STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION
DIVISION OF THE
STATE GEOLOGICAL SURVEY
FRANK W. DE WOLF, Chief

Cooperative Mining Series
BULLETIN 26

COAL RESOURCES OF DISTRICT IV

BY

GILBERT H. CADY

ILLINOIS MINING INVESTIGATIONS

Prepared under a cooperative agreement between the Illinois State Geologica 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
1921

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 agent 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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STATE GEOLOGICAL SURVEY
FRANK W. DeWOLF, *Chief*

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By Gilbert H. Cady

PART I.—GEOLOGIC RELATIONS IN DISTRICT IV

INTRODUCTION

Importance of the Area

District IV of the Illinois Cooperative Investigations (Fig. 1) includes that part of the central portion of the State in which the coal production is from the No. 5 or Springfield bed. Within the district lie those counties having a large production from No. 5 coal, namely, all of Peoria County, a large part of Fulton County, and the part of Sangamon County north of Chatham; and in addition other counties or parts of counties which produce smaller amounts, or are at least underlain by this coal, namely, Cass, Christian, Dewitt, Knox, Logan, McLean, Macon, Mason, Menard, and Tazewell. From the entire district in the year ending June 30, 1920, over 11 million tons were produced from the No. 5 bed. Among the districts of the Cooperative Investigations this one ranks third in order of production. In area it ranks second, and in amount of workable coal present possibly first. The quantity produced since 1881 approximates 140 million tons from No. 5 coal, a tonnage which represents only a small per cent of the coal originally present in the area.

The present report is one of a series on the geology of the coal-bearing rocks and on the coal resources of Illinois. The coal field has been subdivided into districts for convenience, study, and description, the basis for the subdivision being stated in the preliminary bulletin[1] of the series. The outlines of the various districts are indicated on the accompanying sketch map (Fig. 1).

Acknowledgments

As has been the case with earlier reports in the series, this bulletin represents compilation of material secured from various sources.

[1]Preliminary Bulletin Illinois Coal Mining Investigations, p. 12, 1913.

FIG. 1.—Map showing extent of District IV and an adjacent area covered in the report.

Reports on the three important coal-mining areas in the district, namely those in Fulton, Peoria, and Sangamon counties, have already been published and another is in manuscript form.[1]

Acknowledgment is herewith made of a large use of the material presented in these reports, considerable parts of which are directly quoted. Of special assistance have been the field notes of members of the Investigations, especially those of K. D. White and F. H. Kay. The miscellaneous notes of J. A. Udden, F. F. Grout, W. F. Wheeler, Thomas Moses, T. E. Savage, and others have also been of great assistance.

The availability of drill and shaft records and the information collected in the mines is due to the courtesy of the operators and miners in the district. Grateful acknowledgment is made of the Survey's indebtedness to the kindness and generosity of those in a position to give information necessary for its work in connection with the coal mining industry in this and other districts.

GEOGRAPHY

TOPOGRAPHY AND GLACIAL DRIFT

District IV is an area of undulating plain which slopes toward the valley of the Illinois. Much of the area is monotonously level, the Illinois valley being the single important interruption in the continuity of the plain. This valley has a depth of about 200 to 250 feet between Peoria and Chillicothe.

The surface of central Illinois is essentially as left by the last retreating glacier, deposits from which filled up and obliterated all surface indications of valleys and other irregularities which existed in the rock surface prior to glacial time. Within certain lobate belts 2 to 10 miles in width which mark stationary positions of the ice front for long periods, thicker amounts of material accumulated in ridges known as glacial moraines that rise 100 feet or more above the adjacent bordering plains and that are rolling and irregular in profile. The "drift," as the material left by the ice is called, is commonly thicker beneath

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

Udden, J. A. Geology and mineral resources of the Peoria quadrangle, Illinois: U. S. Geol. Survey Bull. 506, 1912.

Savage, T. E., Geology and mineral resources of the Springfield quadrangle: Illinois State Survey Bull. 20, p. 97, 1915.

Savage, T. E., Geologic structure of the Canton and Avon quadrangles: Ill. State Geol. Survey Bull. 33, p. 91, 1916.

