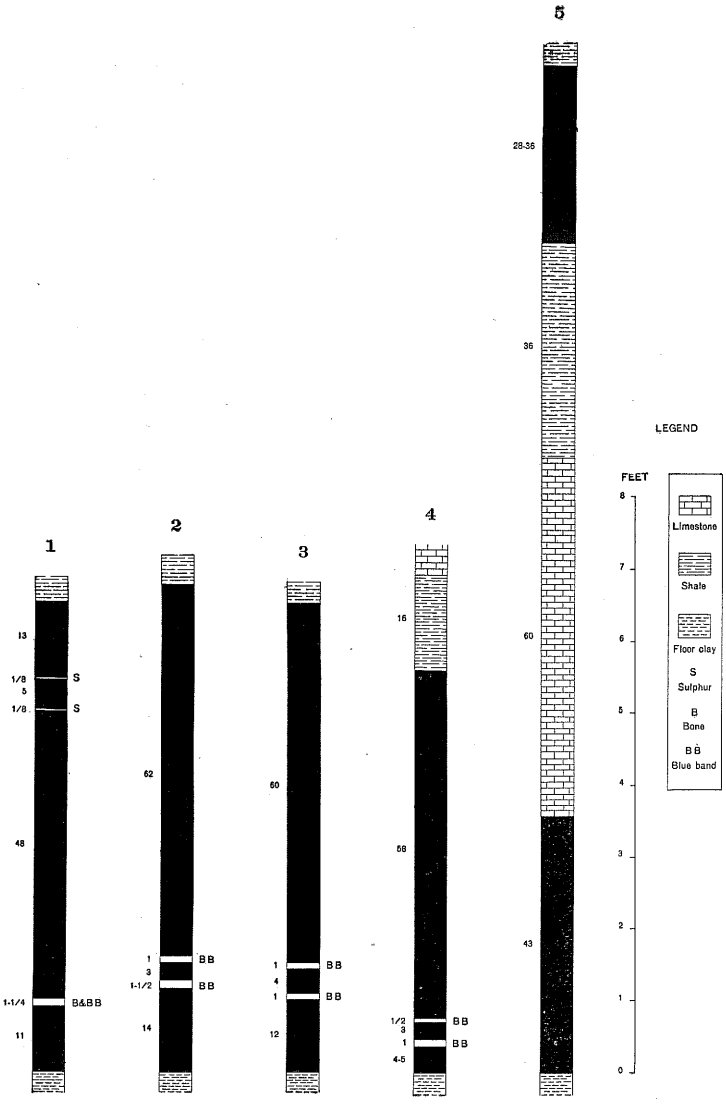

FIG. 20.—Graphic sections of coal No. 6 from measurements made in mines of Marion County.

1. Odin Coal Co., Odin. Room 1, 2nd north, west entry.
2. Centralia Coal Co., No. 2, Centralia.
3. Centralia Coal Co., No. 4, Centralia.
4. Chicago Sandoval Coal Co., No. 2, Sandoval. Room 8 off 2nd south on east side.
5. Kinmundy Coal Co., Kinmundy. (Abandoned.) Air course 300 feet southwest of shaft.

amount. Small bands of pyrite and dirt are noticeable, but the "blue band" is the only one persistent.

At Odin in the northeastern part of the Centralia field at the most easterly mine now operating in the county, the coal varies in thickness from 6 to 7 feet. The top coal averages 15 inches in thickness, and the bottom bench from 4½ to 8 inches.

The following section shows the average physical character of the bed at Odin:

Section of coal No. 6 in Odin Coal Company's mine, Odin

	Thickness	
	Ft.	*In.*
Top coal, clean, bright, laminated	----	16
Pyrite, persistent	----	¼
Coal, clean, finely laminated	----	5
Dirt and pyrite, persistent	----	¾
Coal, laminated, with many dirt bands, and considerable pyrite in lenticular streaks	4	----
"Blue band," gray shale, although in some places pyrite only	----	2
Coal dull	----	10
	6	10

The coal at Odin is very similar to that at Centralia. The gypsum and calcite in the fracture planes are conspicuously abundant. Fibrous ferrous sulphate is developed on the exposed ribs and on the floor, especially in the more moist places. At numerous places in the Odin mine calcareous clay veins cut the bed vertically. In most places they do not exceed 4 inches in width, and as a rule they extend only part way from the top to the floor. Moreover, there appears to be no system to the veins and no means of predicting their occurrence. They are interesting because of their rare development in coal No. 6, and their similarity to the veins in coal No. 5 at Springfield. At Odin they are not large enough to be especially troublesome in mining.

At Kinmundy two beds of coal 8 feet apart lie at the horizon of bed No. 6. In places the interval consists entirely of shale which forms a roof for the lower bed, and in others as much as 5 feet of limestone rests on the lower coal. It is believed that the two benches represent coal No. 6, and that the intervening material is simply a parting similar to that in coal No. 2 at Murphysboro. The top bench varies from 28 to 36 inches and the lower averages 45 inches. Mining has been confined mostly to the lower bench, although the upper bed is said to be the better coal and to have the stronger roof. This coal does not part readily from the roof and its variable thickness renders its commercial value uncertain.

Clay veins similar to those at Odin cut through both coals and the intervening beds. In the Centralia Coal Company's mines No. 2, No. 3, and No. 4 the "blue band" is in most places represented by two thin beds of shale separated by 3 or 4 inches of coal. The lower part of the band is the more persistent of the two.

ROOF AND FLOOR

The limestone cap rock is present over most of the county, and has an average thickness of about 15 feet. In places small shale partings are interbedded with the limestone. Below the cap rock the material overlying the coal is variable. At the Odin mine from 2 to 10 feet of black shale exists above the coal. In parts of the mine the lower 5 inches of this material is removed in mining. Above the shale the usual limestone cap rock is present over the entire mine.

Most of the records show a variable amount of clay under the coal. At the Odin mine the underclay reaches a thickness of 8 feet. It is very rocky and is unfit for commercial use. Ordinarily the clay is dry, but when the mine is idle the floor heaves sufficiently to cause inconvenience. The variability in character and thickness of the underclay of coal No. 6 make it extremely doubtful if any of it in Marion County can compete with the fire clay and shales near the coals in northern Illinois.

IRREGULARITIES

The feature of greatest importance as an irregularity in the county, so far as known, is the Centralia fault mentioned earlier in the report. North of Centralia in mines No. 3 and No. 4 the fault has a displacement of 110 feet, the upthrow being to the east. It is found 1800 feet east of the shaft in No. 3, and 1500 feet east of the shaft in No. 4, having at this point a slight northwest-southeast trend.

Two miles north in the Marion County Coal Company's mine in NW. ¼ NE. ¼ NE. ¼ sec. 31, T. 2 N., R. 1 E., a northeast-southwest fault having an upthrow of 30 feet to the east has been known for several years. The latter fault appears to be responsible for the oil seeps in the mine, which led to the discovery of the Marion County oil fields. At this place an oil sand exists only 17 feet below coal No. 6. The fault not only brings the sand into closer contact with the mine entries, but it also affords channels for the easy movement of oil particles. The relations between the coal and the oil sands are graphically shown in figure 21 which is adapted from figure 1, Bulletin 16 of this Survey.

In the Marion County Oil and Gas Company's well, SE. ¼ SW. ¼ sec. 29, T. 2 N., R. 1 E., about ½ mile east of the mine under con-

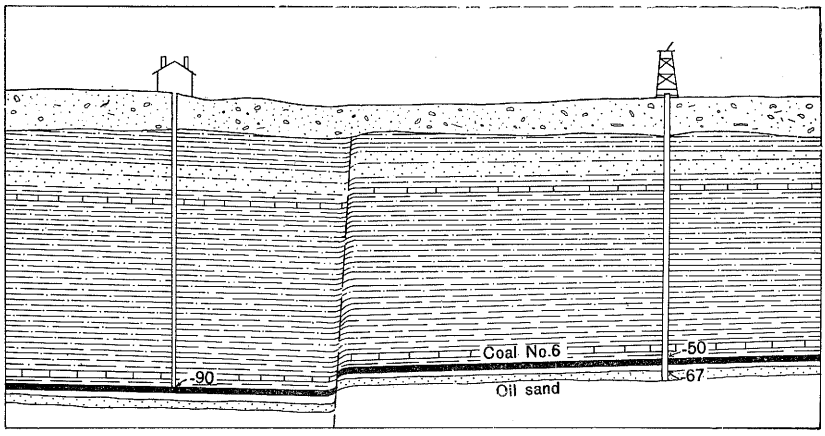

FIG. 21.—Sketch showing probable reason for oil seep in Central City mine. (After Blatchley.)

sideration, the coal and the oil sands were found at depths of 50 feet and 67 feet respectively below sea level. At the mine shaft the coal lies 600 feet below the surface or 90 feet below sea level. From the well westward to the fault, which is about 250 feet east of the shaft, the beds dip 23 feet, which is sufficient grade to allow the oil to gravitate down dip and seep into the mine. For several years this oil has been collected and used for lubricating purposes around the mine.

The direction and character of this fault, and its position along the axis of the Duquoin anticline lend strength to the belief that it is the northward continuation of the Centralia fault described above. The position of the coal in drill holes between Junction City and Centralia furnishes additional support to this belief.

OTHER COALS

Several coal horizons exist above coal No. 6, but all have proved to be commercially valueless under present conditions because they are lenticular, and most of them too thin for profitable mining.

From 35 to 50 feet above coal No. 6 there is commonly one bed, or in places two closely associated beds, which represent coal No. 7. Only one or two of the oil holes record this coal, and it is known chiefly in the shafts and in holes drilled for coal, of which there are but a small number. In the logs available for study, coal No. 7 ranges in thickness from 6 inches to 3 feet 4 inches. One record shows two beds separated by 10 feet of clay, the upper being 1 foot 4 inches and the lower 3 feet 2 inches in thickness. So far as known, no attempt has been made to mine this coal, and no information

regarding its character is available. In mine No. 2, coal No. 8, 200 feet above No. 6, formerly marked the bottom of the shaft. The record shows that it was 7 feet thick, but if so, this is the only place in the State where coal No. 8 attains a great thickness. The shaft was sunk later to coal No. 6, and no coal is now extracted from the upper bed. In other records thin beds of coal are reported near this horizon, but in no case is the thickness more than 14 inches. Many lenticular coals are reported in the shaft logs, but they are thin and can not be traced from one hole to another. None of these lenses exceeds 2 feet in thickness, and they cannot be regarded as important in estimating the coal resources of the county.

Below coal No. 6 the beds are known only through oil-well logs which are unsatisfactory. Although many holes have been drilled in the county, the information regarding the lower coals is practically negligible. Only 7 records show coals below No. 6, although it is almost certain that other beds do exist. Two of these holes in sec. 4, T. 1 N., R. 1 E. penetrate coals said to be 5 feet thick. In one the interval between coal No. 6 and the recorded bed is 115 feet and in the other 220 feet. The latter coal occupies the position of coal No. 2, but data are too meager to correlate it positively with the Murphysboro. The 5-foot coal, 115 feet below coal No. 6, is reported in but one hole, and it is believed that little confidence can be placed in the existence of any commercial bed at this horizon.

Coal No. 5, having a thickness varying from 5 to 7 feet, is reported in 4 holes near Odin and Sandoval. The bed lies from 25 to 45 feet below coal No. 6 in the western part of the county, but in sec. 25, T. 3 N., R. 4 E. at the eastern side the only bed referable to coal No. 5 is 85 feet below coal No. 6, showing a probable increase in the interval between the coals toward the east.

The large number of records and the paucity of coal data bring out forcibly the need of careful drilling and the correct determination of the position and thickness of coals even where oil is the major consideration. It is more economical to secure all possible data in one hole rather than to drill a separate hole for each kind of information. Despite the large amount of money expended, almost nothing is known regarding the areal distribution and thickness of coals below No. 6 in Marion County.

MONTGOMERY COUNTY

Production and Mines

Total production in tons, year ended June 30, 1913. 2,418,329
Average annual production from 1908 to 1913.... 1,840,200
Total production, 1881 to 1913.....16,902,790

During the year ended June 30, 1913, Montgomery County produced 3.89 per cent of the total output for Illinois. Only 10 mines were in operation, of which 6 produced more than 150,000 tons each. The county has increased steadily in its coal production, largely because of its advantageous location, good transportation facilities, and the improvement of its mining equipment.

Below is the list of mines operating in 1913. The Nokomis Coal Company has recently opened a new property at the place of the same name and with its modern equipment will add considerably to the total output for the county.

Table 9.—*List of shipping mines, Montgomery County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production, 1913
			¼	¼	Sec.	T. N.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Peabody Coal Co.	14	SW	NW	32	10	2	665	576	89	8	....	551,772
2	Shoal Creek Coal Co.	1	SW	SE	22	7	4	537	374	163	7	....	542,473
3	Peabody Coal Co.	15	Cen.	NE	23	8	4	620	458	162	8	....	395,003
4	Hillsboro Coal Co.	Hillsboro	....	NE	12	8	4	620?	435	185?	7	....	351,723
5	Peabody Coal Co.	12	NW	SE	6	9	2	665	541	124	8	....	271,839
6	Peabody Coal Co.	11	NE	NW	5	8	3	651	462	189	7	6	167,070
7	Clover Leaf Coal Co.	2	SE	NE	3	7	3	630	517	113	7	6	85,516
8	Farmersville Coal Mining Co.	1	SW	NE	4	11	5	631	370	261	8	6	26,922
9	Litchfield Collieries Co. coal No. 2[5]	7	....	NE	32	9	5	690	702	–12	4	8	20,593
10	Peabody Coal Co.	10	NW	NE	10	10	2	667	630	37	8	6	7,418
11	Nokomis Coal Co.	....	SW	NW	28	10	2	663	658	5	7	6	.....

Coal-bearing Rocks

Although an average thickness of 100 feet of drift covers the underlying rocks in Montgomery County except where streams have cut their valleys into the uppermost part of the coal-bearing forma-

[5]Litchfield coal lies near horizon of No. 2, but is not definitely correlated as No. 2.

tions, from a study of records of 115 coal and oil tests and mine shafts the stratigraphy is well known, especially down to, and including, coal No. 6. Unlike the holes in Marion County, the majority of which were drilled in search of oil, most of the Montgomery logs represent borings for coal and consequently careful attention has been given the Pennsylvanian beds.

In the western part of the county these rocks average about 750 feet in thickness, and the gradual eastern dip increases this thickness to about 1000 feet along the eastern boundary. Coal No. 6 varies in depth from 340 feet on the west to almost 700 feet near the east county line.

Next below the drift in the western half of the county is the Carlinville limestone which is exposed in places by the west fork of Shoal Creek. This limestone varies from about 270 feet to a little more than 300 feet above coal No. 6, the larger intervals appearing in the eastern part of the county. Its average thickness is about 10 feet, although greater thicknesses are reported, and in places it consists of two beds separated by a thin parting of shale. Its persistence in the logs is remarkable when one considers the large number of sources from which the records have been collected.

In Tps. 9 and 10 N., R. 1 W. and in T. 10 N., R. 2 W. the Carlinville limestone is 300 feet or more below the surface; and the New Haven limestone, ranging from 20 to 40 feet in thickness and lying about 200 feet above the Carlinville, forms the bed rock just as the latter underlies the drift in the western part of the county. In the southeastern townships the New Haven was eroded prior to the deposition of the glacial drift, and its line of outcrop, if drawn on the map, would extend parallel to and about 30 miles east of that of the Carlinville.

The limestone cap rock over coal No. 6 is even more persistent than the coal itself. In fact, where the coal has been eroded, it is possible in many places to identify the horizon by the position of this roof limestone. Above the limestone, and separated from it by clay or shale, the drill generally penetrates coal No. 7 about 30 feet above coal No. 6. The higher bed is usually thin, but thicknesses of 2 feet are not uncommon. A short distance above coal No. 7 and usually less than 50 feet above coal No. 6, a thin bed of red or variegated shale is penetrated. Its colors are so pronounced that in spite of small quantity, drillers seldom fail to notice and record it.

Coal No. 8 is found over practically the entire county. It is from 150 to 180 feet above coal No. 6 and averages about 1 foot in thickness. The beds between coals No. 8 and No. 7 are mostly shales, and the same is true of those between coals No. 8 and No. 9,

which are 90 to 110 feet apart. Coal No. 9, where present, ranges in thickness from a few inches up to 1 or 2 feet. The interval between coal No. 9 and the Carlinville limestone above is composed largely of shales and does not exceed 50 feet.

The 200-foot shale interval between the Carlinville and the New Haven limestones is constant. Within this zone two thin coals 55 feet apart are reported in a number of holes, the upper bed being about 80 feet below the bottom of the New Haven limestone.

Below coal No. 6 there are from 300 to 350 feet of Pennsylvanian rocks and in this part of the section they are more sandy than in that part above the Belleville coal. A number of coals exist below coal No. 6 but they are so variable in thickness, character, and position that correlation is extremely difficult with present information. All of the commercial coals will probably be found in a zone not exceeding 250 feet, the top of which is formed by coal No. 6. The individual beds thus far known will be treated under "Other Coals" in this chapter.

The coal-bearing rocks lie on an ancient erosion surface of considerable relief, consequently the base of the Pennsylvanian is extremely uneven. Besides, the "Coal Measures" were deposited on two different formations in Montgomery county. West of a general northeast-southwest line extending from the southwest corner of the county, these overlie the St. Louis limestone known to the driller as the "Big Lime." East of this line beds representing the Chester group are interposed between the "Coal Measures" and the "Big Lime". In the Smith well, sec. 15, T. 7 N., R. 5 W., the Chester is only about 50 feet thick but it probably thickens toward the south and east, where it contains the oil sands of Carlyle, Sandoval, and the main fields of Illinois. The Chester is characterized by red or pink shales, thin limestones, and sandstones interbedded, and the top of the formation can usually be placed at the first limestone or red shale 250 to 300 feet below coal No. 6, and drilling for coal should be discontinued at this point. In the northwestern part of the county several hundred feet of solid Mississippian limestone underlie the coal rocks, and no coal exists below the top of this formation.

In 1886 a number of wells were drilled into the Pottsville formation near Litchfield, and both oil and gas were found. For a number of years the gas was used for lighting purposes, but the pressure decreased and it was abandoned. Oil was pumped until about 1904 and sold for lubricating purposes. The field is similar in size and character to that of Carlinville which is now producing oil and some gas commercially. The sandy nature of the beds forming the base of the "Coal Measures" renders them fit reservoirs for oil and gas where the geological structure is favorable.

The following log of a drill hole in sec. 24, T. 12 N., R. 5 W. records all of the beds in the "Coal Measures" from the Carlinville limestone down to the base of the formation which overlies the St. Louis limestone. Coal No. 6 was reached at 342 feet, and the 3-foot coal at 397 probably represents coal No. 5. The 4½-foot bed at 571, together with the thinner bed 7 feet 9 inches below is probably to be correlated with coal No. 2 (Murphysboro). The base of the coal-bearing rocks is found at 763 feet.

Record of George Hirsh well No. 5

Location—SE. cor. NE.¼ sec. 24, T. 12 N., R. 5 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Dirt	4	....	4	....
Clay	12	....	16	....
Sand and pebbles	10	....	26	....
Clay	9	....	35	....
Sand and pebbles	15	....	50	....
Limestone	11	....	61	....
Shale, dark	2	....	63	....
Shale, gray	13	....	76	....
Limestone, gritty (Carlinville)	10	....	86	....
Shale, black	4	....	90	....
Shale, gray	88	....	178	....
Shale containing sand and mica	8	....	186	....
Shale, gray	9	....	195	....
Limestone, gritty	9	....	204	....
Shale, gray	71	....	275	....
Sandstone, hard	6	....	281	....
Shale, dark	1	....	282	....
Shale, gray	5	....	287	....
Shale, red	6	....	293	....
Shale, gray	16	....	309	....
Shale	3	....	312	....
Shale, gray	4	....	316	....
Stone, hard	4	....	320	....
Stone, gray	4	....	324	6
Limestone	5	8	330	2
Shale, argillaceous	....	8	330	10
Limestone	....	3	331	1
Shale, argillaceous	1	5	332	6
Limestone	....	5	332	11
Shale, argillaceous	1	7	334	6
Sandstone	3	4	337	10
Shale, argillaceous	....	10	338	8
Limestone	2	....	340	8
Shale, black	1	8	342	4
Coal (No. 6)	8	6	350	10
Shale, gray	3	....	353	10

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, white	1	2	355	----
Limestone	4	----	359	----
Shale, white	2	----	361	----
Limestone	2	8	363	8
Shale, argillaceous	6	7	370	3
Shale, gritty	3	9	374	----
Clay, blue	13	----	387	6
Shale, black	9	6	397	----
Coal (No. 5)	3	----	400	----
Shale, argillaceous	1	6	401	6
Limestone	----	9	402	3
Shale, argillaceous	6	3	408	6
Shale	1	----	409	6
Coal	----	1	409	7
Clay, blue, gritty	40	5	450	----
Shale, blue	13	3	463	3
Shale, black	2	6	465	9
Coal	2	9	468	6
Shale, argillaceous	5	4	473	10
Coal	----	6	474	4
Shale, gritty	17	8	492	----
Soap-clay	5	----	497	----
Shale, black	1	4	498	4
Coal	1	6	499	10
Shale, argillaceous	6	2	506	----
Shale, gray	7	----	513	----
Shale, black	8	6	521	6
Coal	----	6	522	6
Shale, argillaceous	2	10	524	10
Limestone	1	3	526	1
Shale, argillaceous	----	11	527	----
Coal	1	6	528	6
Shale, white, argillaceous	5	6	534	9
Shale, gritty	3	----	537	----
Shale, argillaceous	1	1	538	1
Shale, dark	2	----	540	1
Shale, calcareous	1	11	542	4
Shale, argillaceous	5	6	547	6
Clay, blue	18	6	566	----
Shale, black	5	3	571	3
Coal	4	6	575	9
Sandstone	6	6	582	3
Coal	----	4	582	7
Shale, black (No. 2)	----	11	583	6
Coal (No. 2)	2	6	586	10
Shale, black	2	4	588	4
Shale, gritty, and sandstone	21	2	609	6
Sandstone, argillaceous	16	6	626	----
Shale-clay	2	----	628	----

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Sandstone, argillaceous	4	....	632	....
Shale, argillaceous	15	6	647	6
Shale, black	3	6	651	....
Pyrites	....	8	651	8
Clay, black	1	4	653	....
Sandstone	24	....	677	....
Shale, gritty, and sandstone	6	....	683	....
Sandstone, argillaceous	5	....	688	....
Sandstone	2	....	690	....
Sandstone, argillaceous	1	....	691	....
Shale, black	2	....	693	....
Sandstone, argillaceous	9	....	702	....
Shale, black	16	....	718	....
Sandstone	....	6	718	6
Shale, black	2	6	721	....
Limestone	4	....	725	....
Shale, black	5	....	730	....
Sandstone, containing lime	9	....	739	....
Shale, black	4	....	743	....
Shale, blue	8	....	751	....
Sandstone	2	....	753	....
Shale, gritty	10	....	763	....
Lime, gritty	10	....	773	....
Sandstone	10	....	783	....
Lime, gritty	20	....	803	....