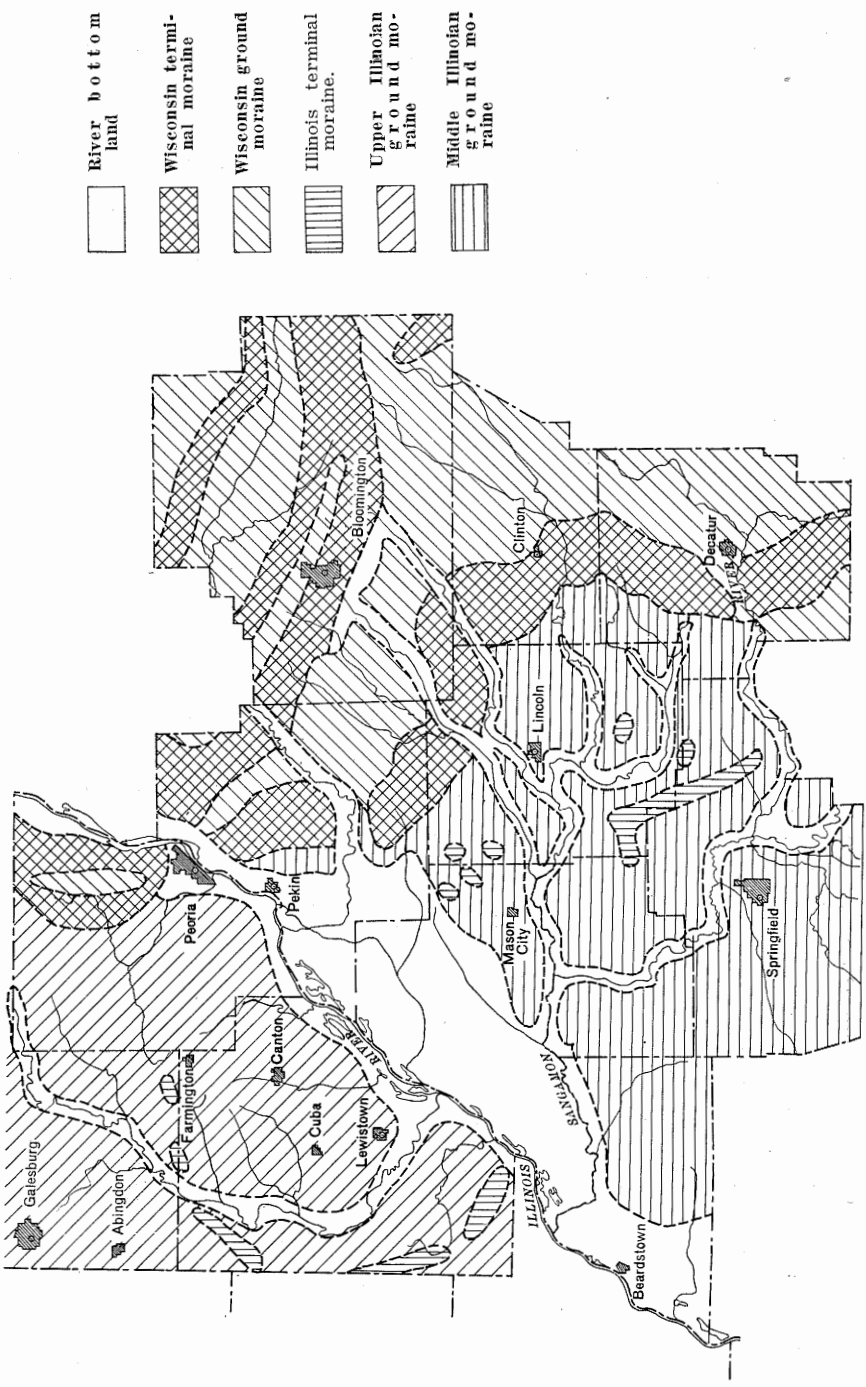

FIG. 2.—Map showing position of the glacial moraines in District IV.

the moraine than beneath the plains, and the height and position of the moraine seems not to be controlled by the relief of the bed rock.

Students of glacial geology in Illinois have mapped two moraines crossing District IV east of the Illinois (Fig. 2), the two uniting north of Peoria and running as a single ridge of thick drift parallel to and west of the Illinois valley through northeastern Peoria County and western Marshall County, to and beyond the boundary of the district. East of the Illinois, one ridge, known as the Shelbyville moraine, swings in lobate curves southward through central Tazewell, eastward through northeast Logan, south through eastern Dewitt and central Macon counties into Shelby County. Clinton, Decatur, and Shelbyville are located on or near this moraine, as are also the villages of Macon, Harristown, Warrensburg, Hallsville, Waynesville, Atlanta, and Delavan. Throughout much of its course the moraine rises ordinarily 75 to 100 feet above the plain and stands out in bold relief when viewed from the south or outer border. "From the north the relief is less noticeable, and is more pronounced for a few miles north and south of the Illinois River than elsewhere in its course, but even there scarcely exceeds 75 feet."[1] The moraine has a breadth of several miles, averaging six to eight, but in places as much as twelve.

The relief of the Shelbyville moraine is a rough indication of the increase in thickness of the drift along the ridge as compared with its thickness on the plains within and without the moraine. In other words, along these ridges a greater thickness of unconsolidated surface material must be penetrated in drilling or shaft sinking than off the ridges. The following table shows the depth to the rock at a number of places along the Shelbyville moraine.

Thickness of drift along the Shelbyville moraine

	Feet
Findlay	168
Windsor, Shelby County, more than	127
Macon	170
Decatur	140
Maroa	273
Clinton	352, 261
Atlanta, more than	200
Delavan, more than	300

The foregoing figures may well be compared with the following, which show the drift to be much thinner at certain places south and west of the moraine.

[1]Leverett, Frank, The Illinois glacial lobe: U. S. Geological Survey Monograph 38, p. 194, 1899.

Thickness of drift south and west of the Shelbyville moraine

	Feet
Shelbyville	27
Tower Hill	31
Blue Mound	75
Niantic	82

The northern morainic belt extending from Peoria through McLean County is known as the Bloomington moraine. Its relief on the southern border seldom falls below 50 feet; the average relief is probably 75 or 100 feet. In Tazewell County the surface south of the moraine varies in altitude from 650 to 725 feet, whereas the crest of the moraine has an altitude varying from 700 to 825 feet above sea level. In McLean County the outer border varies in altitude from 700 to 820 feet and the crest from 775 to 913 feet above sea level.

Along the Bloomington moraine as along the Shelbyville ridge, the drift is much thicker than in the bordering plains. In one shaft at Bloomington 254 feet of drift were encountered and 358 feet in another. Some of this difference is no doubt due to irregularity in the bed-rock surface. At Saybrook a drilling passed through 247 feet of drift and at Washington in Tazewell County 335 feet.

East and north of the moraine in Woodford County at Eureka the drift is 151 feet in thickness. In general, it is believed to be thinner than along the ridge, by an amount just about equivalent to the relief of the moraine. At the position of preglacial depressions or valleys, the distribution and direction of which are independent of the position of the moraines, the drift is always exceptionally thick, in the plain as well as along the moraine.

The thickness of glacial material has an important bearing on mining operations because shaft sinking is commonly more difficult through unconsolidated material of glacial origin than through rock. Especially is this true if the drift is thick and made up in part of beds of water-bearing gravel, as is commonly the case. For instance, in a drilling near Washington in Tazewell County, the lower 128 feet of the 335 feet of drift present is described as sand, quicksand, and gravel. The possibility that a considerable amount of such material may be present makes it very important to determine the character of the drift to the rock, before locating a shaft near or in one of the morainic belts. A definite knowledge of the position and trend of the various large preglacial valleys would be of much practical value, as where these exist the drift is commonly made up of a larger proportion of loose, water-bearing material than it is elsewhere. Unfortunately this information is not available except for small areas in the district where detailed field examinations have been made.

TRANSPORTATION AND MARKETS

Except as the relief of the country reflects changes in the character and thickness of the drift or other surface material, physiographic factors in Illinois exercise little control over the coal industry. To a certain extent, however, the Illinois valley is a barrier separating the coal lands in Schuyler, Fulton, Peoria, and Knox counties from those east of the river. As a result the market for coals west of the river has been more largely to the west than is the case with coals east of the river. Within each part of the district communication is easy and railroads numerous. The western portion is, however, less fortunate than the eastern because it is served by fewer railroads, is more dissected by streams, and is not everywhere so readily accessible. In general, however, the district is in close touch by railroad with Chicago, St. Louis, and the markets of the northwest.

The importance to the coal industry of Illinois River as a means of river transportation for the district may well be pointed out. The coal mines of Peoria and Tazewell counties are especially accessible to barge traffic and it is not improbable that with improvement Sangamon River could be made suitable for water transportation as far upstream as Petersburg, Menard County, and possibly even to Springfield. It is possible likewise that Spoon River could be used in the same way for some distance above its mouth. This is a transportation resource of great potential usefulness which at present is almost entirely neglected, as only one mine in the area, namely that at Lancaster Landing is equipped with facilities for barge loading.

TOWNS

Several important cities and many smaller towns and villages lie within the area. Springfield, Peoria, Bloomington, Decatur, Clinton, Canton, Lincoln, and Pekin are the larger cities of the district. In each of these communities except Clinton the coal-mining industry has been an agent contributory to its growth.

USE OF DRILL RECORDS

Exploration work with the drill has been carried on much less extensively in this district than in other districts of the State with the exception of District III to the west. It is important, therefore, that the Survey be furnished with the results of all new drilling in this district; especially is this true in Menard, Logan, and Dewitt counties, where there has been so little drilling that the stratigraphic succession remains in considerable doubt. Records of drilling should be supplied so far as possible, and the examination by members of

the Survey of churn-drill cuttings and diamond-drill cores is highly desirable. Upon request cloth sacks in which cuttings can be saved, will be furnished drillers or operators using the churn-drill in exploration work. After 40 or 50 of the sacks have been filled they may be forwarded to the State Geological Survey, Urbana, by express collect. It is highly desirable that operators arrange for such study as outlined in connection with contemplated drilling operations. Drill cores are the best means of studying the formations in a drift-covered area of flat-lying rocks like Illinois, and through the cooperation of operators it has been possible for the Survey to obtain such cores from a number of places in the State for examination in this office. One core has been furnished from this district, coming from a well located just south of Springfield, and it is hoped that opportunities will arise of obtaining others at various localities in this district. Upon request the Survey will furnish boxes suitable for the shipment of diamond-drill cores.