Record of Singer well, Peabody Coal Co.
Location—sec. 4, T. 10 N., R. 2 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil and clay	2	....	2	....
Soil and clay	8	....	10	....
Sand and gravel	20	....	30	....
Clay, tough, blue	19	....	49	....
Gravel, coarse	2	....	51	....
Limestone, hard, broken	6	....	57	....
Limestone (New Haven)	28	6	85	6
Sand shale	10	6	96	....
Sand shale with blue shale partings	16	....	112	....
Sand shale	19	....	131	....
Shale, light blue	28	....	159	....
Shale, blue	10	....	169	....
Shale, black	1	....	170	....
Coal	....	4	170	4
Shale, dark	4	8	175	....
Shale, gray	1	....	176	....
Sandstone with blue shale partings	4	....	180	....
Shale, light blue, and sandstone	5	....	185	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, light blue	9	----	194	----
Shale, gray	2	----	196	----
Shale, dark	2	----	198	----
Shale, light blue	17	7	215	7
Sand shale	10	6	226	1
Shale, black	1	6	227	7
Coal	----	8	228	3
Shale	3	----	231	3
Lime shale	1	9	233	----
Lime shale with limestone bands	5	----	238	----
Sandstone	1	----	239	----
Shale, light blue, with sand shale partings	25	----	264	----
Shale, light blue	14	6	278	6
Sand shale	7	6	286	----
Shale, blue, with sand bands	6	----	292	----
Shale, gray	2	6	294	6
Lime shale with nodules	2	----	296	6
Clay shale, dark	3	6	300	----
Lime shale with limestone bands	6	----	306	----
Clay shale, dark, with limestone bands	3	----	309	----
Limestone (Carlinville)	14	----	323	----
Shale, black	2	8	325	8
Coal	----	2	325	10
Clay shale	3	2	329	----
Clay shale, dark	1	6	330	6
Sandstone with blue shale partings	2	6	333	----
Shale, light blue, with sandstone partings	9	----	342	----
Shale, light blue	5	----	347	----
Shale, blue	13	----	360	----
Sandstone	13	----	373	----
Sandstone, dark	12	----	385	----
Shale, blue	----	6	385	6
Limestone	1	2	386	8
Shale, black	6	4	393	----
Coal	----	6	393	6
Shale, dark blue	3	6	397	----
"Slate," light blue	3	8	400	----
Shale, dark blue	4	4	405	----
Sand shale	5	----	410	----
Shale, blue, with sandstone partings	38	----	448	----
Shale, blue, with hard bands	18	----	466	----
Shale, blue, with sandstone partings	9	8	475	8
Sandstone	1	----	476	8
Shale, tough, blue	4	4	481	----
Shale, blue	1	10	482	10
Coal	1	1	483	11
Fire clay	1	9	485	8
Sandstone	13	4	503	----
Sand shale	22	----	525	----

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, dark blue	72	5	597	5
Sandstone	13	10	611	3
Shale, blue	2	9	614	....
Limestone	4	2	618	2
Shale, blue and red	2	10	621	....
Shale, black	2	....	623	....
Shale, blue	1	....	624	....
Shale, dark blue	4	5	628	5
Coal (No. 7)	2	....	630	5
Shale, dark blue	8	3	638	8
Lime shale	3	....	641	8
Limestone	2	4	644	....
Shale, blue	3	....	647	....
Limestone	8	....	655	....
Slate, black	2	10	657	10
Coal	6	5	664	3
Sand, blue } No. 6	....	1	664	4
Coal	1	8	666	....
Fire clay	1	....	667	....

Geologic Structure

In common with the rocks of adjoining areas, the underlying formations of Montgomery county have a general eastern dip. Along the western part of the county coal No. 6 lies from 250 to 300 feet above sea level; whereas along the eastern side the same bed is at sea level, showing a dip of slightly more than 10 feet per mile across the county. This dip is not uniform, however, and slight folds or even reversals of the dip are known in a few localities.

The principal structural features in Montgomery county are the Hillsboro flat or terrace, the Sorento dome and the Ohlman anticline, all of which are described in an earlier part of this bulletin. The relation of the structure to oil and gas accumulation is treated in detail in Bulletin No. 28 by R. S. Blatchley.

Local dips affecting small areas are found in some of the mines, but the general structure is too gentle to have much effect on mining conditions. Faults are infrequent and when present generally do not affect the coal more than the thickness of the bed. One such fault in the Panama mine of the Shoal Creek Coal Company is illustrated in figure 22. It is a north-south fracture about 2500 feet west of the shaft and has been traced 1000 feet.

The erosion channels which are well known in the county will be discussed under the subject "Distribution and thickness". These channels are known to the miner as "faults" but since the coal is ab-

sent because of erosion rather than by reason of fracturing and displacement, the term "fault" is not applicable.

Coal No. 6

DISTRIBUTION AND THICKNESS

The main areas of coal No. 6 in Montgomery County are (1) the narrow portion at the northwest corner projecting northward between Christian and Macoupin counties, and (2) that part east of a northeast-southwest line roughly parallel to and a few miles west of the C. C. C. & St. L. R. R. Between these two areas is another of irregular size and shape in which coal No. 6 is either thin or absent. The existence of the latter area has been known for several years, but hitherto no attempt has been made to outline it except in the most general manner. The lines on the large map indicate its boundaries as closely as they may be drawn with available information. Revision will be necessary from time to time, but the general shape and position of the area is believed to be represented correctly. So far as

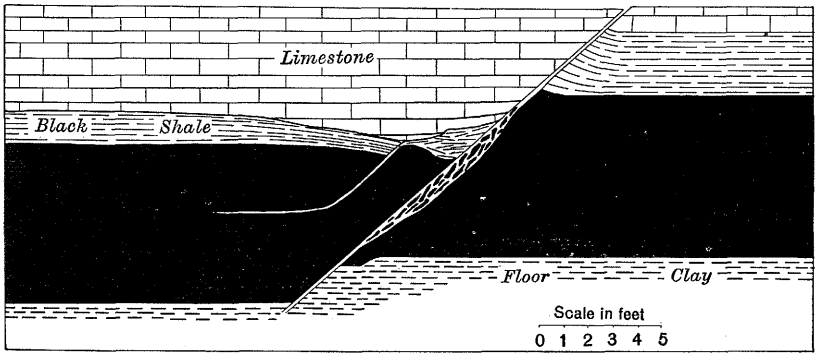

Fig. 22.—Fault in Panama mine of Shoal Creek Coal Co. 1st W., north entry, 2500 feet from shaft.

known it comprises parts or all of the following townships: T. 7 N., R. 5 W.; T. 8 N., Rs. 3, 4, and 5 W.; and T. 10 N., Rs. 2, 3, 4, and 5 W. It is not known whether the absence of the coal is due to lack of deposition or to erosion after deposition. At many places inside the area the bed is represented by a few inches, and in a very limited number of places, by its normal thickness. In the latter case, other holes nearby penetrate only a small amount of coal.

The presence of so variable an amount of coal indicates either that most of the area stood higher than the surrounding swamp during Pennsylvanian time, and the coal was deposited only in pockets, or

that later a large drainage line with its tributaries occupied the area and removed most of the coal. Here and there coal No. 6 is absent, but its limestone cap rock has not been affected; however, many other logs show the absence of both coal and limestone, sandstone being present at the usual position of these beds. Such a condition seems clearly to indicate erosion after the deposition of the roof materials.

It is possible and even probable that minable areas of coal No. 6 will be found inside the boundaries indicated on the map, but the location of such lands will be the result of the most careful diamond drilling and by the placing of holes less than ¼ mile apart. If, as is believed to be the case, an ancient drainage system occupied this part of the county, its tributary streams eroded the coal so that its present boundary is represented by an extremely irregular line which can be known accurately only after much more mining and drilling have been done. In this connection it is probable that the absence of the coal in places near Carlinville, Macoupin County, is the result of the same erosive processes that operated in Montgomery County, and it is also probable that the two areas are directly connected.

On the east side of the barren zone the best-known tributary is a channel 1000 feet wide extending slightly east of south from the main area west of Hillsboro through the east side of mine 15, Peabody Coal Company, Taylor Springs, and probably southward at least to sec. 12, T. 7 N. R. 4 W. The coal was found at about the same level on both sides of the channel, there being no displacement of the beds. However, this feature is known to the miner as a "fault," a term which he uses for any absence of the coal. On the east side of the channel almost one mile southeast of the shaft, coal No. 6 in normal thickness lies only 20 feet lower than at the shaft. The western edge of the channel was reached in the 5th and 6th east stub entries off the 3rd northeast, and thus far it has been the practice to abandon the entries upon reaching the channel. By drilling three or four holes along a line extending in an east-west direction the Montgomery County Coal Company, previous owners of the mine found the channel to be about 1800 feet wide.

The east side of the same erosion channel was probably reached in the northwest workings of mine No. 1, Hillsboro Coal Company, NE. ¼ sec. 12, T. 8 N., R. 4 W. From this point it is said to extend N. 35° E., but this direction appears to indicate only a minor bend in the course of the old stream since drill holes to the north indicate practically a normal thickness of coal. It is believed that the channel extends west from the Hillsboro mine and joins the main erosion area as indicated on the map.

Within the large "pockety" area shown on the map, most of the holes show no coal at the horizon of coal No. 6. Others record from a few inches to almost 4 feet. One hole drilled by the Wilmington Star Coal Company, SW. ¼ SW. ¼ sec. 2, T. 7 N., R. 5 W., reached 8 feet of coal; another drilled close to the first by the same company penetrated only 6 feet of coal, but the measurement is not regarded reliable. The general area in which the existence of the coal is uncertain is well known to the majority of operators, and doubtless many years will elapse before any large amount of drilling will be done where the chance of locating a commercial acreage is slight.

In the mines of Montgomery County, coal No. 6 ranges in thickness from 6 feet to a little more than 9 feet, the average being 7 feet 4 inches. In that part of the county including T. 11 and 12 N., Rs. 4 and 5 W., the same bed averages 8 feet, and it is being mined only at Farmersville.

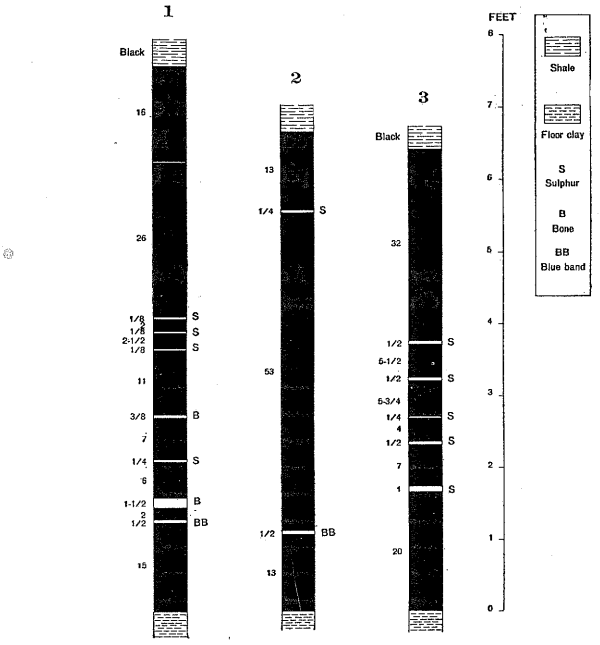

FIG. 23.—Graphic sections of coal No. 6 from measurements made in mines of Montgomery Co.

1. Shoal Creek Coal Co., No. 1, Panama. Room 1, 1st south stub off 8th west, south entry.

2. Peabody Coal Co., No. 15, Taylor Springs. Entry face, 2nd stub west off angle.

3. Hillsboro Coal Co., No. 1, Hillsboro. Room 36, 6th W. off main north.

East of the barren area the county is underlain by uniformly thick coal, most of which has been untouched by mining operations. Forty-six drill holes distributed over the area show an average thickness of 7½ feet for coal No. 6, a thickness which is about 6 inches greater than the average for the entire district covered by this report.

PHYSICAL CHARACTER

As seen at the face in the mines, the coal does not differ materially from that of adjoining counties. Figure 23 shows the physical character of the coal. The three benches persist, the top coal attaining a thickness of 18 inches in a few places. It is not left for roof as regularly as in the Franklin-Williamson district, but at Panama it is not removed where black shale overlies the coal, as it does in about one-half of the mine. At the Hillsboro Coal Company's mine No. 1 about 10 inches of top coal is left to protect the shale which does not make a good roof.

The coal is banded with pyrite, dirt, and charcoal, and its luster is in most places dull, although glance coal is present in small layers. Ordinarily the bottom coal is harder than the higher benches, and in many places it is comparatively free from impurities.

The following section was measured in mine No. 1, Shoal Creek Mining Company at Panama, and is typical of the bed in other mines of this county.

Section of coal No. 6 measured in mine No. 1, Shoal Creek Coal Mining Company, Panama

	Thickness	
	Ft.	*In.*
Top coal	....	14
Pyrite streak	....	....
Coal, clean and hard	....	7
Charcoal and sulphur	....	1⅝
Coal, clean	....	2¼
Charcoal	....	1
Coal, fairly clean	1	1
Dirt band	....	¼
Coal, dull	....	4¼
Dirt	....	¼
Coal, dull with bright coal bands	....	2
Dirt	....	¼
Coal, dull and bright laminated	....	3⅝
Sulphur	....	⅛
Coal, clean	....	5¾
Dirt	....	⅛
Coal, dirty	....	3¾
Sulphur	....	⅛
Coal, dirty	....	5

	Thickness	
	Ft.	*In.*
Sulphur	----	½
Coal, very dull and dirty	1	----
"Blue band," shale, and black jack	----	3½
Coal, clean and hard, streaks of charcoal	1	1¾
	7	⅛

ROOF AND FLOOR

Outside of the barren area described earlier in this chapter the cap rock of coal No. 6 is the usual limestone. At Panama throughout half of the mine limestone directly overlies the coal. Throughout the remainder of the mine is an intervening black shale which falls if exposed to the air. In order to protect this shale 10 to 14 inches of top coal is left in place. Otherwise the shale falls to the cap rock about 3 feet above. In Dering mine No. 22 at Witt, about 18 inches of poorly bedded, calcareous shale underlies the cap rock in places; whereas elsewhere in the mine black shale as great as 5 feet in thickness occupies this position. At mine No. 1, Hillsboro Coal Company, the so-called "white clod" attains a thickness of 5 feet in places; whereas the black shale is generally less than 2 feet thick.

Figure 24 illustrates roof conditions in mine No. 1, Nokomis Coal Company, at Nokomis according to Mr. C. W. Smith, Mining Engineer for the company. On account of the heavy slates it was the original intention to drive wide entries and allow everything below the upper limestone to fall. Where work was begun, conditions were as shown in No. 1, but farther along the entry a thin bed of dirty coal was found in place of the carbonaceous shale and it became necessary to narrow the entries and to hold up all of the roof materials on account of the danger of mine fires. As shown in figure 25 the black shale probably grades laterally into coal. Whether it exists in small areas or over most of the mine depends on conditions at the time of deposition and can not be predicted.

The limestone varies greatly, different reports assigning to it thicknesses between 1 and 15 feet. However, variable as it is, its strength is sufficiently great to provide an efficient roof. Most of the trouble experienced is the result of the inconstant character and the lack of cohesion exhibited by the materials between the limestone and the coal. Where it is convenient to leave the top coal in place it serves to protect the shales, and its own strength is sufficient to require much less timbering than do the shales, if the top coal is removed.

As has been mentioned in the chapter on Macoupin County that the limestone was eroded in the eastern part of the county by the same agencies that removed both limestone and coal farther east along the

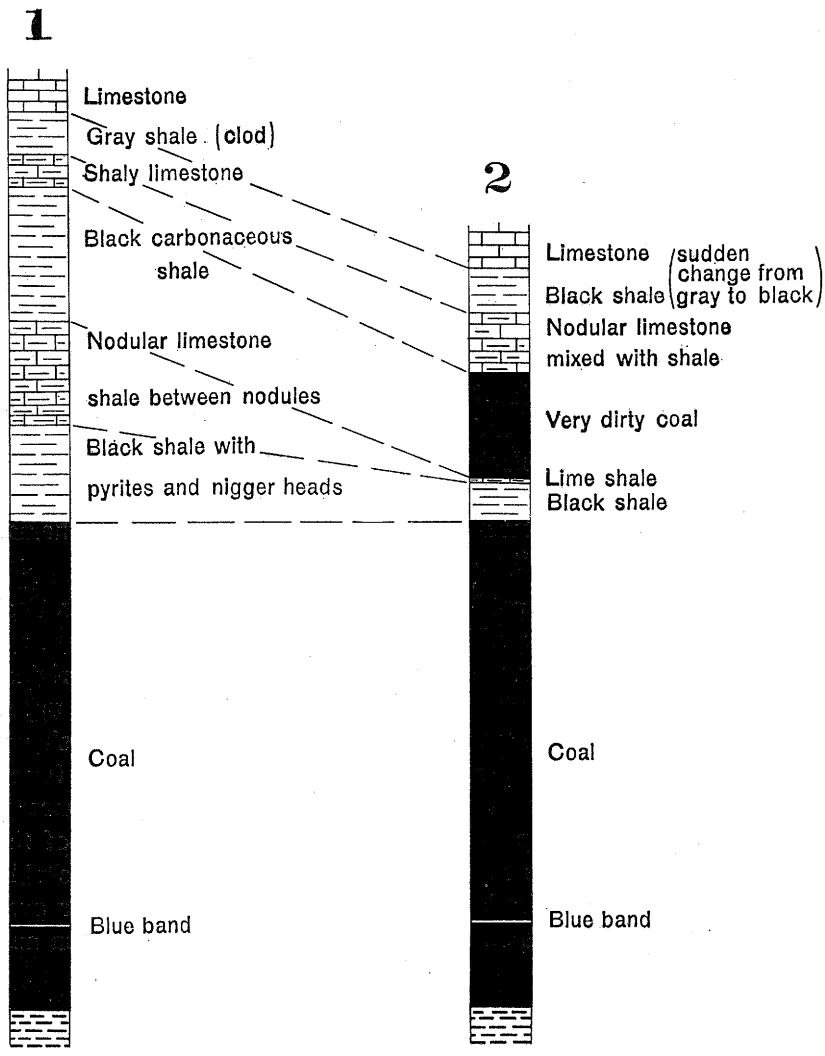

FIG. 24.—Roof conditions Nokomis Coal Co., mine No. 1. (After C. W. Smith.)

Montgomery County line, it is to be expected that near the old drainage area roof conditions will be uncertain.

In places both the limestone and black shale contain concretions known as "niggerheads", which project downward into the coal and

tend to fall when the latter is removed. The concretions in the limestone are probably siliceous; whereas those in the shale are composed of lime carbonate. However, the black shale only rarely shows the presence of lime.

Clay of variable thickness and character underlies the coal. At Panama a fairly constant thickness of 14 feet is reported. It is gray, sandy, and very hard when fresh, but slakes and heaves readily on exposure to the air and especially where water is present. Near the bottom of the clay, lime boulders are common, and below these is a poorly bedded, impure limestone. In other mines of the county the underclay is reported to be variable, ranging in thickness from 18 inches to as much as 12 feet, but its character is not favorable to commercial development.

IRREGULARITIES IN ROOF AND FLOOR

Attention has been called to the chief irregularity in roof coal and floor in the county, namely, the ancient drainage channel. Up to the present time their effect has been known chiefly in the mines immediately south and southwest of Hillsboro. Small channels a few hundred feet wide can be crossed by entries at no great cost, but if a shaft happens to be placed near the edge of a large channel, the area of mining operations is limited to one side of the eroded area. It is probable that future mines located near the edges of the barren area will discover tributary channels of different sizes, the existence of which cannot be ascertained from present drill holes.

The real faults in the mines are insignificant. They are minor fractures along which slight movement has occurred, but the displacement does not ordinarily exceed the thickness of the coal.

Other Coals

The only coal of commercial importance above coal No. 6 is coal No. 7 which lies about 30 feet higher. Coal No. 7 is generally thin, but in T. 10 N., Rs. 1 and 2 W., most of the holes indicate a thickening which is apparently local. A number of drillers report from 2 feet to 2 feet 9 inches for the bed, and in sec. 36 a thickness of 3 feet 2 inches is recorded, although the latter is from a churn-drill record and is somewhat uncertain.

The only coal utilized in the county besides coal No. 6 is a bed averaging 4 feet 8 inches in thickness about 240 feet below coal No. 6 and mined by the Litchfield Coal Company, NE. ¼ sec. 23, T. 9 N., R. 5 W. The bed is in the proper position to be correlated with coal No. 2 (Murphysboro), although it may be slightly older. David White regards it distinctly Pottsville in age which would place it

below coal No. 2. Definite correlation must be postponed until more deep drilling is done. This is the only mine located in the area from which coal No. 6 has been eroded, and it was necessary to operate the best lower bed. The coal lies 690 feet below the surface at the mine and dips 3 degrees northwest and away from the anticline or the arching of the beds which was probably responsible for the oil and gas accumulation southeast of Litchfield. The coal is in one bench and varies from 26 inches to a maximum of 84 inches. It is streaked with layers of pyrite generally not exceeding ¼ inch thick, but larger amounts are not unknown. Its chemical analysis is not unlike that for coal No. 6, and its dissimilarity to the typical Murphysboro coal renders its correlation with that bed doubtful. The roof consists of "clod", poorly bedded calcareous shale, or gray shale; the former attains a thickness of 3 feet, and at least 10 feet of the latter appears in parts of the mine. Above both of these materials is a limestone from 1 to 5 feet thick. The contact of the roof with the coal is uneven, the rolls here and there extending down within 2 feet from the floor. At a depth of 704 feet, the same coal 4 feet 10 inches thick is reported in a drill hole in the SE. cor. NE. ¼ sec. 29, T. 9 N., R. 5 W., and the Felpers well drilled by the Producers Oil Company in the SW. ¼ sec. 29, T. 8 N., R. 5 W. passed through a similar bed 4 feet thick at 575 feet.

Three other coal horizons are reported between coals No. 2 (?) and No. 6. From 25 to 50 feet below coal No. 6 a number of the deeper holes show a coal which ranges in thickness from 8 inches to 3 feet and probably represents coal No. 5. From 30 to 60 feet lower, another horizon is prominent, especially in holes drilled in T. 9 N., R. 5 W. At this horizon the coal consists either of a single bed 3 or 4 feet thick or of two benches separated by a few feet of shale. The upper is said to vary from 2 feet 4 inches to 3 feet 8 inches in thickness. In the same township, 40 or 50 feet below the beds last mentioned, are several thin beds separated by small partings of shale, the group being about 100 feet above the horizon of coal No. 2. Since the various coals enumerated above are reported from drill holes in a small area, and the intervals between the beds are so variable, definite correlations are impossible. It is at least encouraging to know that, although coal No. 6 is absent over a large area in Montgomery County, other beds of possible commercial value exist lower in the coal-bearing rocks, and it is still more encouraging to know that at Litchfield one of these lower beds has been, and is being, mined. Such deep drilling as has been done indicates that sometime in the future, when most of coal No. 6 is mined, further tests will be made of the thickness and character of the coals within the 250-foot zone below

coal No. 6. It will be necessary to use the core drill in order to make careful studies of the physical and chemical character of the various beds.

ST. CLAIR COUNTY

Production and Mines

Production in tons for year ended June 30, 1913... 4,740,212
Production in tons, 1908 to 1913.....21,621,533
Total production, 1881 to 1913.....77,532,658

During the year ended June 30, 1913, St. Clair County produced 7.6 per cent of the State's entire output. The position of the county with respect to the large markets of the St. Louis region, has been a most important factor in keeping St. Clair in the front rank of coal producers. As late as 1911, this county was first in rank, a place it has occupied seven different times between 1881 and 1912. During 1912-13, it ranked fifth owing to large increases in Williamson, Sangamon, Franklin, and Macoupin counties.

Of the 65 mines operating, only 10 produced more than 100,000 tons each. Fifteen local mines were responsible for 102,660 tons of the total production.

Following is the list of mines shipping in 1913.