ROCK FORMATIONS OF DISTRICT IV

Coal-bearing Rocks

GENERAL DESCRIPTION

The coal-bearing strata in Illinois belong, with unimportant exceptions, to what is known as the Pennsylvanian system of strata, so called because the system is very completely represented by the coal-bearing strata of that State. This system is also commonly called the "Coal Measures," a name which will be used frequently in this report. The Pennsylvanian strata are underlain by strata of various ages; in the southern part of the district by rocks of Mississippian age, the next preceding system; and in the northern part of the coal basin by rocks of still older systems, specifically of Devonian and Silurian age. These relationships are shown in figure 3. In District IV the northern boundary of the Mississippian rocks below the "Coal Measures" runs east and west, north of Peoria and Bloomington, and Devonian or possibly Niagaran strata underlie the Pennsylvanian rocks north of the Mississippian boundary to some distance north of the boundary of the district. The Pennsylvanian system is overlain by the unconsolidated clays, sands, and gravels which constitute the glacial drift, as explained in an earlier section of the bulletin, or by river deposits. Without this covering the coal-bearing beds would form the surface material for the entire area considered in this report.

The strata of the Pennsylvanian or 'Coal Measures" system consist of shales and sandstones, and minor amounts of limestone, clay, and coal. The system thickens gradually toward the southeast part of the State, where it attains a thickness of about 2,000 feet. In this district the greatest known thickness of the "Coal Measures" is along its south boundary in Macon County, where the base of the Pennsylvanian lies at a depth of about 1,100 feet, with drift of variable thickness up to about 200 feet at the surface. In the western part of the district the Pennsylvanian or "Coal Measures" strata have a thickness of only about 200 feet or less, the thinning being largely due to the gradual rising of the strata in that direction, the upper beds being planed off or truncated by erosion. In the northern part of the area the base of the Pennsylvanian rocks lies at a depth of between 300 and 600 feet, depending upon the altitude of the surface.

Shales comprise the greater part of the strata and vary, on the one hand, through sandy shales to sandstones, and on the other,

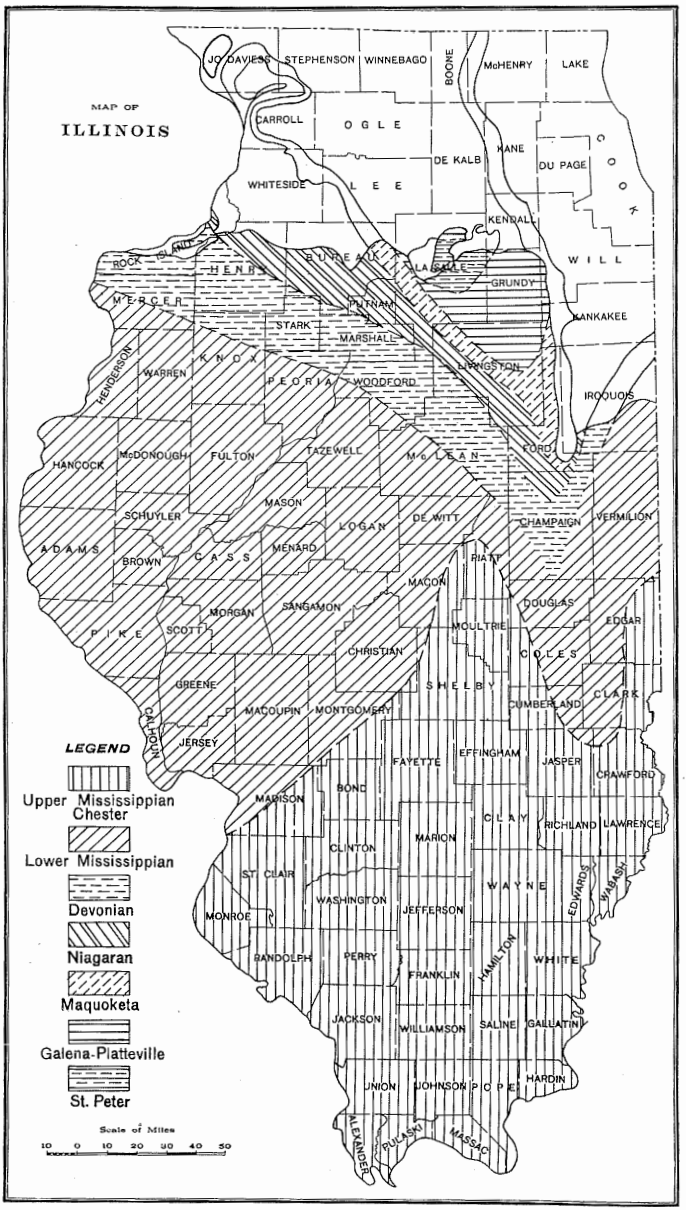

FIG. 3.—Map showing the areal geology of the surface upon which the Pennsylvanian strata were deposited.