TABLE 10.—*List of shipping mines, St. Clair County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	St. Louis & O'Fallon Coal Co.	2	....	cen.	33	2N	8	560	199	361	6	2	713,381
2	Consolidated Coal Co.	17	SE	NW	10	2N	8	584	230	354	6	6	615,318
3	Prairie Coal Co.	....	....	SW	27	2N	8	583	205	378	7	....	420,363
4	Southern Coal, Coke & Mining Co.	8	SW	NE	17	1N	7	475	113	362	7	....	391,316
5	Southern Coal, Coke & Mining Co.	7	NW	SW	18	1N	7	525	131	394	8	....	283,079
6	Jos. Taylor Coal Co.	St. Ellen	NE	NW	26	2N	8	563	205	358	7	....	203,389
7	St. Louis & O Fallon Coal Co.	1	SW	NE	32	2N	8	510	127	383	6	....	153,461
8	Superior Coal Mining Co.	....	NW	SW	1	1N	9	580	153	427	7	....	138,369
9	Kolb Coal Co.	2	cen.	NW	32	1N	6	420	153	267	7	....	124,031
10	Suburban Coal & Mining Co.	....	....	SE	35	2N	9	580	168	412	7	....	121,137
11	Kolb Coal Co.	1	NW	SE	32	1N	6	420	160	260	7	....	98,886
12	Kolb Coal Co.	Fairbank	SE	NE	2	3S	7	449	90	359	6	....	85,672
13	Breese-Trenton Mining Co.	....	SE	NE	25	2N	6	514	335	179	4	6	84,357
14	Mulberry Hill Coal Co.	1	SW	SW	7	1S	7	520	143	377	7	6	81,298
15	Star Coal Co.	Star	SW	SE	30	1S	7	498	83	415	6	8	76,714
16	Joseph Taylor Coal Co.	Taylor	SE	SW	24	2N	8	555	200	355	7	....	74,096
17	Jones Bros. Coal Co.	Eureka No. 1	NW	SE	27	3S	6	450	114	336	6	6	63,853
	Eldnar Coal Co.	....	....	....	....	....	....	....	105	....	6	....	57,296

TABLE 10.—*Continued*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
19	Borders Coal Co.	No. 1	NE	SW	27	3S	6	450	98	352	6	9	53,744
20	Summit Coal Mining Co.	Summit	....	SW	9	1N	8	560	176	384	7	....	52,795
21	Jos. Taylor Coal Co.	{ Ridge / Prairie }	SE	SW	26	2N	8	567	203	364	8	....	51,328
22	Johnson Coal Co.	O. K.	NW	NW	35	3S	6	450	118	332	7	....	49,210
23	White Coal Co.	Miller	NW	SW	15	1N	8	515	113	402	7	....	48,146
24	Pittsburg Mining Co.	....	....	SW	16	1N	8	550	123	427	6	6	43,306
25	Oakdale Coal Mng. Co.	Glendale	SW	SW	23	1N	8	520	114	406	6	4	42,900
26	Fullerton Coal Co.	Fullerton	NW	NE	16	1N	8	550	153	397	....	....	42,593
27	Groome Coal Co.	Richland	NW	SW	1	1S	8	503	83	420	7	....	37,585
28	Gauch Coal & Mining Co.	Enterprise	SW	NW	34	1N	7	450	93	357	7	3	31,500
29	Missouri & Illinois Coal Co.	Rentchler	SE	NE	33	1N	7	470	107	363	7	....	30,845
30	Maule Coal Co.	Harmony	....	NE	12	1N	9	583	173	410	7	....	29,400
31	International Coal & Mining Co.	Carbon	cen.	NW	25	2N	8	560	194	366	6	....	28,237
	L. Senior	....	....	....	....	....	....	....	70	....	6	7	27,169
33	Highland Coal Co.	....	NE	SE	22	1N	8	535	133	402	7	....	25,864
34	New Nat'l Coal Co.	National	....	NE	33	1N	8	470	74	396	6	6	25 250
	Southern Coal, Coke & Mining Co.	Avery No. 1	....	....	....	....	....	....	183	....	6	6	22,554

TABLE 10.—*Concluded*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
36	Tirrie Coal Co.	....	NW	SW	7	3S	6	440	93	347	7	....	21,595
	Kolb Coal Co.	Valley	....	....	....	....	....	....	85	....	7	....	20,464
38	Cluley Miller Coal Co.	Ruby	NE	SW	21	2N	8	560	173	387	6	....	20,409
39	St. Clair Coal Co.	St. Clair	NW	NW	18	1S	7	524	122	402	6	6	19,323
40	Vulcan Coal & Mining Co.	Hippard	SE	SE	34	1N	8	489	93	395	6	6	18,675
41	Golden Rule Coal Co.	....	SW	SE	1	3S	7	422	47	375	6	6	17,334
42	Egyptian Coal & Mining Co.	Meek No. 2	NE	SW	36	3S	6	517	183	334	6	....	16,080
43	Fischer Coal Co.	....	SE	SE	12	1S	9	547	18	529	....	....	15,200
44	Silver Creek Valley Coal Co.	....	....	SW	35	1N	7	470	84	386	6	....	13,961
45	Mulberry Hill Coal Co.	2	NW	NE	19	1S	7	519	143	376	7	6	11,800
	Reeb Bros. Coal Co.	Murphy	....	....	....	....	....	....	40	....	6	....	11,507
47	Missouri & Illinois Coal Co.	Wilderman	....	Cen.	1	1S	8	503	93	410	6	6	8,295
48	Southern Coal, Coke & Mining Co.	5	NE	NW	20	1N	8	543	112	431	6	....	8,294
49	Egyptian Coal & Mining Co.	Advance	NE	NE	28	3S	6	450	97	353	6	6	5,585
50	Kolb Coal Co.	Vinegar Hill	NE	NW	2	3S	7	448	82	366	6	6	561

For a detailed report on mining practices in this county the reader is referred to S. O. Andros: Ill. Coal Mining Investigation, Bull. 4.

Coal-bearing Rocks

The coal-bearing beds cover approximately the eastern three quarters of St. Clair County. The line of outcrop of the basal beds extends north and south about 3 miles west of Millstadt, is parallel to, and a short distance west of, the Mississippi bluffs from a point 2 miles southwest of Centerville to Alton, and leaves the county about 7 miles northwest of the latter city. The outcrop line is obscured by glacial drift, which varies in thickness from 50 to 150 feet; and the underlying rocks are exposed only where streams have removed the surface deposits. West of the line of outcrop of the "Coal Measures", the Mississippian group constitutes the bed-rock of the county, and the same beds underlie the "Coal Measures" in the eastern part of St. Clair County. The coal-bearing rocks consist of shales, sandstones, and a minor amount of limestone; whereas the Mississippian beds are largely limestone and interbedded shales and sands.

Immediately beneath the coal-bearing beds is a group of formations called the Chester which consists of red shales, sandstones, and limestone interbedded. In a general way this group thickens eastward where as much as 600 feet are known in drill records. Its most conspicuous feature is the red shale which lies at different horizons throughout the group, and in drilling the Chester may be recognized as soon as one of these shales is penetrated. These beds are not to be confused with the thin pink to red shale noted in many places about 50 feet above coal No. 6. The Chester contains the oil sands at Carlyle, about 18 miles east of the St. Clair-Clinton county line, a detailed report of which by E. W. Shaw was published by the Illinois State Geological Survey in Extracts from Bulletin 20.

The following log by the P. H. Postel Milling Company at Mascoutah represents the deepest boring in the county, and indicates the nature of the beds underlying the area covered in the report.

Record of P. H. Postel Milling Co., well No. 1

Location—sec. 32, T. 1 N., R. 6. W.

Description of Strata	Thickness	Depth
	Feet	*Feet*
Loess	30	30
Quicksand	5	35
Sand, white	5	40
Sand, gravel and other drift	64	104
Limestone	8	112
Shale, hard, coaly	30	142
Limestone	3	145

Description of Strata	Thickness *Feet*	Depth *Feet*
Coal (No. 6)	6	151
Shale	15	166
"Soapstone"	10	176
Shale	25	201
Coal (No. 5)	5	206
Shale, white	50	256
Shale, blue	40	296
Shale, white	45	341
Red rock	45	386
Shale	35	421
Shale "cave"	113	544
Limestone	5	549
Sandstone	45	584
Shale	25	609
Limestone	20	629
Red rock, probably a hard, calcareous shale	55	684
Shale, white	20	704
Sandstone (Benoist sand of driller?)	20	724
Limestone	460	1184
"Shale rock"	420	1604
Limestone, shaly	390	1994
Marl, red	70	2064
Limestone	126	2190
"Shale rock"	127	2317
Limestone	449	2766
"Shale rock"	58	2824
Limestone	10	2834
Shale and limestone	54	2888
Sandstone and some shale	219	3107

Coal No. 6, otherwise known as the Belleville coal, noted in the foregoing record at 145 feet, outcrops in the bluffs of the Mississippi, and because of its thickness and accessibility, it was among the first coals to be mined in the State. With the other beds it dips eastward at the rate of about 12½ feet per mile, and at Belleville it is reached by shafts at an average depth of about 100 feet, or 400 feet above sea level. The east dip continues to be effective towards Mascoutah, but because the surface of the ground also slopes eastward, the coal bed is only slightly more than 150 feet deep at Mascoutah. The deepest mine is located in the NE. cor. sec. 25, T. 1 N., R. 6 W., and is operated by the Breese-Trenton Mining Company. In it the coal is 345 feet below the surface.

Since 100 to 150 feet of glacial drift exists, only a small amount of the Pennsylvanian above coal No. 6 is present. It consists of shale and a few thin beds of limestone, the most important of which overlies the coal and forms its cap rock. Above the roof limestone there are generally from 10 to 20 feet of calcareous and sandy shales, which

are overlain by a limestone of variable thickness, but exhibit more regular bedding than the layer above the coal.

In southwestern Madison County and in parts of St. Clair coal No. 7 is found beneath the upper limestone, but according to Worthen, shale occupies this horizon at Belleville. The other limestones in the "Coal Measures" are more or less local in development and cannot be traced over large areas.

Below the Belleville coal, the Pennsylvanian beds are extremely variable in thickness and character. At Millstadt coal No. 6 lies only 25 feet above the Chester beds, whereas at Marissa about 300 feet of "Coal Measures" rocks underlie this bed, data which show the irregularity of the surface upon which the coal-bearing rocks were deposited. Sandy beds are more prevalent in the lower portion of this series, but they can not be correlated from one hole to another.

Below is the log of a hole at Marissa, in sec. 27, T. 3 S., R. 6 W. Coal No. 6 lies at a depth of 88 feet, and the top of the Chester is found at a depth of 304 feet.

Drill record of Consolidated Coal Co.

Location—SE.¼ NW.¼ sec. 27, T. 3 S., R. 6 W.

Description of Strata	Thickness	Depth
	Feet	*Feet*
Soil	44	44
Shale	6	50
Coal	2	52
Rock and shale	36	88
Coal (No. 6)	6	94
Fire clay	10	104
Limestone, blue	6	110
Shale, white	17	127
Shale, white, or sandstone	24	151
Shale, black	8	159
Fire clay	4	163
Shale	58	221
Shale, black	7	228
Coal	1½	229½
Clay, hard, gray	7	236
Coal	4	240
Fire clay	8	248
Sandstone, white (salt water)	14	262
Fire clay	20	282
Sandstone	10	292
Fire clay	12	304
Limestone	29	333
Shale, blue	71	404
Limestone rock	50	454
"Soapstone," red	15	469
Limestone	48	517

Description of Strata	Thickness *Feet*	Depth *Feet*
Shale	4	521
Limestone	27	548
"Soapstone"	10	558
"Soapstone"	10	568
Limestone, very hard	27	595
"Soapstone"	13	608
Sand, white, (salt water and oil)	23	631
Limestone, dark, gray, very porous (gas)	33	664
Shale	10	674
Limestone	20	694
Shale	4	698
"Soapstone," red	3	701
Limestone	22	723
"Soapstone," red	11	734
Limestone rock	25	759
Clay, red	25	784
Sandstone, dark	4	788
Clay, red	10	798
Shale	1	799

Geologic Structure

The geologic structure has been determined from the position of coal No. 6 in outcrops, mine shafts, and drill holes. The bed outcrops in the bluffs of the Mississippi at an elevation of about 470 feet and dips eastward at an average rate of 15 feet per mile. The dip is not uniform over all the county, but is modified by small folds, the most important of which are known as the Belleville-O'Fallon and the Darmstadt anticlines. As described earlier in this bulletin, the axis of the former fold extends from a point about a mile east of Belleville slightly east of north, passes about ½ mile west of O'Fallon, continues northeast about 2 miles, and loses its identity in that direction. The top of the fold is relatively flat and broad, and the dips so gentle that they are scarcely noticeable in mining. Just north of Belleville the anticline is almost 5 miles wide.

The Darmstadt anticline has been described by E. W. Shaw of the U. S. Geological Survey in Bulletin 20, Ill. State Geological Survey. The detailed description of the fold is quoted from Mr. Shaw in Part I of the present report. The fold is highest near Darmstadt where the coal lies 297 feet above sea level and dips north, west, and east, but its position to the south is unknown. It is probable that the fold extends northeast at least to the high area at Venedy, also described by Mr. Shaw.

At the southeast corner of the county in sec. 35, T. 3 S., 6 W. the coal stands higher than to the northeast or southeast. Its exten-

sion towards the southwest and northeast is unknown, but Mr. Shaw regards the high area in sec. 35 as a part of the White Oak anticline. Further drilling will be necessary in order correctly to describe its limits. Except for fracture planes along which there has been slight movement, the mines are free from faults. Local sags and hills are not infrequently found, but thus far, they do not appear to be part of any system of well-developed folds. Such irregularities are described fully under subject, "Roof and Floor".

Coal No. 6

DISTRIBUTION AND THICKNESS

Coal No. 6 underlies approximately the eastern three-fourths of St. Clair County. Its actual outcrop line is obscured by glacial drift except along the bluffs of the Mississippi where it has been mined by slopes for many years. The outcrop enters the north side of the county in the eastern part of sec. 6, T. 2 N., R. 8 W., runs southwest along the bluffs to sec. 7, T. 1 N., R. 9. W., thence southeast to the center of sec. 1, T. 1 S., R. 9 W., from which point it swings westward around Millstadt, and then in a general southeast direction to the south boundary line, which it crosses at the southwest corner sec. 33, T. 3 S., R. 6 W. South of the point at which it leaves the bluffs, its position has been determined from drill holes and mines, and although the line as shown on the map may require revision as later information becomes available, it is believed to be very nearly correct. East of this line the county is probably underlain by a solid bed of coal of commercial thickness. Detailed measurements have been made by survey men in 51 mines located in St. Clair County, and the average thickness obtained for coal No. 6 is 6 feet 9 inches, the individual measurements ranging from 5 feet to 8 feet. The same bed in 28 drill holes shows an average of 6½ feet, but since most of the holes were made by the churn drill, less confidence is placed in the latter figures than in the actual mine measurements.

The proximity of so valuable a coal to the surface near the outcrop has stimulated mining by stripping methods. In the vicinity of Millstadt a considerable area is underlain by coal No. 6, the overburden being less than 35 feet, and the combination of these favorable conditions with large markets nearby has by steam-shovel stripping developed a production that reached 15,200 tons in 1913.

The mines of the county are located near the outcrop and along the Baltimore and Ohio and the Louisville and Nashville railroads, which run east and west through the northern half of the county.

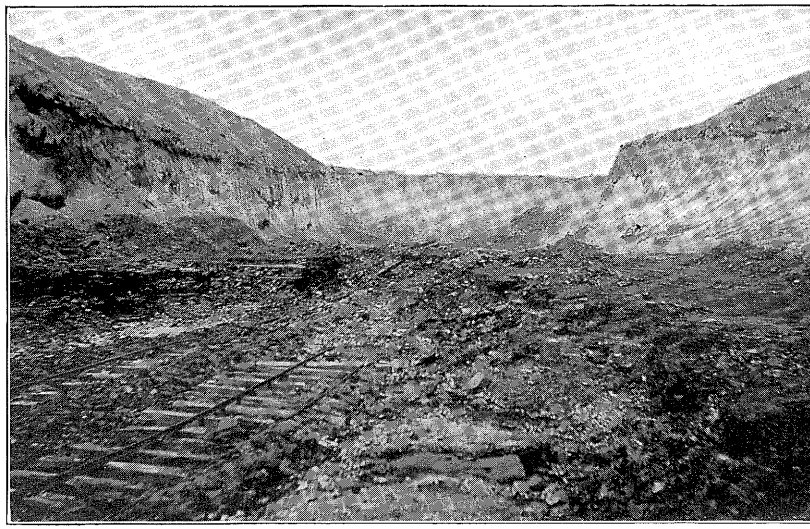

FIG 25.—Stripping mine, Fischer Fuel Co., Millstadt. (Photo by Fischer Fuel Co.)

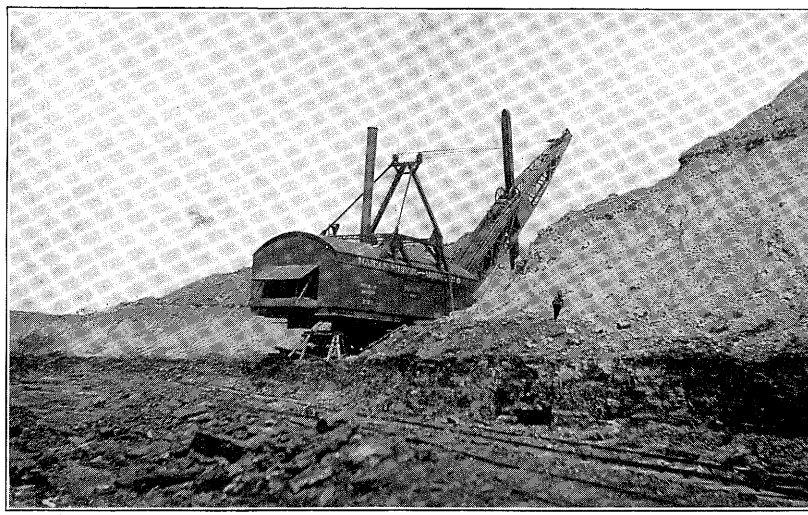

FIG. 26.—Fischer Fuel Co., stripping mine, Millstadt, showing method of removing overburden. (Photo by Fischer Fuel Co.)

PHYSICAL CHARACTER

Coal No. 6 exhibits its usual three benches, but the top coal is seldom left for roof.

Figure 27 shows the physical character of the coal in some of the mines of St. Clair County. According to Worthen the top coal was mined separately in former years and was sold as blacksmith coal at

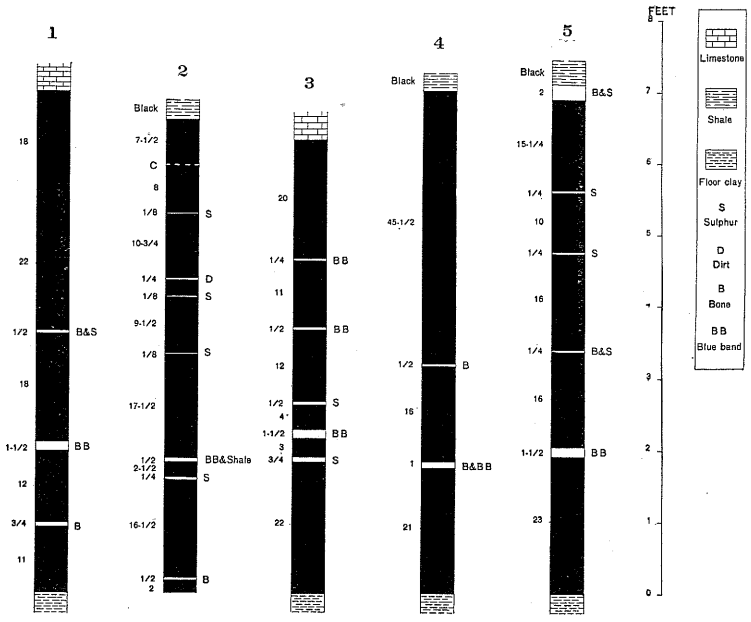

FIG. 27.—Graphic sections of coal No. 6 from measurements made in St. Clair County.

1. Joseph Taylor Coal Co., Taylor mine, O'Fallon. Face 4th N. off E.

2. St. Louis and O'Fallon Coal Co., No. 2, French Village. Face main south.

3. Superior Coal and Mining Co., Superior mine, Ogle. Face main north, 3200 feet from shaft.

4. Southern Coal, Coke and Mining Co., No. 8, Shiloh. Room 8, 6th south, west entry.

5. Borders Coal Co., Borders mine, Marissa. Room 8, 6th E. off N.

2 cents per bushel more than that from the lower part of the bed. It varies in thickness from one foot to about 24 inches, and in most places it is the purest coal in the bed. At Lebanon the top coal is thinner and consists largely of "bone," which is discarded with an overlying 4-inch "draw slate." The condition is probably local and affects only a small area.

The middle bench which constitutes the largest part of the bed, is usually a somewhat duller coal and contains numerous streaks of dirt,

pyrite and charcoal. The "blue band" is a persistent impurity 1 or 2 inches thick and consists chiefly of gray or black shale and some pyrite. In a few places it exists in two streaks separated by an inch or two of coal.

The bottom coal ranging in thickness from 12 to 24 inches or more is variable in character, its quality depending upon the amount of dirt disseminated throughout the coal mass. In places the bottom coal is scarcely more than a carbonaceous shale, but in others it has about the same quality as the middle bench.

Flakes of gypsum and calcite fill many of the cleavage planes and in some of the mines are very conspicuous at the face of the coal.

ROOF AND FLOOR

In this county the usual materials above coal No. 6 are black shale and limestone, the former existing as lenses between the cap rock and the coal. Both kinds of roof are extremely variable in thickness. Even in the same mine the shale may range from an inch to 6 or 8 feet.

In the Shiloh mine of the Southern Coal and Mining Company the black shale is present over part of the mine and reaches a thickness of 3 feet. It is laminated and full of seams or small fracture planes that extend into the overlying limestone. It is blocky and falls in masses which break into cubes. Nodules of limestone and siderite are found in the shale, and clod lies between the shale and the limestone. The latter is a dark-gray, compact stone about 12 feet thick, showing distinct bedding into benches which the miner calls "lifts". Between the bedding planes there is here and there a thin layer of shale as a parting. Small "slip" planes exist in the limestone, as well as in the shale, and displacements of 5 or 6 inches are not uncommon; the roof, therefore, has a tendency to break easily, aided as it is by the water which finds its way to the channel afforded by the slips. In the Taylor mine at O'Fallon there is no shale roof on the east side and but little on the west, but where present it contains many small slips and is difficult to hold in place.

The limestone roof is bedded, and the two lowest benches tend to fall easily. The first ledge, 2 to 6 inches thick, generally drops as soon as the props are removed. The second ledge falls only occasionally, and the main body of the cap rock, which forms an efficient roof, is reported to be about 12 feet thick. Its thickness over the county is extremely variable but averages a little less than 10 feet. Where the limestone overlies the coal the contact is usually uneven, and the irregularities are filled with clod which tends to fall easily. As a whole, the roof conditions are very similar to those of Madison County

which are described and illustrated from photographs in the chapter on the county. Figure 28 shows the relation of the limestone to the shale over a fracture in the coal at the St. Louis and O'Fallon Coal Company's Cameron mine.

As a rule the floor clay in St. Clair County is thin, many of the mines reporting only 1 or 2 feet of this material. In some places it is absent and the coal rests on an impure limestone of marine origin, which here and there according to Worthen contains an abundance of fossils.

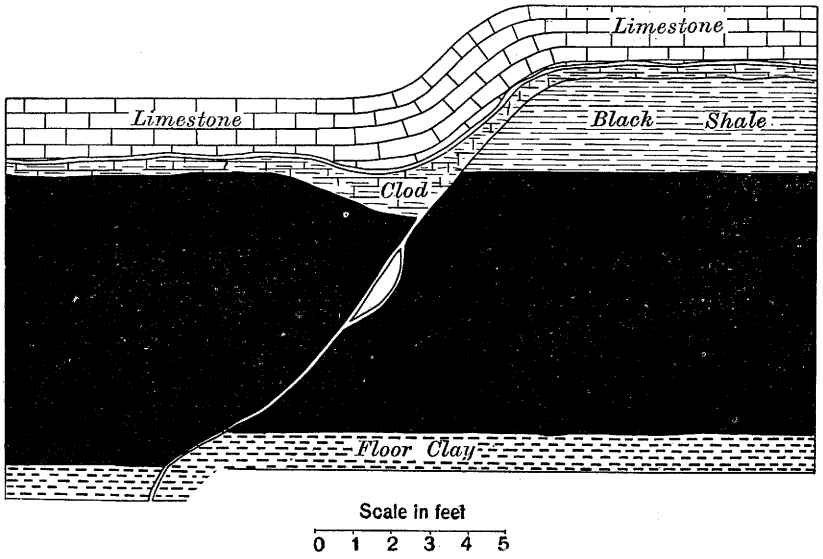

FIG. 28.—Fold in limestone above fault. St. Louis and O'Fallon Coal Co., Cameron. (Main south entry, 700 feet from shaft.)

At Shiloh, a typical mine, the floor is a dark-gray clay. The upper 18 inches is fairly soft, and the lower part contains boulders which vary greatly in size. It heaves especially when wet. At the time of examination in an abandoned entry places were seen where the floor had heaved as much as 3 feet, and the pillars had been pressed down to the underlying limestone. The nature of the clay and its variable thickness do not lend strength to the belief that it might be valuable commercially. A few samples collected in the district are now being tested with others from different parts of the State, and a report will be issued as a separate bulletin later.

IRREGULARITIES IN ROOF AND FLOOR

The county is remarkably free from major disturbances in coal, roof, and floor. The small irregularities accompanied the adjust-

ments incidental to the settling of the coal and the overburden. The shale and the limestone, and in places the coal, show miner slip planes or slickensides that tend to cause roof weakness. In many places these slips are not discernible before the fall takes place, and for this reason, they are most dangerous. Figure 29 shows the nature of a fracture plane which has been filled with clay. In no mine has the displacement of the bed been sufficiently large to affect seriously mining methods.

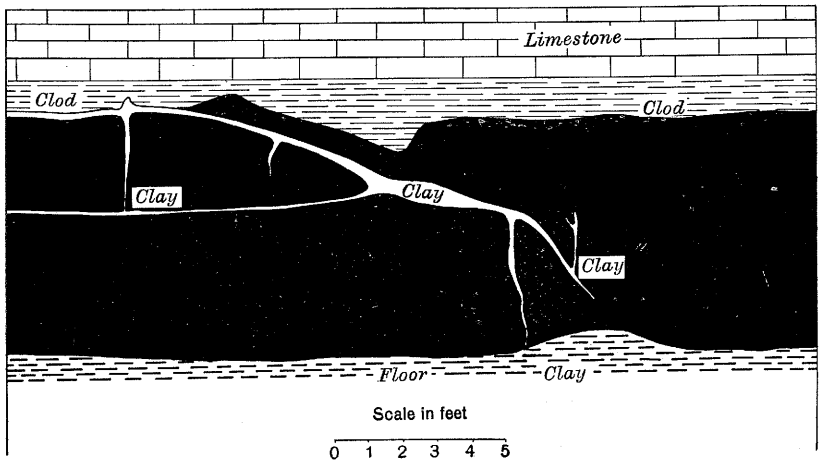

FIG. 29.—Fracture filled with clay. Southern Coal, Coke and Mining Co., Shiloh. (Main west entry.)

OTHER COALS

Very little is known regarding the existence of coals below No. 6 in this county. Worthen reports a 3-foot coal below No. 6 in the river bluffs at the old Pittsburg mines, 1 mile north of Centerville station. It is overlain by bituminous shale and 3 feet of impure, brown limestone, and probably represents coal No. 5. The same bed 5 feet thick is reported at the Postel well in Mascoutah where it is 50 feet below coal No. 6.

St. Clair County lies near the west edge of the coal basin, and it is probable that the coals below No. 6 are very irregular. The surface upon which the Pennsylvanian rocks were deposited was very uneven, and in western St. Clair county, there are places at which the interval between coal No. 6 and the Chester beds below is only 20 or 30 feet. Figure 30 is an ideal sketch showing the relation of the coal-bearing strata to the old land surface. In the vicinity of Marissa two holes penetrated a coal below the horizon of coal No. 5, although the latter is not present. In sec. 21, T. 3 S., R. 6 W. a 2-foot coal lies 110 feet

below the Belleville bed, and in sec. 27 of the same township a 4-foot coal lies 148 feet below coal No. 6. It is overlain by 7 feet of hard, gray clay or shale, above which is an 18-inch bed of coal. No other logs in the county record these beds, and any attempt at correlation would be futile.

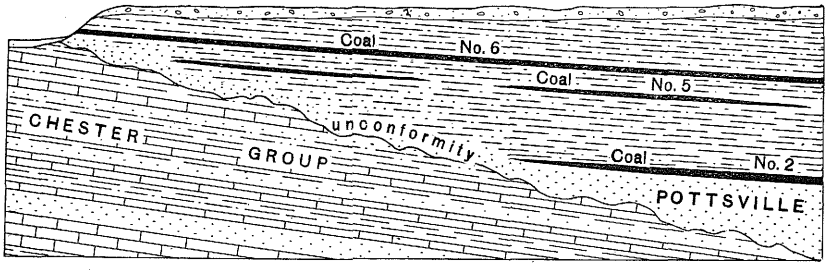

FIG. 30.—Sketch showing relation of "Coal Measures" to ancient erosion surface, St. Clair County.

It is probable that future exploration will disclose commercial coals below No. 6, but the minable areas will undoubtedly be small and disconnected. Test holes for the lower coals should be continued to a depth of 250 feet below coal No. 6, but if limestones and red shales are penetrated before reaching this depth, further drilling will be useless because the underlying Chester beds will have been reached.

PERRY, RANDOLPH AND WASHINGTON COUNTIES

PRODUCTION AND MINES

PERRY COUNTY

Production in tons for year ended June 30, 1913..	1,634,043
Average annual production, 1908 to 1913.....	1,506,365
Total production, 1881 to 1913.....	26,918,284

RANDOLPH COUNTY

Production in tons for year ended June 30, 1913..	712,058
Average annual production, 1908 to 1913.....	977,039
Total production, 1881 to 1913.....	13,618,584

WASHINGTON COUNTY

Production in tons for year ended June 30, 1913..	246,932
Average annual production, 1908 to 1913.....	100,949
Total production, 1881 to 1913.....	1,829,468

Perry County has long been an important coal producer. During 1912-1913 its output equaled 2.6 per cent of that of the entire State. In considering Perry County as a unit, the writer treats also that part of the county east of the Duquoin anticline, which is really closely associated with Franklin and Williamson counties in District VI of the Investigations. In his bulletin on mining practice Mr. S. O. Andros has separated the mines on the basis of their location east or west of the fold; but in this record of coal resources it is almost impossible to locate the axis definitely, especially north of Duquoin, and it is believed that the advantage of setting down the information for the entire county more than offsets the disadvantage of the slight overlap.

In 1913 twenty-three mines were operating, well distributed over the county except in the north central part which lacks railroad facilities. All are working coal No. 6 by shafts except two near Duquoin where the proximity of the coal to the surface has made strip mining possible. Below is given the list of shipping mines in Perry County in 1913.

TABLE 11.—*List of shipping mines Perry County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production 1913
			¼	¼	Sec.	T. S.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Security Coal Mining Co.	1	....	SW	29	5	1	436	90	346	8	....	275,674
2	Willis Coal Mining Co.	1	NW	NW	30	6	4	503	80	203	6	....	244,538
3	Paradise Coal Co.	Paradise	NW	NE	15	6	1	409	371	38	10	....	241,483
4	Majestic Coal & Coke Co.	1	....	NW	23	6	1	402	403	−1	9	....	215,730
5	Ritchey Coal Co	1	....	NW	23	5	3	460	140	320	7	....	158,852
6	Duquoin Operating Co.	Queen	....	NW	15	6	1	411	306	105	6	....	158,704
7	Missouri & Illinois Coal Co.	4	....	NW	30	6	4	497	72	425	6	....	126,726
8	St. Louis-Coulterville Coal Co.	Vulcan	SW	NW	18	4	4	520	275	245	7	....	61,404
9	Bald Eagle Mining Co.	....	....	NW	25	4	4	565	244	321	7	....	48,410
10	Wilson Coal Co.	....	....	SE	5	6	4	496	105	391	5	6	23,859
11	King City Coal & Mining Co.	....	....	SE	6	6	4	498	114	384	6	....	16,816
12	Little Muddy Fuel Co.	....	....	SE	29	4	1	505	211	294	5	8	13,794
13	Bailey Bros. Coal Co.	Diamond	....	NE	30	5	1	461	75	386	5	2	13,752
14	Brilliant Coal & Coke Co.	Horn	SW	SE	19	6	1	440	75	365	5	6	13,047
15	Greenwood-Davis Coal Co.	2	SW	SW	32	5	1	453	75	378	5	4	9,409
16	Bailey Bros. Coal Co.	Sun	....	SW	20	5	1	469	80	389	5	....	7,469
17	Strait Coal Co.	....	....	SW	13	5	3	401	86	315	6	2	3,255
	Dynamic Coal Mining Co.	3	....	....	....	....	....	....	....	....	6	....	1,292

Only about one-fourth of Randolph County is underlain by coal No. 6, but 23 mines added 712,058 tons to the State's production in 1913. All of the mining is done by shaft from coal No. 6. The writer is greatly indebted to Mr. Thomas Jeremiah of Willisville for details regarding the outcrop of the coal in the vicinity of Percy and Willisville.

TABLE 12.—*List of shipping mines, Randolph County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production, 1913
			¼	¼	Sec.	T. S.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Willis Coal and mining Co.	Goalby No. 6		NE	14	6	5	493	82	411	6	....	269,110
2	Jones Bros. Coal Mining Co.	Eureka No. 2	NW	NW	6	4	5	518	194	324	6	10	103,509
3	Wilson Bros. Coal Co.	7	NW	NW	8	5	5	500?	140	360	6	....	78,306
4	Illinois Fuel Co.	4	NE	NW	16	5	5	512	66	446	6	....	75,600
5	Moffat Coal Co.	1	SE	NE	8	5	5	523	123	400	6	....	74,318
6	Bessemer Coal & Mining Co.	Crystal	SW	NE	6	4	5	512	205	307	6	....	27,813
7	Bessemer Coal & Mining Co.	Tilden	SW	NE	6	4	5	512	180	332	6	6	26,805
8	Underwood Coal & Mining Co.		SE	NW	10	4	5	524	186	338	6	....	23,164
9	Randolph County Coal Co.	O. M.	NE	NW	13	4	5	545	300	245	6	6	13,932
10	Boyd Coal & Coke Co.	1	SW	SW	1	5	6	526	94	432	6	....	7,426

Washington County produced 246,932 tons of coal in 1913, of which 200,455 tons were hoisted at mine No. 5, Centralia Coal Company, sec. 25, T. 1 N., R. 1 W. The remaining 44,137 tons were produced at Nashville and at Dubois. All are shaft mines ranging in depth from 300 to 526 feet, and all are operating in coal No. 6.

TABLE 13.—*List of shipping mines, Washington County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production, 1913
			¼	¼	Sec.	T.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Centralia Coal Co.	5	SE	NE	25	1N	1	497	520	−23	6	6	200,445
	Nicholson Coal Co.	Nash-ville	SW	SE	13	2S	3						36,844
3	Kuhn Coal Co.	Dubois			33	3S	1	490	295	195	5	6	7,293

COAL-BEARING ROCKS

The coal-bearing beds underlie all of Perry and Washington counties and the eastern third of Randolph County. They are known not only by studies of mine shafts but also from about 100 drill holes distributed by counties as follows: Perry 67, Washington 16, and Randolph 17. Most of the holes in Perry County were put down as coal tests, only 7 being oil holes; those of Washington are divided about equally between shallow and deep, and most of those in Randolph were drilled into the lower rocks for oil.

The outcrop of the "Coal Measures" is largely obscured by the glacial drift, but it has been traced from the western part of T. 7 S., R. 5 W. in a general northwest direction through Randolph County, intersecting the northern boundary in the eastern part of T. 4 S., R. 7. W. From the outcrop the beds dip northeast and since the surface remains comparatively level, a thickening of the coal-bearing strata takes place in this direction. In Ashley township more than 1000 feet of these beds are present, and farther northeast the thickness is still greater. At all places in the area the "Coal Measures" rest unconformably upon the Chester, which consists of interbedded limestones, sandstones, and red shales.

In Randolph County the coal is shallow except in the northeast corner near Coulterville where it is slightly more than 300 feet below the surface. The glacial drift of gravel, clays, and sands averages about 80 feet, consequently only a small amount of the Pennsylvanian rock remains above the Belleville bed. A thin bed of coal representing coal No. 7 is in most places found 30 or 40 feet above coal No. 6, and the limestone cap rock over the latter coal is usually recorded in the logs. The following section is given by Worthen[6] as typical of

[6]Worthen, A. H., Geology of Randolph County: Ill. State Geol. Survey, vol. I, p. 281, 1866.

the beds that are exposed in the county near the western boundary of the "Coal Measures".

Worthen's section of coal-bearing rocks near western boundary in Randolph County

	Feet
Micaceous sandstone and shale	30 – 40
Limestone	--- 3
Shale	--- 12
Limestone-bituminous shale, in place replacing each other	4 – 6
Coal No. 6 (Belleville)	6 – 8
Shale or shaly sandstone	30 – 40
Limestone	3 – 4
Shale, bituminous	3 – 5
Coal No. 5	2 – 4
Fire clay	2 – 4
Shale and sandstone (conglomerate)	50 – 150

In the following log of a well located in NW. ¼ SW. ¼ sec. 6, T. 5 S., R. 5 W., the base of the "Coal Measures" is found at 493 feet. A bed of coal 4 feet thick lies 5 feet below coal No. 6. A similar coal is reported in 6 other logs from Randolph County; but all the holes were made by the churn drill, and the thickness is not reliable. The interval between coal No. 6 and this reported bed varies from 5 feet to 20 feet.

Record of Sparta City well, No. 3

Location—NW.¼ SW.¼ sec. 6, T. 5 S., R. 5 W., Randolph County

Description of Strata	Thickness	Depth
	Feet	*Feet*
Drift	99	99
Limestone	10	109
Coal (No. 7)	2	111
Limestone	11	122
"Soapstone"	2	124
Sandstone	3	127
Shale	5	132
Limestone	17	149
Coal (No. 6)	6	155
Fire clay	2	157
Limestone	3	160
Coal	4	164
Limestone	40	204
Shale	13	217
Limestone	26	243
Coal	2	245
Sandstone	117	362
Shale	3	365
Limestone	7	372

Description of Strata	Thickness	Depth
	Feet	*Feet*
Shale	19	391
Limestone	11	402
"Soapstone"	13	415
Sandstone	16	476
Shale	17	493
Limestone	16	509
Shale	14	523
Limestone	22	545
Shale	31	576
Sandstone	2	578
"Soapstone"	7	585
Limestone	13	598
Shale	5	603
Sandstone	15	618
Shale	15	633
Limestone	24	657
Shale	5	662
Limestone	22	684
Shale	8	692
Sandstone	7	699
Red rock	13	712
Limestone	15	727
Shale	3	730
Limestone	53	783
Shale	41	824
Limestone	11	835
Shale	16	851
Dark sand	4	855
Shale	11	866
Sandstone	5	871
Shale	9	880
Sandstone, hard	4	884
Shale	2	886
Sandstone	5½	891½

The following log is the record of an oil test near the Union Depot, Coulterville, sec. 13, T. 4 S., R. 5 W. The thickness of the lower coal is no doubt too large, but it is probably to be correlated with coal No. 5. The 215-foot sandstone at 640 probably represents the Pottsville, which probably occupies an ancient valley in the Chester rocks.

Record of Coulterville city well, No. 1

Location—Sec. 13, T. 4 S., R. 5 W.

Description of Strata	Thickness	Depth
	Feet	*Feet*
Drift	30	30
Shale	50	80
"Soapstone"	20	100

Description of Strata	Thickness	Depth
	Feet	*Feet*
Shale, black	40	140
"Soapstone"	15	155
Shale	45	200
"Soapstone"	20	220
Shale	75	295
Limestone	15	310
Coal (No. 6)	7	317
"Soapstone"	30	347
Shale	25	372
Shale, black	23	385
Coal (No. 5, probably incorrectly reported)	8	393
Shale	20	413
Limestone	7	420
Shale, black	10	430
Limestone	5	435
Shale, white	20	455
Limestone	10	465
Shale, white	25	490
Limestone	20	510
"Soapstone"	15	525
Shale, brown	20	545
Sand, white (fresh water)	55	600
Shale	40	640
Sand	215	855
Shale	10	865
Limestone	10	875
Shale	15	890
Limestone	20	910
Shale	40	950
Red rock	10	960
Limestone	40	1000
Red rock	30	1030
Limestone	20	1050
Shale	25	1075
Shale, red	25	1100
Sand, white (salt water) (Benoist?)	17	1117

In Perry County about 1200 feet of the "Coal Measures" strata are present. West of the Duquoin anticline all the rocks dip northward at a uniform rate, but from the axis of the fold which extends through Duquoin and parallels the Illinois Central railroad the beds dip steeply to the east, and coal No. 6 which outcrops at Duquoin is almost 500 feet below the surface three miles to the east.

The most noticeable difference in the stratigraphy east and west of the anticline is the large interval between coal No. 6 and its roof limestone on the eastern side of the fold. A progressive thickening of the shale is apparent in an easterly direction from the crest of the fold, as illustrated by figure 31. It seems probable that shortly after

the deposition of the roof material began, subsidence proceeded rapidly east of the line which marks the axis of the fold, allowing a large amount of muds and silts to be carried into the basin; whereas on the west side of the axis only a few feet of sediment accumulated. The

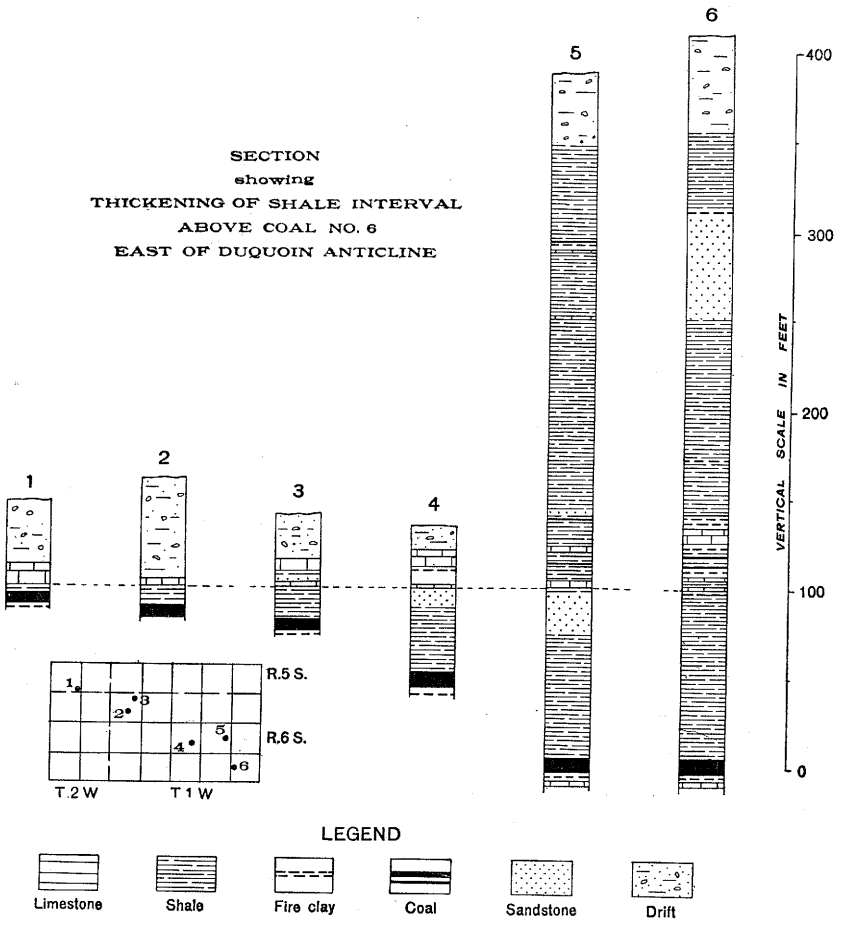

FIG. 31.—Section showing the thickening of the shale interval above coal No. 6 east of the axis of the Duquoin anticline.

sea then became clear, and limestone was deposited over the entire area. Further sinking began, the eastern side again being in the lead, and the result was a sharp folding of the coal with a somewhat smaller effect on the limestone and the other beds above the coal. In the eastern side of the county about 100 feet of shales overlie the coal.

Several of the holes in the eastern part of the county show a thin coal above the limestone in the proper position for coal No. 7, although

of course it is almost 100 feet higher than is usual west of the fold, because of the increased amount of shale mentioned above. One hole in sec. 2, T. 6 S., R. 1 W., shows a thick limestone about 400 feet above coal No. 6. At this place it lies next below the glacial drift, and its boundary no doubt passes southeast into the northern part of Jefferson County.

The following log of Midvalley Oil Company's well in NW.¼ SW. ¼ sec. 17, T. 6 S., R. 3 W. was made by J. A. Udden from samples which were shipped to the office by the company. The printed log includes only the "Coal Measures," although the well was continued to 1198 feet. This well is located near the outcrop of coal No. 6, and it is likely that the coal fragments at 40 feet are from that bed. The detailed description of the coals will be given later in this chapter.

Well record of Midvalley Oil Company

Farm and well—Gallagher No. 1

Location—NW. ¼ SW. ¼ sec. 17, T. 6 S., R. 3 W.

(Description by J. A. Udden)

Description of Strata	Thickness *Feet*	Depth *Feet*
Loess, yellow	6	6
Surface clay, yellow and some sand grains	9	15
Sample lost	9	24
Drift, sand, and pebbles and a little dark shale	8	32
Loess, yellow, and other drift	8	40
Sand, coal fragments and drift pebbles (probably fragments of coal No. 6)	8	48
Sandstone, gray, micaceous and drift pebbles	10	58
Shale, gray, siderite, black shale, gray limestone, drift pebbles and chert	9	67
Sand, siderite, and drift pebbles	7	74
Shale, gray, weathered, containing some calcareous material	10	84
Limestone, black, and yellow glass (?)	13	87
Shale, black, slaty, slightly bituminous, some coal and yellow glass	5	92
Shale, black, some limestone, some sandstone and some fire clay	6	98
Sandstone, gray, and yellow, concretionary limestone, black shale and mineral charcoal	7	105
Shale, dark gray, micaceous	9	114
Shale, gray, sandy, micaceous, showing dark and light laminae, and gray sandstone with imbedded yellow spherules of siderite	6	120
Sandstone, gray, white, and yellow, and dark gray, sandy shale and some white and yellow sandstone. Some of the sandstone contains shreds of carbonaceous material and some contains spherules of siderite	7	127

Description of Strata	Thickness *Feet*	Depth *Feet*
Shale, black, very bituminous, waxy to the knife, and a dark gray, coarse, organic, brecciated limestone	8	135
Shale, black, "clod" containing a small tuberculated gasteropod and other fragments of other fossils, coal, and fire clay	8	143
Coal and fire clay	10	153
Sandstone, gray, micaceous, and some fire clay	7	160
Sandstone, white, micaceous	6	166
Sandstone, gray, with imbedded spherules of siderite	6	172
Clay shale, gray, and gray sandstone, siderite, pyrite, and some limestone	6	178
Shale, gray, sandy, and black shale, limestone, concretionary siderite and pyrite	6	184
Shale, gray, and fire clay, coal, black shale and pyrite	6	190
Shale, black, and gray fire clay, coal, pyrite and some limestone	6	196
Shale, black, and coal, organic, calcareous fragments, woody tissue, pyrite and fire clay	6	202
Shale, sandy, gray and some greenish-gray shale	4	206
Shale, gray, some coal and limestone	6	212
Shale, gray, and black; shale, coal, siderite and limestone	6	218
Sandstone, gray, and gray shale, black shale, coal and pyrite	6	224
Shale, dark and black, and gray sandstone, concretionary siderite, carbonaceous, woody tissue and pyrite	6	230
Shale, black, and gray sandstone, siderite, fragments of red, brown, and yellow stone	6	236
Limestone, yellowish-gray and gray shale, gray, sandy shale, bright red rock fragments and sandstone	6	242
Sandstone, dark gray, soft and of fine texture	6	248
Shale, gray, sandy, and siderite, pyrite, and some white calcareous fragments	6	254
Shale, gray, with some siderite and pyrite	6	260
Shale, gray, and gray sandstone with carbonaceous fragments, some fragments of red rock, some limestone and pyrite	6	266
Shale, dark, and light-gray shale with fragments of siderite	6	272
Coal, siderite, fire clay and pyrite	6	278
Shale, black, containing laminae of coal, white and gray limestone with crinoid stem and a small tuberculated gasteropod. Pyritized woody tissue, and bright red rock noted and some siderite	6	284
Pyrite, black shale, pyritized woody tissue, siderite, some calcite and some limestone	6	290
Limestone, gray, and concretionary siderite and pyrite	5	295
Shale, gray, micaceous, and some gray sandstone with carbonaceous shreds and some siderite	6	301
Shale, dark, micaceous, with some fragments of calcareous material	5	306
Sandstone, gray, and gray shale	6	312