(Preliminary)

through limy shales to limestones. A commonly occurring grayish, fine-grained, well-laminated shale, which is very slippery when wet is called "soapstone" by the miners. Hard gray shale with well-developed laminae goes under the name of "slate," especially if its color is dark or black. Shale containing a considerable amount of limestone distributed irregularly may receive the name "lime shell" or simply "shell" from the miner or driller. "Niggerheads" are concretionary masses of lime and iron pyrites or lime alone, having more or less concentric structure, which are found in some of the "Coal Measures" strata. Such concretionary nodules or masses are commonly found in the roof shale of the No. 5 (Springfield) coal in this district.

Sandstones are prominent at several horizons in the Pennsylvanian. The system commonly terminates at the base in a coarse sandstone, especially in the western part of the district. Other sandstones are rather widespread about the middle of the system. These beds are generally lenticular in cross-section and some, especially in the vicinity of Peoria, seem to be in the nature of channel deposits of rather local distribution; accordingly, the sandstones cannot be identified with much certainty from drill hole to drill hole, particularly when the drilling is as scattered as it is in this district. The sandstones are commonly fine-grained and micaceous, with numerous fragments of coaly material embedded in them, which represent logs, branches, or pieces of wood which were buried in the sand.

The limestones, although constituting but a small part of the "Coal Measures," are nevertheless stratigraphically important, as they furnish a means of identifying strata with which they are associated. Several horizons have been identified and traced over a large part of this and adjoining areas. One of these is the cap rock of No. 6 coal which is commonly found less than 30 feet above the coal. In a few places this limestone is reported to rest directly upon the coal, but most commonly it is separated from the coal by a few feet of shale. A limestone known as the Lonsdale in the Peoria district and as the Rock Creek in the Springfield district seems to be widespread in District IV. This limestone is found about 100 feet above No. 6 coal in Peoria County and about 75 feet above the coal in the Springfield area. It has been traced west into Fulton County, north into Bureau County, and northeast into Livingston and LaSalle counties. In the southern part of the district two limestones are found in the interval lying between 200 and 300 feet above No. 6 coal. The lower is known as the Carlinville and the upper as the Shoal Creek limestone. Where only one of these limestones is recorded by the driller it is not always

possible to determine which one is present. In the Springfield region a limestone known as the Crows Mill limestone, found about 230 feet above No. 6 coal, may correspond either to the Carlinville or to the Shoal Creek limestone. The New Haven limestone, which lies about 500 feet above No. 6 coal, and is of rather wide distribution in the southern half of the coal basin, is not known to underlie any of this district except possibly southern Macon and northern Christian counties.

Fire clays are normally associated with coal beds. Fire clays at or near the top of the Pottsville formation have some economic importance in the western counties of this district, chiefly in Schuyler and Fulton counties, but these clays are of still greater importance west of the district.

DIVISIONS OF PENNSYLVANIAN SYSTEM

For convenience of study, the coal-bearing beds of Illinois have been separated into the following divisions, each of which is called a formation. The formations are numbered in the order of age and deposition:

3. McLeansboro
2. Carbondale
1. Pottsville

POTTSVILLE FORMATION

GENERAL DESCRIPTION

The Pottsville formation, the oldest division of the "Coal Measures" rocks, consists of a succession of sandstones, shales, and thin coals, all of which lie below No. 2 coal. The beds were deposited upon an old land surface and consequently are variable in thickness and character. Furthermore, these deposits were apparently made in a rising sea, in a relatively shallow basin, so that the upper beds of the formation are more widespread than the lower, and the formation becomes thinner toward the border of the coal field.