Description of Strata	Thickness *Feet*	Depth *Feet*
Sandstone, white, micaceous, laminated with some shale	6	318
Sand, white	16	334
Sandstone, gray, and red; siderite, black shale, pyrite, spherules of siderite and limestone	6	340
Sandstone, white and some shale	6	346
Sand, coarse, white	6	352
Sandstone, white, micaceous, coarse, with a few fragments of limestone, pyrite and siderite	6	358
Sand, white	12	370
Sandstone, white, fairly coarse	6	376
Sand, white, micaceous	8	384
Sandstone, light gray	6	390
Sand, white, micaceous	6	396
Sand, gray, and shale	5	401
Sandstone, white, some shale and calcareous material	3	404
Shale, light, dark gray, and a little brown, and fine sandstone	3	407
Sandstone, fine, white, micaceous	3	410
Sand, coarse, white	5	415
Sandstone, laminated, white, micaceous. A pebble of quartz about 1/8 in. noted	5	420
Sandstone, fine, white, micaceous	5	425
Sand, gray, micaceous	5	430
Sand, gray	5	435
Sand, coarse, of many well-rounded grains	5	440
Sandstone, white and gray, of coarse rounded grains, with infiltrated carbonate of lime and some small pieces of shale	5	445
Sand, coarse, gray, micaceous and a little dark shale	5	450
Sandstone, fairly coarse, gray	5	455
Sand, white	6	461
Sandstone, coarse, white, and a little pyrite	5	466
Sandstone, white, micaceous	6	472
Sandstone, white	12	484
Sand, white, micaceous	6	490
Sand, white	18	508
Sand, pure white	6	514
Sand, white	6	520
Sand, coarse, white	5	525
Sandstone, gray, calcareous of fine texture	5	528
Shale, mostly gray, dark and black; and some sandstone and quartz grains	5	535
Sandstone, limestone, pyrite and shale	5	540
Shale, dark, and white sandstone and a little limestone	6	546
Sandstone, gray and red, and gray shale and pyrite	6	552
Sandstone, white, micaceous, and some gray shale	6	558
Sandstone, white, fairly coarse	6	564
Sand, gray, micaceous, and a little dark shale	5	569
Sandstone, white, and a little red shale. Sand grains with secondary crystals	5	574
Sandstone, pink, purple, brown, yellow and white	6	580

Description of Strata	Thickness *Feet*	Depth *Feet*
Sandstone, white, gray, dark, pink, and brown	5	585
Sand, white quartz	5	590
Sand, white, with secondary crystallization	6	596
Sandstone, white, and a little gray shale	6	602
Sand, white, with some grains showing secondary growth	6	608
Sand, clean white	6	614
Sand, pure white, secondary crystallization	6	620
Sandstone, white, and a few grains of coal	5	625
Sandstone, white and fine grained, and pyrite, a little coal and a little shale	5	630
Limestone, black and white shale, fine sand, and quartz crystals	5	635
Sand, gray, micaceous, and a little gray shale	5	640
Quartz sand, fine grained, some black shale and fragments of limestone	5	645
Sand, gray	5	650
Sand, gray, micaceous, and fairly coarse, and a little shale, and some limestone	5	655
Sandstone, white, with dark laminae, fragments of coal, some shale fragments of siderite concretions, some pyrite and some red grains	5	660
Sandstone, white	5	665
Sand, gray, micaceous, some limestone and some gray shale	5	670
Sandstone, gray, and pink; and dark gray shale	5	675
Sandstone, gray, calcareous, showing minute shreds of vegetation and pyrite	5	680
Limestone, dark, and shale, some calcite, pyrite, and a little white limestone. Brachiopod spine noted	5	685
Shale, gray, with some fragments of limestone and pyrite	5	690
Shale, bluish, black, and organic fragmental limestone	5	695
Sandstone, gray, calcareous, dark gray shale and some fragments of black bituminous material, some gray limestone and pyrite	5	700
Sandstone, gray, red, and white; and gray and black shale, and some limestone. Aspect: Pottsville	5	705
Sandstone, gray, dark shale, some red, green, brown, fragments of limestone, and a little pyrite	5	710
Sandstone, gray, and dark shale	5	715
Sandstone, gray, micaceous, and some black shale	5	720
Sandstone, gray, and black shale, some coal, some petrified wood and some pyrite	3	723
Sandstone, gray, laminated of fine texture	4	727
Sandstone, laminated, dark gray, and fragments of pyrite	5	732
Sandstone, gray, showing carbonaceous shreds and layers	6	738
Shale, greenish black, with few fragments of red shale	6	744

In Washington County the coal-bearing beds range in thickness from 600 feet in the southwestern to 1200 or 1300 feet in the northeastern part. Coal No. 6 is 160 feet deep in the southwest corner,

and the dip carries it 520 feet below the surface at Centralia Coal Company's mine No. 5 near the northeast corner of the county. The strata above the coal consist largely of shales which are variable in character and cannot be correlated from one hole to another.

The following records of coal shafts at Ashley and mine No. 5, Centralia Coal Company, show typical sections of the beds above coal No. 6.

Well record of Ashley mine shaft (abandoned)

Location—NW.¼ sec. 26, T. 2 S., R. 1 W., Washington County

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
No record	123	....	123	....
Limestone	9	....	132	....
"Slate"	4	....	136	....
"Soapstone"	12	....	148	....
Coal	....	10	148	10
Conglomerate	4	6	153	4
Fire clay	1	6	154	10
Sandstone	46	6	201	4
Shale, blue	5	....	205	4
Shale, black	4	....	209	4
Lime	1	....	210	4
Shale, blue	2	6	212	10
Fire clay	4	6	217	4
Conglomerate	3	6	220	10
Shale, sandy	21	....	241	10
Shale, blue	3	6	245	4
"Soapstone"	3	....	248	4
Shale, sandy	41	....	289	4
"Slate," blue	18	....	307	4
"Slate," blue	3	6	310	10
"Slate," black	2	6	313	4
Lime	1	....	314	4
Coal	1	....	315	4
Fire clay	3	....	318	4
Shale, blue	5	6	323	10
Sand	22	....	345	10
"Soapstone"	83	....	428	10
Lime, gray	....	6	429	4
Fire clay	1	6	430	10
Sand	3	6	434	4
Lime	1	6	435	10
Shale, black	1	6	437	4
Shale, blue	5	....	442	4
Shale, black	6	....	448	4
Lime, gray	2	....	450	4
Lime, white	1	6	451	10
Shale, blue	6	....	457	10
Lime	14	....	471	10

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
"Slate," black	2	....	473	10
Coal and dirt	4	6	478	4
"Soapstone"	6	....	484	4
Coal	....	8	485	....
Shale, "soapstone"	....	4	485	4
"Soapstone," shale	3	6	489	10
Coal seam worked (No. 6)	5	....	495	10

Shaft record of mine No. 5 of Centralia Coal Co.

Location—SE.¼ NE.¼ sec. 25, T. 1 N., R. 1 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Surface	16	....	16	....
Shale, soft, black	4	....	20	....
Shale, black clay	38	....	58	....
Conglomerate lime	1	....	59	....
"Slate," black	1	....	60	....
Coal	....	3	60	3
Fire clay	11	6	71	9
Shale, black, sandy, and light sandy peat	14	....	85	9
Conglomerate sand rock	1	6	87	3
Shale, black, sandy	2	9	90	....
Lime, conglomerate	....	6	90	6
Shale, black, sandy	3	....	93	6
Lime, conglomerate	2	3	95	9
Sand rock	1	9	97	6
Clay shale, black	2	6	100	....
Coal	....	6	100	6
Fire clay	....	6	101	....
Clay shale	1	3	102	3
Shale, black, sandy	3	....	105	3
Sand rock	5	....	108	3
Clay shale	....	3	108	6
Coal	....	6	109	....
Fire clay, dark	3	9	112	9
Shale, dark, sandy and light sandy peat	16	....	128	9
Clay shale, black	14	....	142	9
Lime	2	....	144	9
Fire clay	4	....	148	9
Clay shale	25	....	173	9
Lime, shaly	1	6	175	3
Limestone, gray (Carlinville)	9	9	185	....
"Slate," black	3	6	188	6
Clay shale	3	3	191	9
Coal	....	3	192	....
Fire clay lime pebbles	4	9	196	9
Fire clay and lime mixed	2	....	198	9
Shale, black, sandy	28	....	226	9

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Clay shale, blue	19	....	245	9
Lime, conglomerate	2	....	247	9
"Slate," black	2	6	250	3
Lime, conglomerate	1	6	251	9
Fire clay, dark	5	....	256	9
Lime, blue, sandy	12	....	268	9
Clay shale, blue	44	....	312	9
Sand rock	5	....	317	9
Sand rock, and dark shaly peat	5	....	322	9
Shale, blue, sandy, and sandy peat	3	....	325	9
Clay shale, dark, and limy peat	11	....	336	9
Lime, conglomerate	1	....	337	9
Clay shale, dark	5	....	342	9
Coal (No. 8)	1	....	343	9
Fire clay, lime pebbles	3	....	346	9
Lime, sandy	3	6	350	3
Fine rock	1	....	351	3
Shale, sandy	4	....	355	3
Sand rock, oil-bearing	4	....	359	3
Shale, blue, sandy and light sandy peat	5	6	364	9
Shale, blue, sandy	68	....	432	9
Clay shale, blue	23	....	455	9
Fire clay	3	....	458	9
Sandy shale, blue	8	....	464	9
Shale, dark, sandy and light sandy peat	3	6	468	3
"Slate," black	....	6	468	9
Fire clay	2	....	470	9
Fire clay, dark	3	....	473	9
Fire clay, hard, dark	2	....	475	9
Lime rock, gray	5	....	480	9
Fire clay	4	....	484	9
Shale, dark	2	9	487	6
Coal (No. 7)	1	6	489	....
Fire clay	3	....	492	....
Coal	....	6	492	6
Fire clay	1	6	494	....
Shale, dark	....	3	494	3
Coal	....	9	495	....
Fire clay, sandy	2	....	497	....
Fire clay, green and lime	2	3	500	9
Lime, gray	3	....	503	9
Lime, gray and dark shale	3	....	506	9
Lime, gray	1	....	507	9
Shale, dark	2	....	509	9
Lime, dark	7	....	516	9
Lime rock, black	6	6	523	3
"Slate," black	2	....	525	3
Coal (No. 6)	6	6	531	9
Fire clay	....	6	532	3

Below is given the log of a well drilled by the Gibson estate on the Finke farm. Coal No. 6, its cap rock, and a 5-foot bed 100 feet lower are the only coals noted.

Drill record of Veitch, Gibson Co.

Location—Sec. 12, T. 2 S., R. 3 W.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pennsylvanian strata—				
Soil	12	....	12	....
Gravel	12	....	24	....
Shale and some limestone	326	....	350	....
Limestone, hard	26	....	376	....
Coal (No. 6)	6	....	382	....
Shale and some limestone	98	....	480	....
Limestone	2	6	482	6
Coal (No. 5)	6	6	489	....
Shale and some limestone	66	....	555	....
Sandstone (little salt water)	8	....	563	....
Shale and some limestone	147	....	710	....
Sandstone (salt water)	70	....	780	....
Shale and limestone	8	....	788	....
Sandstone	22	....	810	....
Shale	30	....	840	....
Sandstone (much salt water)	15	....	855	....
Shale	35	....	890	....
Sandstone (much salt water)	60	....	950	....
Shale	40	....	990	....
Mississippian series—				
Chester group—				
Sandstone (salt water)	10	....	1000	....
Shale and red rock	20	....	1020	....
Sandstone (Carlyle) (good show of oil)	14	....	1034	....
Sandstone (salt water)	31	....	1065	....
Sandstone and some red rock (salt water)	80	....	1145	....
Sandstone (salt water)	60	....	1205	....
Shale	25	....	1230	....
Limestone	5	....	1235	....
Sandstone (show of oil)	10	....	1245	....
Sandstone	55	....	1300	....
Shale and red rock	125	....	1425	....
Sandstone	35	....	1460	....
Shale and red rock	40	....	1500	....
Limestone	5	....	1505	....
Sandstone	10	....	1515	....
St. Louis formation—				
Limestone, hard	1	....	1516	....

In the northeast half of the county it is generally possible to recognize the Carlinville limestone in drillings or on the outcrop. In the Huegeli shaft at Nashville it lies 80 feet below the surface, and it is exposed north of Nashville along the west side of the creek in the NW. ¼ sec. 13, T. 2 S., R. 3 W. It has also been quarried in the SW. ¼ sec. 34, T. 2 S., R. 2 W. Ordinarily the fresh limestone is bluish gray and very hard and breaks into irregular pieces. It turns brown on weathering. In Washington County it lies about 300 feet above coal No. 6 and its dip carries it from the outcrop to a depth of 150 to 200 feet or more in the northeast corner of the county. Although it averages but 7 feet in thickness, it is persistent and can be traced from point to point with considerable success.

Below coal No. 6 is a series of shales and sandstones ranging in thickness from 400 to 800 feet, the irregularity being due to the unconformity at the base of the "Coal Measures." Most of the records make no mention of coals below coal No. 6, but it is believed that the apparent absence of the lower coals is due to the unsatisfactory work of the churn drill. Three logs in different parts of the county record a coal lying at intervals of 70, 110 and 150 feet respectively, and ranging in thickness from 3 to 5 feet. They probably do not represent the same bed, but their presence adds strength to the belief that careful drilling will disclose at least small areas of workable coal below No. 6.

Geologic Structure

Most of the area concerned in this report is underlain by beds that have a general northeast dip averaging 12 feet per mile, as shown by the position of coal No. 6. Minor undulations exist, the axes of which extend in the direction of the dip. For detailed description of the Venedy dome, the White Oak anticline, and the Nashville anticline the reader is referred to "Geological Structure" in Part I of this bulletin.

The major structural feature of the region is the Duquoin anticline, the axis of which enters the county in the eastern part of T. 6 S., R. 2 W., extends about N. 10 E. through Duquoin, thence practically parallel to the Illinois Central Railroad as far north as Sandoval, north of which it loses its identity. The fold is best known in T. 6 S., R. 1 W., Perry County, where a large amount of mining and drilling has been done. At Duquoin, and for some distance west, the beds lie almost flat, but east of the city the dip reaches as much as 300 feet per mile. Figure 32 is a structure section across the anticline. The position of the structural contours is not definitely known but the eastern dip is steep along the west side of Jefferson County;

whereas west of the axis the beds show a uniform, northward dip. In other words, the axis of the fold dips gently northeastward.

It seems certain that in some way a barrier existed along the line of the Duquoin fold for at least some distance north during the deposition of the coal, because the coal east of the axis, not only in

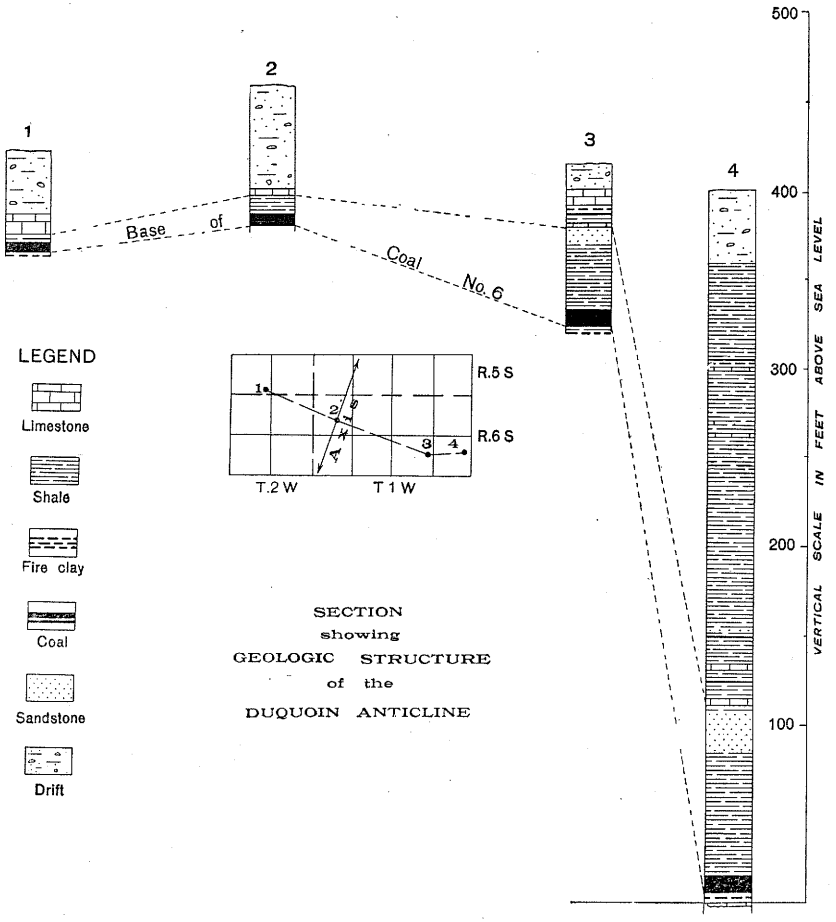

FIG 32.—Section showing structure of the Duquoin anticline.

southeast Perry County, but also in Franklin and Williamson counties, differs physically and chemically from the coal deposited contemporaneously west of the axis. The difference in the coals is most noticeable as far north as the northern boundary of Franklin County. No such change is apparent east of the fold in Marion County, and it is not now known where the Franklin-Williamson type of coal No. 6 stops and the Belleville type begins on the east side of the Duquoin fold.

The absence of the coal at Ashley and Irvington, on the axis of the fold, may signify former submergence in that part of the region now occupied by the fold. Scattered records in western Jefferson County show irregularities in the coal, including thick partings of shale, especially in the upper part of the bed, and are significant because they are apparently related to the irregular conditions noted above. These, in turn, may be connected with the barren area disclosed by the Oppenlander well, sec. 16, T. 2 S., R. 1 W., and by a well in sec. 4, T. 2 S., R. 2 W. Data are now too meager to unravel the true conditions, but future investigation may prove that the area of thin or irregular coal, as mapped in western Clinton County, continues southeastward through northeastern Washington County and includes the territory near Ashley and Irvington. The latter territory may have been below sea level so that instead of receiving coal deposition, it formed an area of sluggish drainage, south of which the embryonic fold acted as a barrier between the eastern and western parts of the coal basin. At least the effect of such a barrier is not apparent north of Perry County. Some faulting occurred coincident with the formation of the Duquoin anticline. Those faults encountered in mining will be described under the subject "Roof and Floor."

Coal No. 6

DISTRIBUTION AND THICKNESS

An area of 694 square miles in Perry County is underlain by coal No. 6, this being the entire county except an irregularly shaped tract in the south central part aggregating 49 square miles. The outcrop enters the county about 1 mile south of Willisville, extends east across Galum Creek, thence northeast swinging across Beaucoup Creek, southwest along the tributary of Beaucoup to sec. 20, T. 6 S., R. 2 W., thence east to the central part of section 24, and south to the county line. The position of the outcrop on the map is based on all available information, but later some revision will doubtless be necessary, especially in the vicinity of Beaucoup Creek. North and east of this line coal No. 6 is persistent throughout the county.

West of the Duquoin anticline the bed shows the uniform thickness of 6 feet, but east of the axis in T. 6 S., R. 1 W. the average thickness is increased to 8 feet. Coal No. 6 is thinnest on the crest of the broad fold where it is near the surface. That it is consistently thinner along the crest probably signifies that less vegetal material was deposited, but in places near Duquoin erosion removed part or all of the coal before the glacial material was deposited. Such erosion is particularly noticeable in parts of secs. 7 and 16, T. 6 S., R. 1 W.

A few of the mining companies operating near Duquoin have found by drilling that the coal is absent along certain northwest-southeast lines which suggest former stream channels. It has also been noted that near the barren areas the coal is split into a number of benches by shale partings, the result, perhaps, of the interbedding common to stream deposits, a condition no doubt related to the succession of low and high-water periods. The erosion channels at Duquoin are not so large as those in Montgomery County and appear to affect only the top of the fold near the southern outcrop. The mines along the crest of the fold show coal ranging in thickness from 5 feet 2 inches to 5 feet 10 inches.

In Randolph County, the outcrop forms an irregular northwest-southeast line from a point one mile south of Willisville to the northwest corner of sec. 4, T. 4 S., R. 6 W. The streams in this part of the county flow southwest and, since the dip of the rocks is toward the northeast, the coal outcrop may be followed up the sides of the valleys to the point where the bed dips beneath the channel. Originally the coal was mined along the outcrop near Percy and in the vicinity of Sparta. Later it was mined by shallow shafts in the same region and finally deeper shafts were sunk in the northeast corner of the county.

Detailed measurements at the face of the coal in 9 mines show that the bed averages 5 feet 11 inches in thickness; whereas 19 drill holes distributed throughout the coal-bearing area indicate an average thickness of 6 feet 1 inch.

The coal of Washington county is not well known, since in its shallowest parts it lies 200 feet below the surface and the streams do not erode sufficiently deep to expose it. Information regarding the coal is confined to the few shafts and about 15 drill holes in different parts of the county. The available records indicate that coal No. 6 is developed over a large part of the county. It is known to be somewhat thinner than normal along the axis of the Duquoin fold in the eastern tier of townships, and its absence at Irvington and also in sec. 16, T. 2 S., R. 1 W. and in sec. 4, T. 2 S., R. 2 W. suggests some connection with the barren area towards the northwest in Clinton county. It is also possible that the absence of coal in the drill holes mentioned is due to the same processes that reduced the thickness of the coal in the eastern part of Clinton county. Before any definite relationship can be established, however, other holes must be drilled in the northeast quarter of Washington county. The drill records available for study are from wells so widely separated that generalizations regarding distribution and thickness of coal No. 6 are almost worthless. It

is regarded best, therefore, to present the known information in tabulated form.

TABLE 14.—*Thickness of coal No. 6 in Washington County*
From drill records and logs of mine shafts

Company	Location				Coal No. 6		
		Sec.	T.	R.	Depth	Thickness	
Drill holes:					*Feet*	*Ft.*	*In.*
Irvington Coal Co.	Irvington	....	....	....	Absent	....	....
Centralia Coal Co.	SE.¼ NE. ¼	25	1N	1W	525	6	6
Central Refining Co.	.....	17	1S	4W	335	10	....
Ashley shaft	Ashley	....	2S	1W	497	5	....
Schaffer & Smathers	Ashley	....	2S	1W	Absent	....	....
Ohio Oil Co.	.....	16	2S	1W	Absent	....	....
Egyptian Heat & Power Co.	.....	4	2S	2W	Absent	....	....
Gibson Estate	.....	12	2S	3W	376	6	....
Consolidated Coal Company	.....	13	2S	3W	418	6	....
M. H. Cohen	.....	21	2S	3W	325	1–2	
R. Zeppenfeld	.....	29	2S	4W	216	8	....
C. L. Coulter	NW.¼ SW.¼	13	3S	4W	351	7	....
Shoup Oil Co.	.....	14	3S	4W	303	3	....
David Thomas	Oakdale	....	....	....	345	7	....
Mine shafts:							
Finke & Harris Coal Co.	NE.¼ SE.¼	13	2S	3W	424	7	....
J. A. Kuhn	NE.¼	33	3S	1W	294	5	6
Gallatin Coal & Coke Co.	Nashville	....	....	....	419	6	4

PHYSICAL CHARACTER

The coal of Washington, Randolph, and the western parts of Perry counties, differs physically and chemically from that east of the Duquoin anticline where it is thicker, and contains less dirt and a

smaller percentage of sulphur. The latter coal belongs with that of Franklin-Williamson or District VI of the Investigations. In treating the subject of coal resources in county units, however, some overlapping of districts is unavoidable.

Figures 33, 34 and 35 show the physical character of coal No. 6 in some of the mines of Perry, Randolph, and Washington counties. On both sides of the fold the bed shows the usual division into three benches, and the "blue band" maintains its position and general characteristics. As a whole, on the west the bed has a duller luster than on the east. In most places the top coal is not left in mining except below bad roof as at the Horn mine 1½ miles southwest of Duquoin,

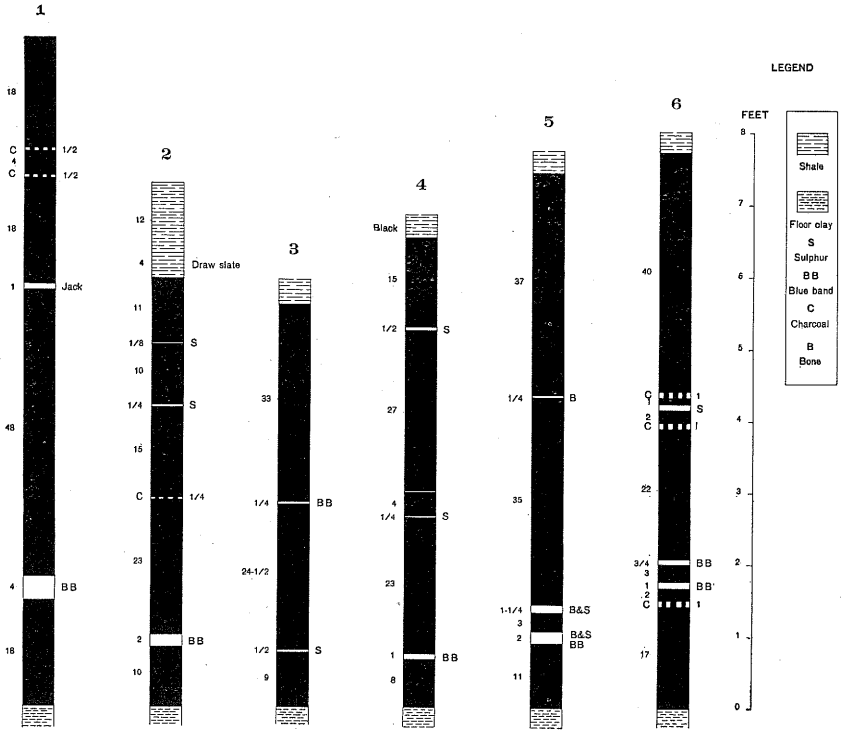

FIG 33.—Graphic sections of coal No. 6 from measurements made in mines in Perry Co.

1. Paradise Coal and Coke Co., Paradise mine, Duquoin.
2. King City Coal Mining Co., Barnard mine, Cutler.
3. Little Muddy Fuel Co., Little Muddy mine, Tamaroa, 2nd north entry.
4. Willis Coal Mining Co., No. 1, Willisville. Room 10, 13th S. off main east entry.
5. Brilliant Coal and Coke Co., Horn mine, Duquoin. Room 24, 7th S. off 7th W. on N.
6. Ritchey Coal Co., No. 1, Pinckneyville. Face 4th, off main N., 1000 feet from shaft.

where 18 inches of coal forms the roof and is separated from the middle bench by a parting of charcoal and pyrite.

East of the anticline the character of the coal is seen typically at the Paradise and Muddy Valley mines. In the former the bed varies in thickness from 8 to 11 feet, the average being 10 feet. The top coal measures 26 to 30 inches and the lower bench averages 18 inches. At the latter mine the coal varies in thickness from 6 to 11 feet on the east side of the mine and is but 7 feet on the west. The "blue band" on the west is but 1½ inches thick and from 7 to 10 inches on the east and consists of bone, coal, and dirt. At the Paradise mine also the "blue band" is peculiar in that it consists of an upper and lower layer of shale varying from 1 to 2 inches in thickness, and separated by about one inch of coal. Various names are applied to particular partings or to benches developed at individual mines. At the abandoned

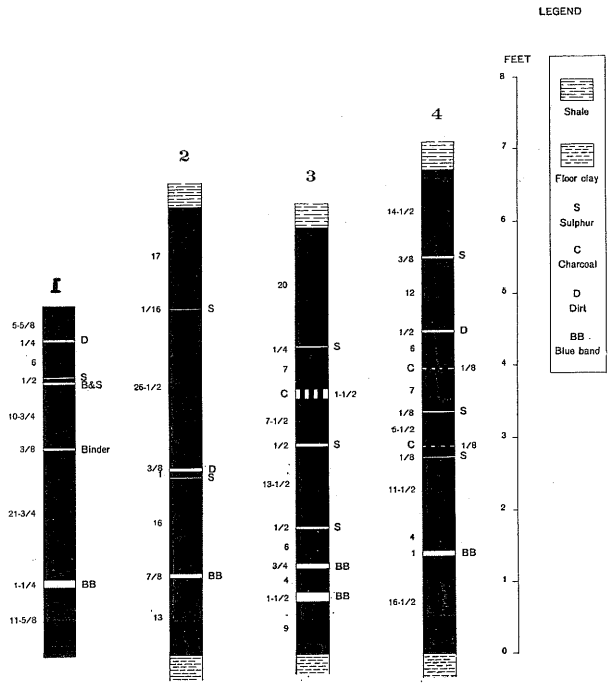

FIG. 34.—Graphic sections of coal No. 6 from measurements made in mines in Randolph County.

1. Boyd Coal & Coke Co., No. 1, Sparta. Main north, 600 feet from main west.

2. Bessemer Coal and Mining Co., Crystal mine, Tilden. Room 16, 6th west off main south.

3. Moffatt Coal Co., No. 1, Sparta. Face 4th west off main S., 2800 feet from shaft.

4. Willis Coal and Mining Co., No. 6, Percy. Room 16, 1st south, main east.

mine of the Greenwood-Davis Coal Co., Duquoin, a softer coal is present below the 26-inch top bench, and to this is given the name "nine inch ply". Such terms as "drift band," "steel band" and others are applied to local features in certain mines. Besides the "blue band" which is persistent and the parting below the top coal, no other partings can be consistently traced from one mine to another.

At Nashville in Washington County the coal appears to contain thicker shale partings than elsewhere, and below the lower bench 12 to

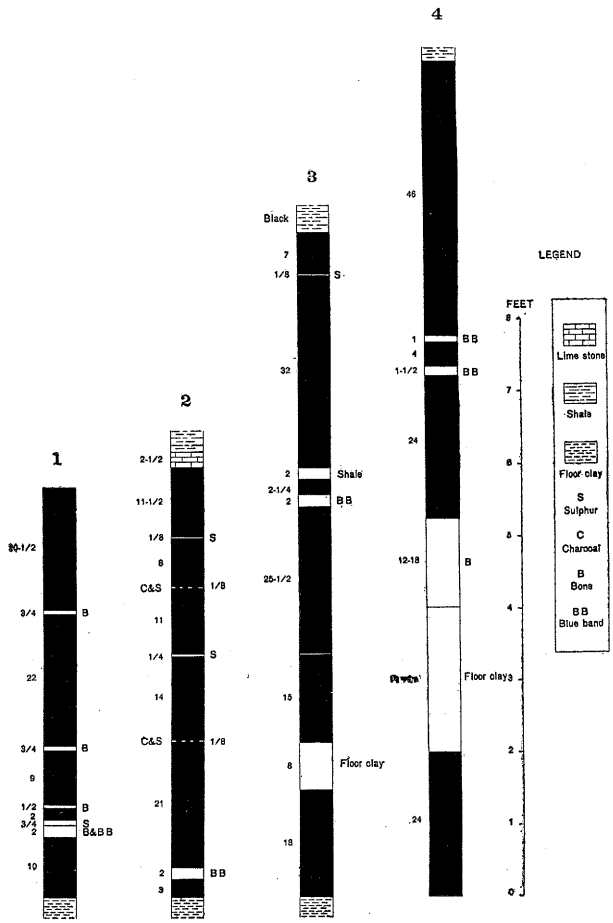

FIG. 35.—Graphic sections of coal No. 6 from measurements made in mines in Washington Co.

1. Centralia Coal Co., No. 5, Centralia. Room 1 off 4th N.
2. Kuhn Coal Co., Dubois. 2nd W. main entry.
3. Finke and Harris Coal Co., No. 1, Nashville. (Abandoned.) Main N. entry, 4200 feet from shaft.
4. Gallatin Coal and Coke Co., Nashville. Room 3 and 2nd W. off main N. (Abandoned.)

18 inches of bone and a foot or two of clay overlie a small bed of coal ranging in thickness from 18 to 24 inches. The main part of the bed seems to be intact, the "blue band" being in its proper place, and the small coal below is probably a local development in a small basin.

The following section was measured at the face 4200 feet from the shaft on the main north entry, in mine No. 1, Finke and Harris Coal Company, Nashville, now abandoned.

Section of coal, Finke and Harris mine No. 1, Nashville

	Thickness	
	Ft.	*In.*
Shale, roof, black	2	....
Coal	....	7
Pyrite	....	1/8
Coal	2	8
Shale	....	2
Coal	....	2 1/4
"Blue band"	....	2
Coal	2	1 1/2
Bone coal	1	3
Clay	....	8
Coal	1	6
Clay	1	6
	12	8 7/8

The "blue band" in this mine appears as a double parting separated by a few inches of coal, but the upper band of shale is not uniform in thickness.

At Dubois the coal averages 5½ feet in thickness, and the only difference in the character of the bed is the position of the "blue band" only 2 or 3 inches above the floor. In the extreme northeast corner of the county, which is part of the Centralia field, the coal varies from 5 feet 4 inches to 8 feet in thickness, and the "blue band" lies from 3 to 12 inches above the bottom.

Throughout the district, a considerable amount of gypsum and some calcite are deposited in the cleavage planes of the coal.

ROOF AND FLOOR

West of the axis of the Duquoin anticline the normal roof of coal No. 6 is black shale overlain by a strong, gray limestone. In places a gray shale or "white top" partly or entirely replaces the black shale, and in others the limestone rests directly on the coal. East of the anticline the shale increases in thickness eastward, and what appears to be the same limestone that overlies the coal to the west is found 100 feet or more above it in the southeast corner of the county.

There seems to be no regular succession of black and gray shale, the order depending on local conditions at the time of deposition. At the Horn mine near Duquoin gray shale overlies the coal to an average height of 12 feet, and in places as much as 23 feet is known. The black shale forms the roof in only a small area. At Willisville black shale lies over the coal in most of the mine, the maximum thickness being 3 feet. A "white top" roof from 2½ to 4½ feet thick containing numerous slickensides, which cause it to fall when unsupported in circular and lenticular masses, prevails through 15 per cent of the mine. The same lenticular, gray shale is seen at the Ritchey mine in Pinckneyville where it exists as a lens between the coal and black shale throughout 50 per cent of the mine. A dark-colored shale ranging in thickness from a mere streak to about 18 inches and averaging from 2 to 4 inches, lies just above the coal in most places. This material is removed as a "draw slate" in mining. The "white top" is fairly soft and contains a little sand and a few concretions scattered through the lower 2 feet, whereas the black shale is very hard and sheety.

At mine No. 1 of the Moffatt Coal Company the limestone cap rock is 35 feet thick, the main ledge of which is about 6 feet in thickness and not more than 4 feet above the coal. Where the limestone is not in contact with the coal, the intervening space is occupied by black or gray shale. Between the limestone and the coal, or between the limestone and the black shale, there is in most places a carbonaceous, limy shale which is very hard when fresh, but slakes quickly on exposure to the air. It averages 4 inches in thickness and is known to reach 12 inches in places.

In the mines of Washington County a few feet of gray or black shale forms the regular roof with a cap rock of limestone. At mine No. 5 of the Centralia Coal Company from 9 to 14 inches of top coal is left for roof while going forward, but between the coal and the limestone three different kinds of roof are found. Figure 36 illustrates the occurrence of the ordinary black shale in the eroded areas of which the gray shale or "white top" has been deposited. It also shows the contact of the cap rock with the coal, no shales intervening. Along such a contact the lower part of the limestone is generally impure and poorly bedded. Where the distance between the cap rock and the coal is small the shale is practically a draw slate which must be removed in mining.

It is said by the miner that the coal is thickest under the "white top". If this is true, it is probably because none of the top vegetal matter was mixed with the gray sediment as it was with the "black top."

Over the entire region treated in this chapter, the floor is a clay of variable thickness and character. In Perry County it has been found to range from a few inches to 8 feet or more. In the Paradise mine it is generally less than 3 feet in thickness, and it rests on a light-gray, compact limestone. It has a marked tendency to heave. In the different mines of the county the floor varies from a soft, plastic clay to a hard, sandy material containing pebbles or boulders, especially in its lower part. In many places the records show the presence of a thin limestone beneath the floor clay, and here and there the coal rests on the limestone.

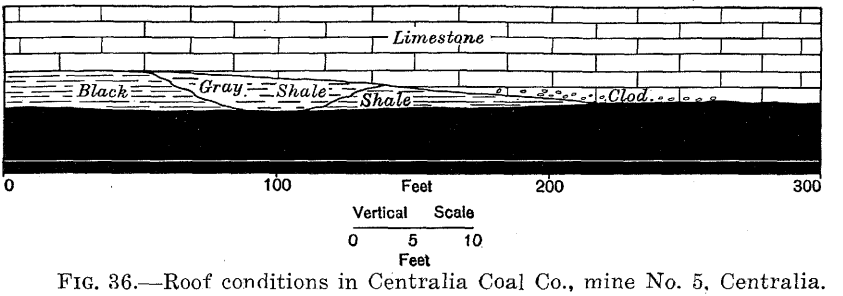

FIG. 36.—Roof conditions in Centralia Coal Co., mine No. 5, Centralia. (diagrammatic.)

The greatest irregularity in the floor is noted at Nashville, Washington County, where a thin coal from 18 inches to 2 feet thick is present only 2 or 3 feet below the coal, the lower bed resting on a variable amount of clay, generally less than 3 feet in thickness, and the latter underlain by limestone.

Besides the non-uniformity of the roof materials as described above, structural irregularities such as faults, rolls, and slickensides render mining more difficult. It is not uncommon in this region to find the roof filled with slickensided planes, the result of adjustments coincident with slightly irregular settling. These slips are most likely to occur in the gray shale, and in many places they do not extend downward into the coal. In some areas the slips run parallel to one another in certain directions, and the roof falls in wedge-like masses. At Moffatt Coal Company's mine No. 1, Sparta, the limestone is affected and falls in masses similar in shape to the shale wedges, a condition somewhat unusual. In other places some of the slips extend downward into the coal but not through it, and it is plain that unequal strain has simply forced a small part of the roof downward into the coal, and the resulting structure is known as a "roll". If the strain is sufficiently great the entire bed is fractured and displaced. No regularity is discernible in the rolls and prediction of their presence is impossible.

Numerous small faults are encountered throughout the area, the throw amounting to only a few feet. The greater number of these displacements is east of the Duquoin fold along the steep eastward dip. They are well shown in the Paradise and Majestic mines where they run slightly northeast-southwest. The largest fault at Paradise was found on the main west entry. It is a step fault with a downthrow of at least 20 feet towards the west. The exact amount could not be measured at the time of examination. It is probable that this is the fault the continuation of which was found in the Majestic mine.

The presence of stringers of coal in the overlying shale is another cause of roof trouble in parts of Perry County. They have been noted only in the vicinity of Duquoin, being especially developed in the Horn and Paradise mines. Figures 37, 38, 39, 40 and 41 show

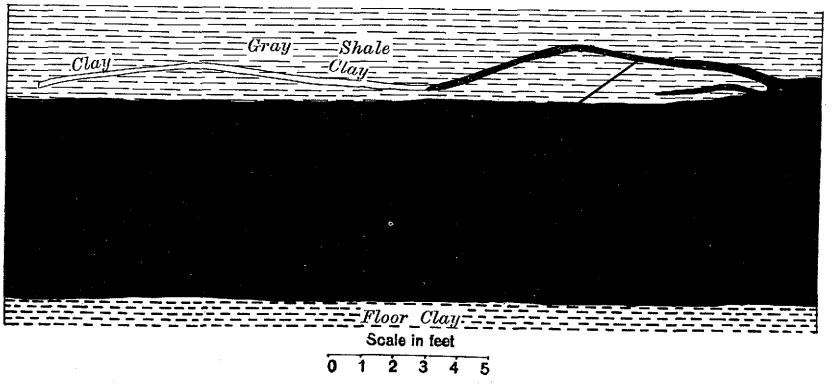

FIG. 37.—Coal stringer, Brilliant Coal and Coke Co., Horn mine, Duquoin (West plug 6th N., 4700 feet from shaft.)

typical stringers covering lenticular masses of roof shale as sketched in the mines mentioned. Almost every stringer is somewhere joined to the main coal; in other words, they are not later deposits. In this area most individual stringers do not exceed 1 foot in thickness, whereas most of them range from a mere streak to a few inches. Ordinarily a single stringer cannot be traced more than 20 or 30 feet along an entry. Considered in their entirety, they are thin layers of coal at the top of the bed, separated in places from the main coal by an irregularly shaped, lenticular mass of material similar to the roof shale. In the vicinity of the larger lenses, small movement planes may be found in the coal below, and slickensides are noticeable along the contact of the shale and coal. T. E. Savage[7] regards them as having

[7]Savage, T. E., Econ. Geol. vol. 2, p. 178.

been formed by unequal settling of the coal and roof material where the latter is capable of flowage in the geological sense, in order to adjust unequal strains.

It is not regarded advisable here to discuss at length the possible modes of origin of the lenses. In a general way they appear to be due to peculiar conditions of sedimentation at the close of the period that

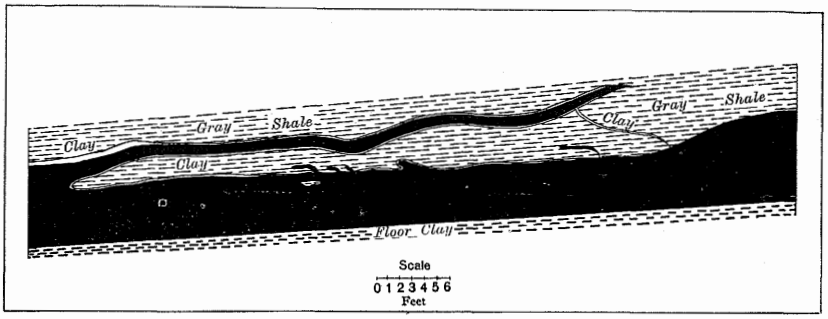

FIG. 38.—Coal stringer, Brilliant Coal & Coke Co., Horn mine, Duquoin. (7th W.-N., 2700 feet from shaft.)

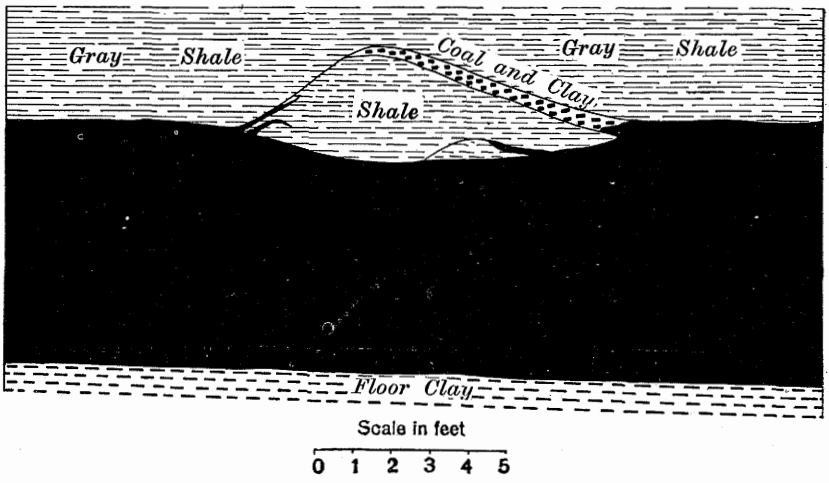

FIG. 39.—Coal stringer, Brilliant Coal & Coke Co., Horn mine, Duquoin. (7th west, north entry.)

produced the vegetal matter for coal No. 6. In comparatively small areas after the incursion of slowly moving waters bearing fine sediment and filling therewith many of the hollows at the surface of the coal swamp, a period ensued during which vegetal matter, fallen or transported, covered to varying depths many of the depressions that had previously been filled with sediment. Subsidence of the swamps

permitted the deposition of the main mass of roof material, and the later adjustments as evidenced by the slickensides appear to have resulted from the wide difference in the compressibility of shale and vegetal matter by the weight of the overburden.

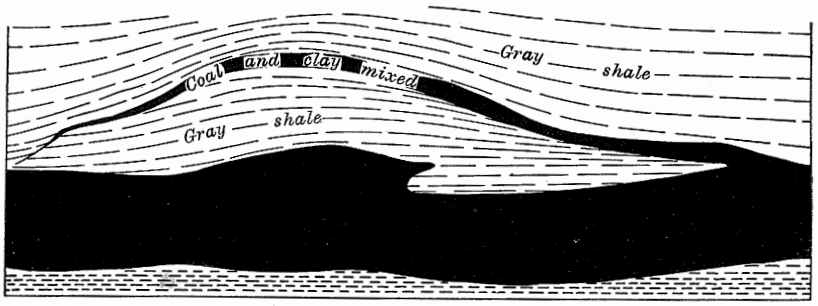

FIG. 40.—Coal stringer, Paradise Coal Co., Paradise mine, Duquoin. (Main west entry, 2000 feet from shaft.)

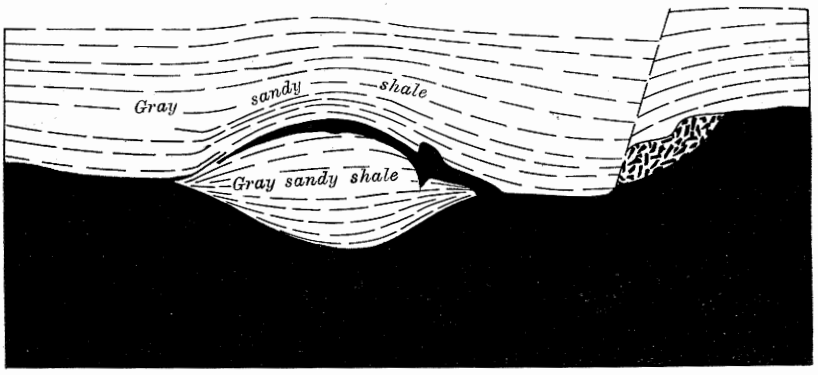

FIG 41.—Small coal stringer, Paradise Coal Co., Paradise mine, Duquoin (150 feet from stringer shown in fig. 40.)

The lenses have but little effect on the quantity of minable coal, but their deleterious influence on the roof renders them troublesome features. Dangerous falls are numerous because the "slip" planes in the lenses and in many places along the coal stringers destroy any cohesion inherent in the shale, and it falls unexpectedly when the coal is mined, unless much careful timbering is done.

OTHER COALS

Except the outcrop of the lower coals at the south, information regarding their existence, thickness, and character must be gained from drill-hole records. In the early years of settlement and before

any large demand for coal existed, two or three of the thin beds above coal No. 6 where mined by drifts along the outcrop. A. H. Worthen mentions the highest coal in Washington County not far southeast of Ashley. It is only one foot thick and is of course commercially unimportant.

The next consistent bed is found 15 to 50 feet below the Shoal Creek limestone, and it does not generally exceed 14 inches in thickness. The following list of exposures of coal No. 9 is quoted from Worthen. "It is exposed on the Okaw River in the southeast quarter of section 1, township 1, range 6; and was found in the trial shaft four miles west of Nashville in the southeast quarter of section 17, township 2, range 3; also in the Nashville shaft in the southeast quarter of section 13, township 2, range 3; then on the upper course of a branch in the southwest quarter, corner of section 5, township 3, range 2; on Beaucoup Creek, and also on a branch in the southwest quarter of section 35, township 2, range 2; and near Little Muddy Creek in the north part of section 21, township 3, range 1 W." Although it is not a commercial bed, it is a good horizon marker a short distance below the limestone.

A thin bed, coal No. 8, generally a few inches thick lies in places about 180 feet above coal No. 6, and coal No. 7 is usually developed 30 to 50 feet above coal No. 6. It is in most places too thin to be commercial, although some drillers report it 3 or 4 feet thick. Most of these holes were made by the churn drill for oil, and it is believed that coal No. 7 does not average more than 1 foot in thickness; for this reason is not regarded an important possibility as a commercial coal bed.

Along the outcrop in Randolph County, coal No. 5 is found 40 to 60 feet below coal No. 6 and has an average thickness of about 3 feet. Several records from wells in the vicinity of the Sparta oil field show three coals within 100 feet below coal No. 6, the first being about 4 feet thick and 20 feet below the Belleville coal; the second, 2 to 4 feet thick and 40 feet lower; and the third, 3 feet thick and slightly more than 30 feet below the last. It is believed that the bed 40 feet below coal No. 6 represents coal No. 5 and the others are apparently local developments which are not traceable throughout the northeast part of the county. It is thought highly probable that at least one coal bed exists below coal No. 6 sufficiently thick to render it valuable in the future when the main coal is extracted. It is reported in only one hole drilled for water at Baldwin. At this place it was found at a depth of 300 feet practically 250 feet below coal No. 6 and is developed to a thickness of 4½ feet. Careful diamond drilling may yet

disclose the existence of coal No. 2 underlying the northeast part of the county.

In Washington County only a few logs record coal below No. 6. In the Finke well, sec. 12, T. 2 S., R. 3 W., a 5-foot bed is reported about 105 feet below coal No. 6. The Shoup well in sec. 14, T. 3 S., R. 4 W. penetrates coal No. 5, 3 feet thick, at a depth of 300 feet, 70 feet below coal No. 6. It is not likely that these two beds are the same, since the interval between them and coal No. 6 is so different. It is probable that lenses of coal below No. 6 exist in Washington County, and that future drilling will develop areas suitable for exploitation. With the present information, however, any estimate of the areal distribution of such coals would be worthless.

Of all the drill holes in Perry County, only 9 of those in possession of the survey record coals below No. 6. Most of the holes are stopped at the horizon of coal No. 6, and in some of the oil holes no coals are recorded, the absence being due no doubt to carelessness in noting the drillings from the upper part of the well.