Information concerning the Pottsville in this district is based upon exposures in Schuyler and Fulton counties and a few drillings in Fulton, Peoria, Sangamon, Logan, Macon, and McLean counties. The log of one of these drill holes, located half a mile southwest of Springfield in the S.E. ¼ sec. 5, T. 15 N., R. 5 W., supplies the most reliable section of the Pottsville formation in the Survey files. The drillers' record of this hole, together with the core, was turned over

to the Survey. The log, verified and revised from the core by T. E. Savage, is given below and is shown graphically on Plate II:

Log of boring half a mile southwest of Springfield, in the S. E. ¼ sec. 5, T. 15 N., R 5 W.[1]

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Quaternary system				
Pleistocene and Recent—				
Clay and gravel	34	....	34	....
Pennsylvanian system—				
McLeansboro formation—				
Coal (No. 8)	1	6	35	6
Clay shale	4	....	39	6
Shale, fine, gray, micaceous, sandy	5	....	44	6
Sandstone, fine grained, gray	5	6	50	....
Shale, sandy, micaceous	15	....	65	....
Shale, fine, sandy, micaceous, with many dark carbonaceous spots	45	....	110	....
Shale, dark	....	3	110	3
Shale, bluish, micaceous	17	4	127	7
Shale, dark bluish, fossiliferous	2	....	129	7
Shale, dark blue	3	3	132	10
Shale, black, coaly (No. 7 coal)	....	2	133	....
Clay shale, light gray	10	5	143	5
Shale, gray, with red bands and blotches	6	5	149	10
Limestone, gray argillaceous	1	4	151	2
Shale, gray	4	10	156	....
Shale, dark	5	....	161	....
Shale, yellowish, calcareous	4	11	165	11
Limestone with *Fusulina*, *Reticularia*, *Seminula*, and *Productus semireticulatus*	6	9	172	8
Shale, blue to gray	3	....	175	8
Carbondale formation—				
Coal, Herrin (No. 6)	....	6	176	2
Shale, bluish gray	4	....	180	2
Shale, light gray	1	10	182	....
Shale, gray, calcareous	3	3	185	3
Shale, gray	24	....	209	3
Limestone, gray, shaly	....	10	210	1

[1]U. S. Geol. Survey Folio 188, p. 2, 1913.

Log of boring half a mile southwest of Springfield—Continued

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Shale, black, fissile, with *Orbiculoidea* and other fossils	4	6	214	7
Shale, black, shelly, pyritiferous	....	6	215	1
Coal, Springfield (No. 5)	6	4	221	5
Shale, gray (fire clay)	6	8	228	1
Shale, bluish	6	....	234	1
Shale, black	3	4	237	5
Shale, gray	3	8	240	1
Shale, grayish blue to yellow	35	2	275	3
Coal (No. 4)	2	8	277	11
Shale, gray, impure (fire clay)	1	....	278	11
Shale, black, carbonaceous	....	8	279	7
Shale, dark	20	5	300	....
Shale, blue	31	....	331	....
Shale, black	2	....	333	....
Coal (No. 3)	1	6	334	6
Shale, clay	12	6	347	....
Shale, bluish gray	15	....	362	....
Shale, black	1	4	363	4
Coal	....	3	363	7
Shale, blue	2	5	366	....
Shale, sandy, micaceous	5	6	371	6
Shale, bluish	5	....	376	6
Shale, gray	2	....	378	6
Sandstone, shaly, micaceous	11	6	390	....
Shale, bluish	1	....	391	....
Sandstone, coarse grained, micaceous	9	....	400	....
Shale, dark, micaceous	7	....	407	....
Clay shale	1	....	408	....
Shale, brown, with hard bands	5	....	413	....
Coal	1	3	414	3
Dark shale — Coal (Murphysboro or No. 2)	3	11	418	2
Coal	....	10	419	....
Pottsville formation—				
Shale, blue	8	....	427	....
Shale, dark	10	....	437	....
Clay shale	2	....	439	....
Shale, dark gray	12	2	451	2
Coal	1	4	452	6
Shale, dark gray	6	6	459	....
Shale, black	4	....	463	....
Shale, gray	6	....	469	....
Shale, black	5	6	474	6
Shale, light gray	1	6	476	....
Shale, dark, slickensided	....	6	476	6

Log of boring half a mile southwest of Springfield—Continued

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Shale, light	3	6	480	....
Shale, dark	49	....	529	....
Shale, sandy	15	4	544	4
Shale, light blue	1	....	545	4
Shale, dark blue	1	....	546	4
Shale, light, clayey	7	....	553	4
Shale, black	1	....	554	4
Coal (No. 1?)	....	10	555	2
Shale, black	24	10	580	....
Sandstone, coarse, carbonaceous, in places micaceous	13	....	593	....
Sandstone	1	....	594	....
Shale, dark	27	....	621	....
Shale, light	4	....	625	....
Shale, black	2	4	627	4
Shale, conglomeratic, carbonaceous, and gray sandstone	23	2	650	6
Shale, dark	6	....	656	6
Shale, conglomeratic, dark, and sandstone interlaminated	4	10	661	4
Sandstone, coarse, brown to gray	36	2	697	6
Mississippian system—				
St. Louis and Spergen limestones—				
Limestone	12	6	710	....
Shale, hard, light colored	2	....	712	....
Limestone, light gray, argillaceous, somewhat conglomeratic	11	....	723	....
Limestone, argillaceous	11	....	734	....
Limestone, impure, argillaceous	26	....	760	....
Shale, gray, in places calcareous and somewhat conglomeratic	15	....	775	....
Limestone, gray	7	....	782	....
Shale, bluish, variable and somewhat calcareous	10	....	792	....
Limestone, impure, gray, in places with argillaceous bands	16	....	808	....
Limestone, gray	20	....	828	....
Limestone, arenaceous	14	....	842	....
Limestone, dark, sandy	8	....	850	....
Shale, impure	2	....	852	....
Shale, calcareous	9	....	861	....
Limestone, impure, shaly, and in places sandy	35	....	896	....
Limestone, white	5	....	901	....
Limestone, sandy or shaly	12	....	913	....