In the vicinity of Pinckneyville and southwest of this place on Galum Creek, a few holes record a coal 25 to 30 feet below coal No. 6. The bed varies considerably in thickness, but in places it is known to be more than 4 feet. It is probable that this bed represents the Harrisburg (No. 5) coal, although the interval between it and coal No. 6 is smaller than normal. About 250 feet below coal No. 6, a single bed, or in places two beds close together, are reported in a majority of the holes. It is reported to vary from a foot or two to almost 5 feet, and its persistent development renders it a promising bed for prospecting. Several lenticular beds between 2 and 6 feet thick are reported, and it is not always possible to correlate the continuous beds correctly. In the record given below, coal No. 2 may be represented by the 3-foot 5-inch bed 220 feet below coal No. 6 or by the thin beds, the topmost of which lies 244 feet below No. 6.

Record of drill hole

Location—Galum Creek, Perry County, on line of W. C. & W. R. R., July, 1887

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Surface soil	17	6	17	6
Shale, black	1	10	19	4
Limestone, dark blue	8	8	28	....
"Slate," black	2	6	30	6
Coal (No. 6)	5	10	36	4
Fire clay	1	6	37	10
Limestone	1	3	39	1
Shale, soft, white	2	3	41	4
Limestone, light gray	2	....	43	4

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, sandy	7	10	51	2
Limestone, hard, white	6	7	57	9
Shale, hard, gray	2	....	59	9
Limestone, hard, blue	....	6	60	3
Coal (No. 5)	4	8	64	11
Fire clay	11	1	76	....
Limestone	....	9	76	9
Shale	2	....	78	9
Shales, sandy with a little sandstone	40	1	118	10
Shales, sandy	12	6	131	4
Shales, blue with limestone nodules	5	3	136	7
Limestone	1	4	137	11
"Slate," black	8	3	146	2
Coal	3	1	149	3
"Soapstone", gray	1	8	150	11
Coal	....	2	151	1
Shales, dark, with sulphur nodules	2	4	153	5
Shales, gray, with iron pyrites	....	9	154	2
Shale, gray	....	10	155	....
Shale, black, with limestone nodules	6	2	161	2
Limestone	....	1	161	3
Shales	13	10	175	1
"Slate," black	2	9	177	10
Coal	2	2	180	....
"Slate," dark gray	1	11	181	11
Shales, gray with sulphur	6	7	188	6
Limestone	....	7	189	1
Rock, hard, brown	....	2	189	3
Shale, green	....	9	190	....
Shales, sandy, and sandstone	3	....	193	....
Shales, with 4 inches sandstone and 4 inches limestone	15	4	208	4
Limestone, brown	....	3	208	7
Shales	9	8	218	3
Coal	1	6	219	9
Shales, green, clay	....	6	220	3
Limestone	....	11	221	2
Coal	2	6	223	8
Fire clay	1	7	225	3
Shale, gray	....	8	225	11
Limestone, sandy	....	8	226	7
Shale, gray, with limestone nodules	....	9	227	4
Shale, dark	....	5	227	9
Coal, soft, and rock mixed	....	9	228	6
Shales, brown and gray, with limestone nodules	7	6	236	....
Shales	12	9	248	9
Sandstone	4	6	253	3
"Slate," black, with sulphur	1	7	254	10

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shales, black with fossils	....	4	255	2
Coal	3	5	258	7
"Slate," black	....	5	259	....
Shales, dark, sandy	8	7	267	7
Shale, gray, with limestone nodules	1	9	269	4
Shale, hard, gray	5	11	275	3
Rock, hard	....	1	275	4
Shale	....	10	276	2
Rock, hard	....	3	276	5
Shale, dark, gray	6	3	282	3
Coal	1	7	283	10
Shale, dark, with limestone nodules	2	2	286	....
Shales, sandy and gray	6	9	292	9
"Slate" and coal mixed	....	1	292	10
Shales	5	....	297	10
Coal and slate mixed	....	4	298	2
Shales	28	9	326	11
Sandstone, white, with thin coal seams	1	....	327	11
Millstone grit	14	8	342	7
Sandstone, pebbles	1	....	343	7

The following table shows the location of holes in Perry County that have penetrated coals below No. 6.

TABLE 15.—*Position and thicknesses of coals below coal No. 6 in Perry County*

Location					Depth below No. 6 coal	Thickness		Coal bed
¼	¼	Sec.	T. S.	R. W.				
					Feet	*Ft.*	*In.*	
		25	4	4	110	2	4	
		35	5	4	24	4	8	No. 5
					110	3	1	
					141	2	1	
					181	1	6	
					185	2	6	
					219	3	5	
					246	1	7	No. 2?
....	NE	3	6	2	116	2	....	
					233	3	....	No. 2
....	NE	3	6	2	233	3	....	No. 2
....	NE	18	6	2	120±	1	7	
					240±	3	....	No. 2
SE	SW	19	6	2	235±	4	7	No. 2
NW	SW	17	6	3	224	5±	....	No. 2

From the material available for study it seems certain that coal No. 5 underlies at least parts of Perry County in workable thickness. Since it lies within 50 or 60 feet below coal No. 6, the extra drilling should always be done to determine the thickness and character of the lower bed.

It is almost certain that at least some coal exists at the horizon of coal No. 2, and its high quality in the Murphysboro district will later stimulate prospecting for it in Perry County. Careful drilling will probably outline areas in which it will be commercial, but such explorations will probably not be undertaken until coal No. 6 has largely been removed.

SHELBY AND MOULTRIE COUNTIES

Production and Mines

SHELBY

Production in tons for year ended June 30, 1913...	202,968
Average annual production, 1909 to 1913.....	89,868
Total production, 1881 to 1913.....	1,989,116

MOULTRIE

Production in tons, year ended June 30, 1913...	105,280
Total production in 1913.....	181,335[8]

Shelby and Moultrie counties are not large producers of coal. During the year ended June 30, 1913, Shelby County's output was 3/10 of 1 per cent of that for Illinois, and Moultrie mined only a little more than half as much. The lack of large mining operations is due in large part to the great depth of coal No. 6 which lies from 600 to 900 feet below the surface in these counties. Moreover, the coal does not underlie the entire area, and investors hesitate to spend large sums in testing deep territory as long as any shallower coal is available. In the future when the coal nearer the surface becomes scarce, drilling and mining operations will be pushed eastward into parts of Moultrie Country. At present Tower Hill Coal Company No. 1, at Tower Hill, and Lovington Coal Mining Company, No. 1, at Lovington, are the only mines operating coal No. 6 in the two counties. In Shelby County coal No. 5, the Springfield bed, is mined at Moweaqua, and a 2-foot bed lying from 50 to 160 feet below the surface and about 700 feet above coal No. 6 is being mined in a small way in the vicinity of Shelbyville. Worthen mentions early mining from this bed which he calls coal No. 15, or the "Shelby Coal", and also from

[8]Lovington Coal Mining Company No. 1, the only mine in Moultrie County, began to produce in 1909.

his coal No. 14, which varies in thickness from 16 to 22 inches. The latter was worked formerly in the south part of sec. 15, T. 9 N., R. 1 W. It lies a few feet above the New Haven limestone; whereas the coal now being worked is 100 to 120 feet above this horizon.

Below is a list of shipping mines in the two counties.

TABLE 16.—*List of shipping mines, Shelby and Moultrie counties, 1913*

Map No.	Company	Mine	Coal bed	Location ¼	Location ¼	Location Sec.	Location T. N.	Location R. E.	Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production, 1913
									Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
	Shelby County—													
1	Tower Hill Coal Co.	1	6	NW	NW	23	11	2	665	798	−133	7	....	145,756
2	Moweaqua Coal Mining & Mfg. Co.	1	5		NW	31	14	2	635	620	15	5	4	49,813
			6			....	....	....	.....	580	55	5	7	.....
	Moultrie County—													
1	Lovington Coal Co.	1	6	NE	SE	27	15	5	680	904	−224	8	....	105,280

COAL-BEARING ROCKS

Eighteen logs available for study in Shelby County and two in Moultrie show a remarkable similarity, especially since they were obtained from various sources. About 1450 feet of "Coal Measures" rocks are known from drill records, and it is likely that a somewhat greater thickness exists along the eastern border of these counties.

The most striking characteristics of the logs when plotted by symbols and placed side by side are coals No. 6 and No. 7 and associated limestones between 700 and 800 feet below the surface, a group of thin limestones 250 to 300 feet above coal No. 6, representing the Carlinville and Shoal Creek, and another thick limestone 200 to 250 feet above the latter and regarded as the New Haven. The latter is regularly developed to a thickness of 20 to 50 feet in every log studied from the two counties. Very little sandstone exists above coal No. 6. Below this coal the logs are much less regular. No distinct limestones or sandstones are traceable throughout the area, but in a general way the beds are more sandy. Lenticular coals are noted especially at the horizons of coals No. 5 and No. 2, although only a few of the logs record such beds.

Lying beneath the "Coal Measures" are the interbedded limestones, sandstones, and red shales of the Chester. In drilling for coal it is not necessary to penetrate all of the "Coal Measures" rocks, since all the important beds lie within 300 feet below coal No. 6.

The following logs will aid the driller in identifying the beds in Shelby and Moultrie counties.

Drill record of H. L. Hargrave
Farm—T. Vidler
Location—Sec. 8, T. 10 N., R. 1 E.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Clay, hard, and pebbles	17	....	17	....
Sand, gravel, clay	14	....	31	....
Clay, dark	55	6	86	6
Shale, lime	1	....	87	6
"Slate"	....	6	88	....
Coal	1	....	89	....
Drift	5	....	94	....
Shale, lime	7	....	101	....
Shale, blue	3	....	104	....
Limestone (New Haven)	37	....	141	....
Sandstone, soft	6	....	147	....
Shale, dark, sandy	17	....	164	....
Shale, dark	59	....	223	....
Coal	1	....	224	....
Shale, gray	11	....	235	....
Shale, brown	4	....	239	....
Shale, blue	9	....	248	....
Shale, dark	22	....	270	....
"Slate," black	2	....	272	....
Coal	1	....	273	....
Shale, blue	18	....	291	....
Shale, dark	4	....	295	....
Sandstone, hard	3	....	298	....
Shale, dark, sandy	24	....	322	....
Shale, dark, with limestone bands	8	....	330	....
Shale, dark	17	....	347	....
Shale, black	1	....	348	....
Shale, blue	8	....	356	....
Shale, blue, with limestone bands	3	....	359	....
Shale, blue	13	....	372	....
Limestone (Shoal Creek)	14	....	386	....
Shale, dark	1	....	387	....
"Slate," black	3	6	390	6
Shale, brown	3	6	394	....
Shale, dark	7	....	401	....
Coal	1	....	402	....
Shale, dark	2	....	404	....

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
"Soapstone," light	13	....	417	....
Shale, dark	9	....	426	....
"Slate," black	5	....	431	....
Limestone (Carlinville?) and lime shale	22	....	453	....
Shale, hard	28	....	481	....
Shale, soft	45	....	526	....
Coal (No. 8)	....	6	526	6
Fire clay, soft, white	1	6	528	....
Shale, light	1	....	529	....
Sandstone	3	....	532	....
Shale, light, sandy	8	....	540	....
Shale, dark	77	....	617	....
Shale, very dark	4	....	621	....
Shale, light blue	3	....	624	....
Shale, blue, with limestone bands	2	....	626	....
Shale, blue	4	....	630	....
Shale, soft, black	2	....	632	....
Shale, dark	5	6	637	6
Limestone	6	6	664	....
Shale, dark blue and yellow	2	....	646	....
Shale, dark	4	....	650	....
Shale, red	....	6	650	6
Shale, blue	1	6	652	....
Shale, black	4	....	656	....
Limestone and shale	2	....	658	....
Shale, blue	4	8	662	8
Coal (No. 7)	3	6	666	2
Shale, blue	1	1	667	3
Limestone, soft	4	11	672	2
Shale, hard, black	2	1	674	3
"Slate," black	....	9	675	....
Shale, blue	1	....	676	....
Shale, sandy, lime	2	9	678	9
Shale, blue	1	6	680	3
Limestone	1	4	681	7
Shale, blue	....	8	682	3
Limestone	....	11	683	2
Shale, soft, dark	....	10	684	....
Shale, hard, dark	3	....	687	....
Limestone	2	....	689	....
Shale, dark	1	....	690	....
"Slate," black	2	4	692	4
Coal (No. 6)	6	6	698	10
Fire clay, hard				

Record of Shelby Coal, Oil, and Natural Gas Co. well

Location—Shelbyville

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Clay and boulder	19	....	19	....
Shale, blue	20	5	39	5
Coal	1	1	40	6
Fire clay	3	6	44	....
"Soapstone"	12	....	56	....
Sandstone	1	....	57	....
"Soapstone," gray	3	....	60	....
Shale, sandstone	30	....	90	....
Shale, blue	8	6	98	6
Shale, bituminous	1	6	100	....
Coal (mined at Shelbyville)	....	10	100	10
Fire clay	1	2	102	....
Shale, gray	7	....	109	....
Sandstone, hard	4	....	113	....
Shale, sandstone	14	5	127	5
Coal conglomerate	....	2	127	7
Shale, gray	2	5	130	....
Shale with sandstone partings	9	....	139	....
Sandstone	3	....	142	....
Shale, blue	19	....	161	....
Shale, fossil	....	9	161	9
Coal	....	9	162	6
Shale, Clay	10	....	173	6
Limestone (New Haven)	7	....	180	6
Shale, clay	3	....	183	6
Limestone	5	....	185	6
Limestone	29	6	215	....
Shale, blue	18	6	233	6
Shale, blue	36	....	269	6
Sandstone	5	....	274	6
Shale, blue	10	6	285	....
Coal	....	6	285	6
Shale, clay	5	....	290	6
Sandstone	9	....	299	6
Shale, gray	5	....	304	6
Shale, clay, and limestone beds	5	....	309	6
Shale, clay	6	....	315	6
Shale, bituminous, black	21	....	336	6
Rock, fossil	2	6	339	....
Coal	....	10	339	10
Fire clay	1	8	341	6
Shale, clay	10	....	351	6
Sandstone	7	....	358	6
Shale, sandstone	11	....	369	6
Shale and sandstone partings	15	....	384	6
Shale, black	1	....	385	6
Coal	1	2	386	8

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, black	6	10	393	6
Fire clay	4	....	397	6
Limestone	1	....	398	6
Shale, gray	9	....	407	6
Sandstone	5	....	412	6
Limestone (Shoal Creek)	10	6	423	....
Shale, black	1	6	424	6
Coal	....	2	424	8
Shale, clay	10	10	435	6
Sandstone	4	....	439	6
Limestone	1	6	441	....
Shale, gray	4	6	445	6
Shale, gray	22	....	467	6
Shale, gray	4	....	471	6
Shale, fossil	2	....	473	6
Fire clay	6	....	479	6
Shale, black	4	....	483	6
Sandstone	6	....	489	6
Shale, sandstone	25	....	514	6
Shale, blue	21	....	535	6
Shale, black	1	....	536	6
Shale, blue	6	....	542	6
Rock, fossil	....	10	543	4
Shale, black	1	....	544	4
Coal (No. 8)	....	6	544	10
Fire clay	2	8	547	6
Shale, gray	15	....	562	6
Shale, blue	10	....	572	10
Limestone	9	....	581	10
Shale, blue	2	6	584	4
Limestone	5	6	589	10
Shale, gray	3	....	592	10
Shale, striped	7	....	599	10
Shale, blue	10	....	609	10
Shale, gray	26	....	635	10
Coal	3	....	638	10
"Slate," clay	8	....	646	10
Limestone	3	....	649	10
Shale, gray	25	....	674	10
Shale, sandstone	15	....	689	10
Shale with sandstone partings	10	....	699	10
Sandstone	3	....	702	10
Shale, sandstone	2	....	704	10
Sandstone	8	....	712	10
Shale, sandstone	10	....	722	10
Sandstone	22	11	745	9
Coal (No. 6)	1	1	746	10
Sandstone with coal	1	....	747	10
Sandstone, soft	15	....	762	10

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Sandstone	69	10	832	8
Sandstone (coal partings)	....	1	832	9
Sandstone	17	1	849	10
Sandstone	29	9	879	7
Coal	....	1	879	8
Shale, sandstone	2	2	881	10
Shale, gray	16	....	897	10
Shale, black	7	8	905	6
Coal	1	4	906	10
Shale, sandstone	1	6	908	4
Sandstone	9	6	917	10
Shale, sandstone	19	....	936	10
Shale, black	2	....	938	10
Coal	....	9	939	7
Sandstone (?)	15	3	954	10
Shale, sandstone	24	....	978	10
Shale, blue	3	8	982	6
Shale, bituminous	1	6	984	....
Coal (No. 2?)	2	10	986	10
Shale, blue	2	....	988	10
Sandstone (?)	6	....	994	10
Shale, black	3	....	997	10
Shale, blue	2	....	999	10
Coal	....	8	1000	6
Shale, clay	1	4	1001	10
Shale, blue	8	5	1010	3
Coal (No. 2?)	3	8	1013	11
Fire clay	1	3	1015	2
Sandstone	2	....	1017	2
Shale, gray	4	....	1021	2
Limestone	2	10	1024	....
Shale, black	....	2	1024	2
Shale, gray	6	6	1030	8
Shale, black	2	6	1033	2
Coal	....	1	1033	3
Shale, clay	6	6	1039	9
Limestone	1	6	1041	3
Shale, gray	6	....	1047	3
Limestone, bastard	2	....	1049	3
Shale, bituminous	3	....	1052	3
Shale, black	4	....	1056	3
Shale, sandstone	7	....	1063	3
Shale, gray	3	....	1066	3
Coal (No. 1?)	2	9	1069	....
Fire clay	1	....	1070	....
Shale, gray	11	....	1081	....
Shale, black	4	....	1085	....
Limestone, fossil	1	....	1086	....
Coal	1	9	1087	9

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Fire clay	3	3	1091	....
Shale, black	1	10	1092	10
Coal	1	2	1094	....
Fire clay	4	....	1098	....
Shale, clay	9	....	1107	....
Coal	1	9	1108	9
Shale, gray	12	9	1121	6
Shale, blue	37	9	1158	3
Coal	....	3	1158	6
Sandstone	8	....	1166	6
Shale	5	....	1171	6

The 3-foot coal 106 feet above the horizon of coal No. 6 is not in proper position for coal No. 7, and it appears to be a small lens. It is possible that this bed does represent coal No. 7, since wherever it appears too high in the section, coal No. 6 is either thin or absent, due to erosion or to some condition which prevented regular deposition and it is scarcely to be expected that the intervals between 6 and adjacent beds will be regular.

The limestone cap rock of coal No. 6 is not present, a fact which argues for erosive action, and the coal itself is represented by only 13 inches. Coal No. 2 is probably represented by the 2-foot 10-inch bed at a depth of 986, or by the 3-foot 8-inch bed at 1009, and coal No. 1 is found at 1065 having a thickness of 2 feet 9 inches. The lower coals are not reported in any of the other logs, and it is likely they are small lenses. It is believed that the so called 8-foot coal at the bottom of the hole is really a black shale since no such coal is known in any other part of the State.

Geologic Structure

The geologic structure of the beds in Shelby and Moultrie counties is not known in detail. The holes are confined to the southern half of Shelby and the town of Lovington in Moultrie, and they are so scattered over the area that postulation of detailed structure is impossible.

In the northwestern part of Shelby County, at Moweaqua, coal No. 6 lies 55 feet above sea level; whereas at Lovington 22 miles slightly north of east the same bed is 209 feet below sea level, a condition indicating a dip of 12 feet per mile. Along an east-west line from Pana, Christian County, to Shelbyville, the coal dips east at the rate of about 10 feet per mile. In the southeast part of the county, however, there are two holes in which coal No. 6 is higher than at Shelbyville. In sec. 24, T. 10 N., R. 4 E. the coal is about 70 feet

higher than at Shelbyville, although if regular dips prevailed, it would be somewhat lower. About 8½ miles east of the last hole mentioned is another in which the horizon of coal No. 6 is 35 feet higher than in the first. The eastern part of Shelby lies in the trough that runs parallel to the La Salle anticline on the west. The dip of the beds in this part of the county is apparently to the west. The position of the coal in the few wells available for study points to the fact that the lower part of the Illinois coal basin undulates, and that small folds of different types may be expected. Again it may be true that the axis of the trough may not be parallel to the La Salle anticline, but may run slightly east of north. The strike of the beds is represented by a line connecting Shelbyville and Lovington at each of which the coal lies practically 200 feet below sea level. The fact that the coal is only 40 feet below sea level in sec. 24, T. 6 N., R. 2 W., Fayette County, seems to indicate that an east-west anticline the axis of which lies in T. 10 N. separates synclinal basins on the north and south, all these features being parts of the general trough-like basin.

Coal No. 6

DISTRIBUTION AND THICKNESS

The holes that have been drilled in Shelby County lie south of a line drawn east and west through Shelbyville. The logs indicate that the south boundary of the area in which coal No. 6 is thin or absent as shown in Christian County continues eastward into Shelby and extends east and south toward the southeast corner of the county. Its exact position between Tower Hill and Shelbyville is unknown. It is believed that the largest block of coal No. 6 exists in the following townships:

T. 9 N., Rs. 1, 2, 3, 4, and northwestern part of 5 E.

T. 10 N., Rs. 1, 2, 3, 4, and western part of 5 E.

T. 11 N., Rs. 2 and south ½ of 3 E.

Coal No. 6 is either absent or too thin to be commercial in the vicinity of Shelbyville, which lies near the southern boundary of the ancient drainage area. The northern boundary of this area enters Shelby County a short distance northeast of Assumption but cannot be traced because of meager information. Coal No. 6 is known to exist at Moweaqua in the northwest corner of the county where it is 5 feet 7 inches thick but at this place coal No. 5 (Springfield coal) is mined. No holes have been drilled east of Moweaqua. It is possible that this barren area connects with the eroded crest of the La Salle anticline but no proof is available at this time.

Throughout the townships listed above, coal No. 6 averages about 6½ feet in thickness. At Tower Hill mine the bed is somewhat

thicker and probably averages 7 feet. The only information regarding coal No. 6 in Moultrie County is derived from the Lovington mine and two nearby drill holes. At the mine the coal varies in thickness from 4 to 9½ feet, the average being 8 feet. It seems probable that the Lovington coal lies on the north side of the wide erosion area described earlier in this chapter, and that this is a local thickening of the coal. The mine is located on the north boundary of the area in which coal No. 6 is workable, and the variability in thickness is due probably to its proximity to the edge of the ancient swamp. Whether a solid block of coal underlies the surface from Lovington west to Moweaqua and Blue Mound is uncertain; but there is little doubt that if such a connected coal exists, it does not attain so great a thickness as at Lovington.

PHYSICAL CHARACTER

Coal No. 6 has been seen in only two mines, Tower Hill and Lovington. At the former the average thickness is a little more than 7 feet. Figure 42 shows graphically the physical character of coal No. 6

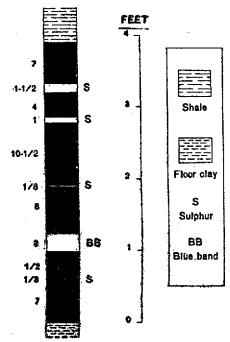

FIG. 42.—Graphic section of coal No. 6 in Shelby County. Tower Hill Coal Co., mine No. 1, Tower Hill.

in Shelby County. The top coal about 16 inches thick is the best; the middle bench contains a number of pyrite bands some of which are 1½ inches thick. The "blue band," which is only about 12 inches from the floor, is thicker than usual, three inches of it having been measured in one section of the mine where it was overlain by 6 or 8 inches of more or less impure coal. In a few places small clay seams varying from 1 to 12 inches in thickness extend 2 or 3 feet into the coal from the top, but rarely cut the entire bed.

At Lovington the top coal is about 30 inches thick in parts of the mine, and the "blue band" lies as much as 24 inches above the floor where the bed is thickest. Figure 43 shows the physical character of

coal No. 6 in parts of Moultrie County. The middle bench contains a number of pyrite bands varying in width from a streak to about 1 inch. About 300 feet south of the shaft on the main entry the bed measures 9 feet 4 inches in thickness which is 2 feet in excess of the average for district VII.