Log of boring half a mile southwest of Springfield—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Warsaw and Keokuk formations—				
Shale, calcareous	14	....	927	....
Shale, blue	5	6	932	6
Shale, sandy	3	4	935	10
Shale, blue	2	2	938	....
Shale, dark	4	....	942	....
Limestone	1	....	943	....
Shale, gray	12	....	955	...
Shale, blue	6	....	961	...
Shale, sandy	3	....	964	....
Sandstone	1	....	965	....
Shale, sandy	2	3	967	3
Sandstone	3	9	971	....
Shale, sandy	14	6	985	6
Shale, bluish gray	19	6	1005	....
Shale, hard, gray	15	....	1020	....
Shale, hard, bluish gray	33	4	1053	4
Limestone, oolitic	3	8	1057	....
Shale, blue	6	....	1063	....
Shale, blue, with limestone bands	14	....	1077	....
Burlington limestone—				
Limestone, hard, with chert bands	4	....	1081	....
Limestone, hard, gray	20	....	1101	....
Limestone	9	....	1110	....
Limestone, broken, cherty	15	....	1125	....
Limestone, cherty	7	....	1132	....
Chert	10	6	1142	6
Limestone, cherty, with *Spirifer grimesi* and other fossils	16	....	1158	6
Chert, with some limestone	9	....	1167	6
Limestone, with some chert	16	....	1183	6
Kinderhook group—				
Limestone, reddish, shaly, in places cherty	43	6	1227	....
Limestone, gray, with chert bands	14	....	1241	....
Shale, greenish	11	....	1252	....
Shale, hard, greenish gray	34	....	1286	....
Shale, bluish gray, upper part with zones of fine-grained oolite	53	....	1339	....
Devonian system—				
Shale, black or very dark, with *Sporangites*, *Lingula*, etc., common	133	....	1472	....
Limestone, gray	28	....	1500	....

STRATA COMPRISING THE POTTSVILLE FORMATION

The rock at the base of the Pottsville formation is commonly a coarse-grained sandstone. Such a sandstone is present in the well near Springfield, as shown in the log reproduced above with a thickness of about 36 feet, with conglomerate shale beds above for a distance of 25 or 30 feet. Thirty feet of sandstone lie near the base of the Pennsylvanian in a well near Macon at a depth of about 1,020 feet. In the Peoria region the base of the Pennsylvanian seems to be argillaceous material reported as either soapstone or shale, a sandstone 10 feet in thickness being reported in one out of seven water wells.[1] Farther west in Fulton County where the Pottsville is relatively thin the basal member is commonly sandstone or sandy shale. Toward the northern part of the district and farther north in District I sandstone is not a conspicuous constituent of the Pottsville. It seems probable, therefore, that the basal sandstone member is limited in distribution to the western border of the district and to the central and southern portions with possibly a greater thickness to the southeast than elsewhere.

Other sandstones are not uncommon in the Pottsville formation east of the Illinois and probably, as in District VII, they are variable in character and distribution. Drillings are too few, however, to test this probability or to justify reliable generalizations concerning the details of the rock succession over much of the area. A sandstone or sandy shale is noted in several wells in the upper 90 feet of the formation above the horizon of No. 1 coal as noted below.

A few coals lie within the Pottsville. Locally one bed, known as No. 1 (Rock Island, or Seville) coal, is of workable thickness. This is one of the two important coals of District III to the west and is of workable thickness beneath at least part of Fulton County in this district. The coal is mined at Seville and Ellisville along Spoon River, where it occurs about midway in the Pottsville section, 35 to 55 feet below No. 2 coal. At Seville it is 3 to 4½ feet thick and at Ellisville 3 to 5½ feet. The character and distribution of No. 1 coal in Fulton and Peoria counties will receive attention in greater detail in later sections of the report, and in the bulletin describing the coal resources of District III.