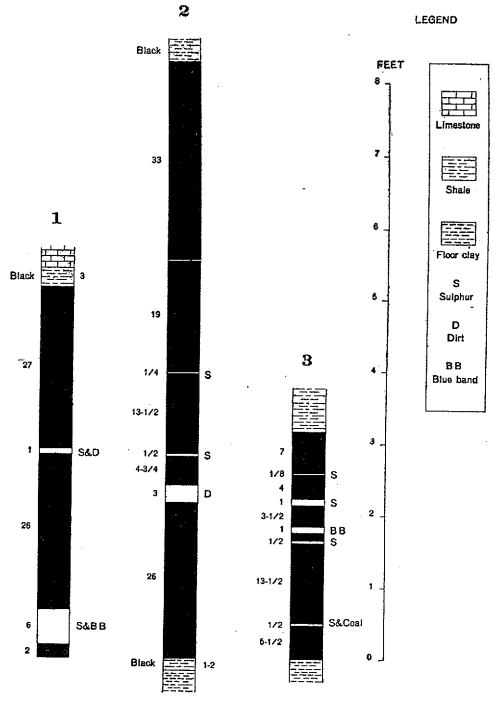

FIG. 43.—Graphic section of coal No. 6 in Moultrie County. Lovington Coal Mining Co., Lovington.

1. Cross-cut between man-way and air-way.
2. Room 1, back south entry.
3. Main south entry, 300 feet from shaft.

ROOF AND FLOOR

Where coal No. 6 exists in its normal thickness, the regular succession of shale and limestone roof materials is present, but in the area where the coal is reduced in thickness, as at Shelbyville, the roof has also been affected. In most of the holes located north and east of the line representing the approximate boundary between normal coal on the south and thin coal on the north, the roof consists of shale, sandstone, or a mixture of the two instead of the limestone. At Tower Hill the limestone lies on the coal in a few places, but over most of the mine shale attaining a thickness of 6 feet intervenes. It

is also reported that above the regular top coal and separated from it by a few inches of black shale, there is in places at Tower Hill a thin lenticular coal. Such a condition has also been noted at the new mine of the Nokomis Coal Company in Montgomery County. The roof at Lovington consists of about 2½ feet of shale overlain by 9 feet of limestone.

Fourteen feet of shale underlies coal No. 6 at Lovington, and below this a 4-foot coal is reported. Such a coal is not mentioned in the log of the shaft, and it is probably lenticular. At Tower Hill the underclay varies from 3 to 4 feet. No regular succession of beds exists below coal No. 6; some of the logs show limestone under the floor clay, but others show only shale or sandstone.

Coal No. 5

The only mine operating coal No. 5 in District VII is located at Moweaqua. This bed lies 40 feet below coal No. 6 which is 5 feet 7 inches thick. Coal No. 5 bears all of the characteristics of the same bed at Springfield. It averages 54 inches in thickness; is overlain by black shale, shaly limestone and gray shale in ascending order; and the coal itself has many clay veins. They vary in width from mere veinlets to several feet in size and consist of clays which have been forced downward into vertical fractures in the coal, as a result of unequal settling of the vegetal matter and its overburden. They will be discussed in detail in the report on District IV.

In different parts of Shelby County, logs show the existence of a somewhat persistent coal from 25 to 80 feet below coal No. 6, which is no doubt coal No. 5. Its thickness at Moweaqua and in some of the holes in the southwestern part of the county indicates that this bed may become very important in future years, especially in the northern part which really joins the Springfield area. The south boundary line of present commercial coal No. 5 probably passes east and west through the northern part of Shelby County, a few miles south of Moweaqua. Whether or not thick coal No. 5 underlies Moultrie County is unknown. It is recommended that future drilling, especially with the core drill be continued at least 80 feet below coal No. 6, unless coal No. 5 is penetrated at less depth.

Other Coals

Mention has already been made of the Shelby coal called coal No. 15 by A. H. Worthen. It is now mined for local use to the extent of about 7500 tons yearly. It outcrops "on Copperas Creek and at several places above its mouth near Little Wabash River, at the water's edge near Shelbyville and occasionally for 10 miles south, on Rich-

land Creek and its tributatries, on Robinson's Creek near the railroad, above on Mud Creek and Brush Creek below Prairie Bird, and on Beck's Creek at the railroad." The Shelby coal varies in thickness from about 18 inches to 3 feet, but is reported in the mines to average 2 feet.

In the vicinity of Shelbyville this coal lies from 50 to 160 feet below the surface and is about 700 feet above the horizon of coal No. 6, or from 100 to 120 feet above the limestone referred to as the New Haven.

The present writer prefers the name Shelbyville coal for this bed since its correlation as coal No. 15 implies the existence of a number of persistent coals capable of being identified over large areas; whereas most of the beds between coal No. 6 and the coal at Shelbyville are only a few inches thick and not positively identifiable from one hole to another.

Seven holes in Shelby County have passed through the "Coal Measures," and three of them report a coal 3 to 4 feet thick 225 to 250 feet below coal No. 6, probably to be correlated with coal No. 2. From 60 to 100 feet lower two or three thinner beds are known occupying the position of coal No. 1. The uppermost of these beds at Shelbyville lies 1068 feet below the surface and attains a thickness of 2 feet 9 inches. Three other beds ranging in thickness from 1 foot 2 inches to 1 foot 9 inches and separated from each other by thin shales exist in a 40-foot zone of which the 2-foot 9-inch coal mentioned above is the top. At the time these beds were being deposited coal-forming conditions were interrupted by irregular periods in which the surface was sufficiently low to permit mud deposits. This alternation did not occur simultaneously over the area, and the result was a number of thin beds here and there, only three or four representing the same general period of coal deposition.

From meager data at hand regarding the earliest coal beds in this region, it is useless to attempt to outline their areal distribution, but later need will no doubt develop commercial areas of coal No. 2. Formerly the Moweaqua shaft was sunk to a depth of 924 feet and one of the lower beds, corresponding probably to coal No. 2 was worked for a short time, but was abandoned in favor of coal No. 5, 300 feet higher in the shaft.

SANGAMON COUNTY

Only the southern part of Sangamon County is treated in this report, the northern portion being included in District IV to be described in a later bulletin.

A northeast-southwest line, passing about 2 miles north of Chatham and extending toward Mechanicsburg, marks the northern limit of the area in which coal No. 6 is sufficiently thick to be commercial. North of this line the position of which is shown approximately on the large map, the "blue-band" coal averages only a few inches in thickness and mining is confined to coal No. 5 which ranges in thickness from 5 to 6⅔ feet in the area of the Tallula-Springfield quadrangle.[9]

Production and Mines

Total production[10] coal No. 6, 1881-1913.....62,100,919

During the year ended June 30, 1913, six mines in the southern part of the county produced 2,036,002 tons of coal No. 6 or 3.28 per cent of the State's output. The average annual production of coal No. 6 from this county for the five-year period, 1909 to 1913 inclusive, was 1,624,984 tons. The following mines were operating coal No. 6 in 1913.

Table 17.—*List of shipping mines producing coal No. 6, Sangamon County, 1913*

Map No.	Company	Mine	Location					Surf. elev.	Depth to coal No. 6	Alt. top coal No. 6	Average thickness		Production, 1913
			¼	¼	Sec.	T. N.	R. W.						
								Feet	*Feet*	*Feet*	*Ft.*	*In.*	*Tons*
1	Chicago, Wilmington and Vermilion Coal Co.	1	SW	NW	34	13	6	648	293	355	6	8	551,787
2	Illinois Midland Coal Co.	5	SW	NE	12	13	5	628	322	306	6	....	488,445
3	Madison Coal Corporation	6	NE	SW	21	13	5	614	312	302	8	....	403,284
4	Black Diamond Coal Co.	Black Diamond	.....	SW	15	13	6	628	301	327	7	....	368,907
5	Auburn and Alton Coal Co.	....	.....	.....	10	13	6	628	264	364	7	....	112,554
	Lefton Coal Co.	....	.....	.....	....	....	....	.....	261	.....	7	....	111,025

[9]Shaw, E. W., and Savage, T. E., U. S. Geol. Survey, Geol. Atlas, Tallula-Springfield folio (No. 188), p. 11, 1913.

[10]Estimated.

Coal No. 6

DISTRIBUTION AND THICKNESS

Coal No. 6 in Sangamon County is best known in the southeastern part. It is mined extensively along the Chicago and Alton, Illinois Central, and Illinois Traction lines. East of the mines several holes have been drilled near the Christian County boundary. West of the Chicago and Alton R. R. only local mining has been carried on, and the position and character of the coal are not well known.

The hole in the NE. ¼ SW. ¼ sec. 7, T. 13 N., R. 7 W., drilled for the Waverly Coal Mining and Prospecting Company is the only one available for study in the southwest corner of the county. At this place coal No. 6 lies 150 feet below the surface and is somewhat thinner than to the east in the principal mining area. Data are not sufficient to locate the line between thin and thick coal southwest of Chatham.

Holes in the northeast parts of secs. 8 and 9, T. 13 N., R. 4 W. indicate that some irregular condition affects the coal locally since the bed is represented by only a small thickness in places; whereas other holes nearby show a regular thickness. It is not unlikely that where the coal is thin the drill has penetrated a roll in the roof similar to others in the mines of the county described under the subject "Roof and Floor of Coal No. 6." The average thickness of coal No. 6 in the mines where the bed is worked is 7 feet, and the drill holes in the southeast corner of the county are reported to have found an average of 8 feet for the same bed. No information is available for the area between Chatham and Mechanicsburg. In the shaft at the latter place coal No. 6 was mined formerly but its thickness was extremely irregular and the bed was abandoned when a commercial thickness of coal No. 5 was found 27 feet lower. From a thickness of 6 feet at the shaft coal No. 6 thins to 2 inches in a distance of 800 feet. The mine appears to be at the north line of workable coal No. 6.

In common with other beds in this part of the State, the coal shows a gentle dip in a direction slightly south of east. In sec. 7, T. 13 N., R. 7 W., the coal lies at an altitude of 530 feet, while at the southeast corner of the county it is only 260 feet above sea level, showing a dip of 13 feet per mile. No important irregularities are known.

PHYSICAL CHARACTER OF THE COAL

At Divernon coal No. 6 ranges in thickness from 7 to 10 feet, the top bench averaging about 12 inches. Figure 44 shows the physical character of coal No. 6 in some of the Sangamon County mines.

The "blue band" is a little more than 2 feet above the floor. The following section was measured by K. D. White at the face of the 7th north off the west entry, Madison Coal Corporation, mine No. 6. The coal at this place is unusually soft and the cleavage planes are poorly developed.

Section of coal No. 6, Madison Coal Corporation, mine No. 6, face 7, north entry off main west

	Ft.	*In.*
Top coal, bright, texture woody, soft, blocky	1	----
Middle bench, breaks into small pieces on shooting. Numerous charcoal, sulphur, and bone streaks	4	9
"Blue band," carbonaceous shale	----	1½
Bottom coal, bands of "jack" in lower part	2	7
	8	5½

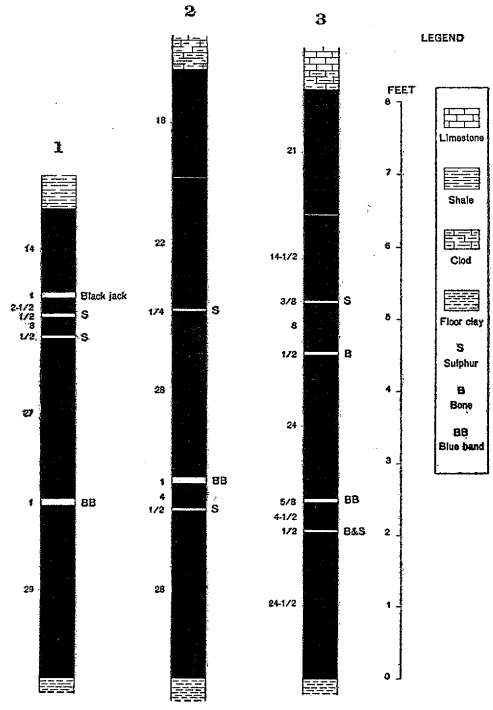

FIG. 44.—Graphic sections of coal No. 6 made from measurements in mines of Sangamon County.

1. Chicago, Wilmington and Vermilion Coal Co., Thayer. Face 4th W., off southeast entry.

2. Black Diamond Coal Co., Auburn. 7th N. off main west, 2500 feet from shaft.

3. Madison Coal Corporation, No. 6, Divernon. Cross-cut on 5th NW., 375 feet north of 6th west.

At the Auburn mine of the Black Diamond Coal company the top coal is left in place where the roof consists of black shale. At this mine the coal is said to vary in thickness from 4½ feet to 11 feet. The contact of the roof and the coal is irregular, due probably to the unevenness of the surface of the vegetal matter at the time the roof material was deposited.

ROOF AND FLOOR OF COAL NO. 6

The normal black shale-limestone roof of the Belleville district is typically developed in the mines of southern Sangamon County. The shale is extremely irregular in thickness being absent in some places and as much as 8 feet thick in others. Ordinarily where it is only a few inches thick it is necessary to leave the top coal in place in order to prevent the shale from falling. At Divernon 1 to 6 inches of clod underlies the black shale. A considerable area in the mine is affected by a depression in the coal which decreases the thickness of the bed to about one-half its normal amount. The depression extends north-

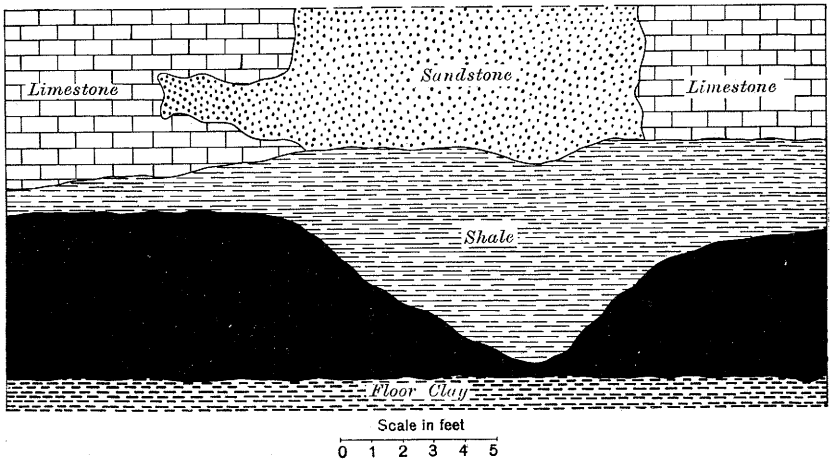

FIG. 45.—Roll, Madison Coal Corporation, mine No. 6, Divernon. (4th west, 7th north, west entry.)

east-southwest and has been traced about 900 feet. At the time of examination it was typically exposed in room 2, 4th west entry, 7th north, on the west side of the mine. In the depression, clod and limestone form the roof, the latter material being nodular, clayey, and full of concretions that fall easily and render the roof unsafe. In the area thus affected the coal is noticeably impure. Figure 45 shows a sandstone lens in the roof limestone and a roll cutting the coal down to a thickness of only 1 foot. The sandstone may occupy its present

position as the result of filling an erosion cavity or a cavity formed by solution of the limestone by acid waters as is often the case.

It is apparent that some erosion affected the black shale after deposition. In the Black Diamond mine very irregular contacts are noted between the cap rock and the shale as shown in figure 46.

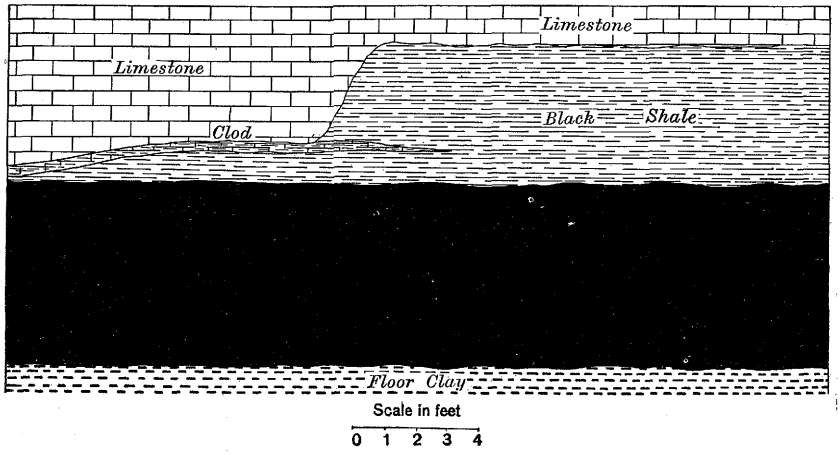

FIG. 46.—Irregular contact between cap rock and shale, Black Diamond Coal Co., Auburn.

The normal limestone roof is a dark gray, noncrystalline rock having well-developed cleavage planes. In this condition it is strong and forms an excellent roof. However, in places it is nodular, contains clay and niggerheads, and falls easily. At the face of the main south entry on the east side of this mine, limestone-shale and shale-coal contacts are very irregular. At this place the coal shows many small "slip" planes and is impure. See figure 47.

At the Thayer mine of the Chicago, Wilmington and Vermilion Coal Company, the normal roof is present except in one or two places where the black shale is only 6 inches thick and is overlain by 3 or 4 feet of light gray or yellow, sandy shale. From 4 to 8 inches of top coal is left ordinarily but is generally taken down after the rooms are mined out.

At the Victor mine of the Illinois Midland Coal Company a roll 100 feet wide intersects the workings in the shape of a horseshoe, the toe of the shoe pointing toward the shaft from the south. At its widest part it measures approximately 2000 feet. Where the roll is effective, the coal is only 4 feet thick.

As a rule the floor clay in the county is thin. At Divernon the upper 6 feet is a white clay which grades downward into a harder, greenish-blue shale. The clay slakes on exposure and heaves readily.

A layer of boulders lies 5 feet below the floor. At the Black Diamond mine the clay averages 2½ feet in thickness. It slakes in the air and heaves readily when wet.

Other Coals

In the area underlain by coal No. 6 in Sangamon County very little drilling has been done to determine the position of and character of the lower coals. Through the kindness of Mr. A. J. Moorshead, General Manager, Madison Coal Corporation, the Survey has been able to examine the log of the company's shaft No. 6 at Divernon.

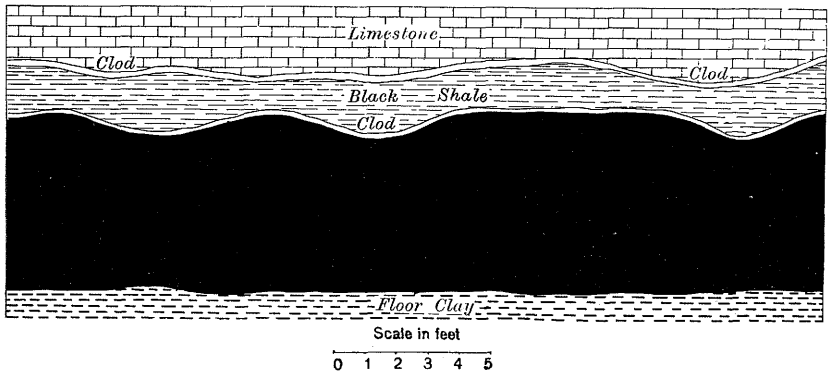

FIG. 47.—Irregular contact between limestone, shale, and coal, Black Diamond Coal Co., Auburn. (Face main south, east side.)

This shaft was sunk to a depth of 604 feet or 274 feet below the "blue-band" coal. In this distance 7 coals ranging in thickness from 1 foot to 4½ feet were penetrated. Coal No. 5, 46 feet below coal No. 6, is 2 feet 11 inches thick, half of its thickness in the vicinity of Springfield. A 2-foot 2-inch bed was found 61 feet below coal No. 5. At intervals of 30, 60, and 82 feet below the last bed mentioned are coals having the respective thicknesses of 13, 14, and 20 inches. A 4-foot 5-inch bed which probably represents the Murphysboro (No. 2) coal was penetrated 235 feet below coal No. 6.

The beds regarded as most favorable for future operations are coals No. 2 and No. 5. The former is doubtless developed over most of the county, and its thickness wherever it has been found in District VII is sufficient to strengthen the belief that it will be economically important at some future time.

In the northern part of Christian County coals No. 5 and No. 6 are of about the same thickness, and in many places it is almost impossible to distinguish one from the other in drill-hole logs. It is

believed that the same conditions will be found in Sangamon County when deeper drilling is carried on in Tps. 14 and 15 N., especially in the eastern side of the county. At this time it is impossible to outline the workable area of coal No. 5 with any degree of accuracy. In the townships mentioned, however, it is almost certain that coal No. 5 will be developed to a much greater degree than at present.

The thin coals mentioned cannot be correlated at present. Locally one or another of them may be developed to workable thickness, but it is regarded doubtful that they will ever be extensively operated.

SUMMARY OF COAL RESOURCES

In the following summary of coal resources, attention has been confined to coal No. 6 because most of the information available relates to this bed. Furthermore, comparatively little is known regarding the lower coals in District VII, and estimates regarding them would necessarily be extremely unreliable.

In the calculations represented in the figures a tracing of the map, Plate I, was used. All of the information regarding the coal was placed by the side of the symbols representing drill holes and mines, and it was then possible to outline areas underlain by coal No. 6 and to determine its average thickness in a given area. Areal measurements were made with the planimeter, and computations were based on an average specific gravity of 1.3, or an average of 1770 tons of coal per foot per acre. Figures on coal production were taken from the reports of the Bureau of Labor Statistics and those of the Mining Board.

TABLE 18.—*Summary of coal resources (coal No. 6) in District VII.*

County	Area	Average thickness		Original tonnage	Amount mined 1881-1913 inclusive	Amount rendered unminable	Total amount mined and rendered unminable	Amount remaining in ground, end of 1913
	Sq. mi.	*Ft.*	*In.*		*Tons*	*Tons*	*Tons*	*Tons*
Bond	270	7	....	2,140,992,000				
	68.67	5	....	388,946,880				
	30.78	3	4	116,225,280				
				2,646,164,160	3,160,126	2,585,558	5,745,684	2,640,418,476
Christian	163	7	....	1,292,524,800				
	132	5	11	884,766,643				
	84	7	6	713,664,000				
	70	7	....	555,072,000				
	81	4	....	367,027,200				
				3,813,054,643	21,654,626	17,717,421	39,372,047	3,773,682,596
Clinton	34.83	3	....	118,366,272				
	101.61	6	10	786,504,172				
	96.57	4	....	437,577,984				
	265.14	7	....	2,102,454,144				
				3,326,536,300	16,032,809	13,117,752	29,150,561	3,297,385,739
Macoupin	430.92	7	....	3,417,023,232				
	434.97	4	....	1,970,936,064				
				5,387,959,296	73,459,119	60,102,915	133,562,034	5,254,397,262

TABLE 18.—*Continued*

County	Area	Average thickness		Original tonnage	Amount mined 1881-1913 inclusive	Amount rendered unminable	Total amount mined and rendered unminable	Amount remaining in ground, end of 1913
	Sq. mi.	*Ft.*	*In.*		*Tons*	*Tons*	*Tons*	*Tons*
Madison	500	6	5	3,634,588,800	56,005,118	45,822,369	101,827,487	3,532,761,313
Fayette	176.4	6	6	1,298,868,480				
	564.75	4	....	2,558,995,200				
				3,857,863,680				3,857,863,680
Marion	450	4	....	2,039,040,000				
	139.5	6	....	948,153,600				
				2,987,193,600	20,228,469	16,550,565	36,779,034	2,950,414,566
Montgomery	113	8	....	1,024,051,200				
	322	7	6	2,735,712,000				
				3,759,763,200	16,902,790	13,829,555	30,732,345	3,729,030,855
Perry	599	6	....	4,071,283,200				
	95	8	....	860,928,000				
				4,932,211,200	26,918,284	22,024,050	48,942,334	4,883,268,866
Randolph	111.6	6	....	758,522,880	13,618,584	11,142,478	24,761,062	733,761,818
St. Clair	436	6	9	3,333,830,400	77,532,658	63,435,811	140,968,469	3,192,861,931

TABLE 18.—*Concluded*

County	Area	Average thickness		Original tonnage	Amount mined 1881-1913 inclusive	Amount rendered unminable	Total amount mined and rendered unminable	Amount remaining in ground, end of 1913
	Sq. mi.	*Ft.*	*In.*		*Tons*	*Tons*	*Tons*	*Tons*
Washington	491	5	....	2,781,024,000	1,829,468	1,496,837	3,326,305	2,777,697,695
Sangamon	244	7	....	1,934,822,400				
	72	4	....	326,246,400				
				2,261,068,800	18,630,275	15,242,952	33,873,227	2,227,195,573
Shelby	311	6	6	2,289,955,200				
	90	5	....	509,760,000				
				2,799,715,200	1,133,796	927,651	2,061,447	2,797,653,753
Grand Total	6,978.14			46,279,496,159	347,106,122	283,995,914	631,102,036	45,648,394,123

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