In the Peoria region what is possibly No. 1 coal lies 130 feet

[1] Udden, J. A., Geology and mineral resources of the Peoria quadrangle: U. S. Geol. Survey Bull. 506, p. 13, 1912.

below No. 2 coal.[1] This coal was at one time mined in a shaft at Pottstown. Doctor Udden states in regard to it:

"It is in two benches, the lower one varying from 2 feet 2 inches to 3 feet in the Pottstown mine, and the upper measuring about 1 foot 3 inches. The two benches are separated by nearly 3 feet of shale. The average thickness of the coal and the included shale is 6 feet." [2]

At Peoria a thin, probably lenticular, coal lies at a still greater depth, about 80 to 104 feet, below No. 1 coal, or 20 feet above the base of the Pottsville formation at one locality. The Pottstown shafts and two water wells penetrated a thin coal about 40 feet above the horizon of No. 1 coal. Between this coal and No. 2 all exploration in the Peoria region shows considerable sandstone or sandy shale measuring from 70 to 80 feet in thickness.

In the Springfield region a 10-inch coal bed which lies about 142 feet above the base of the Pennsylvanian system and 140 feet below No. 2 coal, probably corresponds to the coal designated as No. 1 in the Peoria region. One boring, at least, indicates the presence of sandstone between No. 1 and No. 2 coals as in the Peoria region. A coal 12 to 16 inches thick is found in places in the Springfield region 35 to 40 feet below No. 2 coal.

Farther west a record of a diamond-drill boring at Blue Mound in Macon County reports several coals in the upper 130 feet of the Pottsville formation. The record of the boring at Blue Mound is reproduced herewith and is shown graphically on Plate II.

Record of a diamond-drill boring near Blue Mound, Macon County

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Quaternary system—				
Pleistocene and Recent—				
Clay and sand	18	....	18	....
Sand	5	....	23	....
Clay and coarse gravel	3	....	26	....
Clay and gravel cemented	5	....	31	....
Clay, blue	22	....	53	....
Clay and gravel, cemented	3	....	56	....
Clay and sand	14	....	70	....
Clay and gravel, cemented	3	....	73	....
Boulders and gravel	2	....	75	....

1Op. cit., p. 24.
2Op. cit., p. 25.

Record of a diamond-drill boring near Blue Mound—Continued

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Pennsylvanian system—				
McLeansboro—				
Clay and shale, soft	23	....	98	....
Clay, soft	1	....	99	....
Shale, black	1	....	100	....
Coal, bone	....	6	100	6
Clay and shale, soft	10	6	111	....
Sand shale	3	....	114	....
Limestone	5	....	119	....
Sandstone	6	....	125	....
Clay shale	9	....	134	....
Clay shale	20	....	154	....
Clay shale	9	....	163	....
Clay shale with hard bands	22	....	185	....
Clay shale	6	....	191	....
Limestone (Carlinville?)	9	....	200	....
Clay shale, blue	1	....	201	....
Shale, black	4	....	205	....
Shale, dark blue	7	10	212	10
Bone	....	2	213	....
Fire clay	5	....	218	....
Limestone, bastard	7	....	225	....
Clay shale, blue	7	....	232	....
Limestone	1	....	233	....
Clay shale, light	6	....	239	....
Sand and limestone mixed with shale	5	....	244	....
Shale, sandy	11	....	255	....
Shale, sandy	5	....	260	....
Sand shale	8	....	268	....
Sand shale	7	....	275	....
Clay shale	16	....	291	....
Clay shale	10	....	301	....
Shale, black	1	....	302	....
Coal	....	6	302	6
Fire clay	1	6	304	....
Shale, clay	9	....	313	....
Clay shale with hard bands	17	....	330	....
Clay shale with hard bands	22	....	350	....
Clay shale, black	15	....	365	....
Clay shale, soft, will cave	12	....	377	....
"Soapstone," soft, red	5	....	382	....
"Soapstone," soft, red	3	....	385	....
Limestone	4	....	389	....
Clay shale	6	....	395	....
Clay shale	14	....	409	....

Record of a diamond-drill boring near Blue Mound—Continued

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Clay shale	6	....	415	....
Clay shale	4	....	419	....
Clay shale	9	....	428	....
Shale, dark blue	4	8	432	8
Coal	2	6	435	2
Fire Clay	1	6	436	8
Coal	....	8	437	4
Clay shale	13	8	451	....
Limestone	4	6	455	6
Clay shale	4	3	459	3
Carbondale—				
Coal (No. 6)	3	6	463	3
Shale	1	3	464	6
Limestone	4	6	469	....
Clay shale	10	....	479	....
Clay shale	7	....	486	....
Shale, black	3	....	389	....
Coal, clean parting (No. 5)	5	3	494	3
Fire clay	1	6	495	9
Clay shale	8	3	504	....
Clay shale	14	....	518	....
Clay shale	12	....	530	....
Shale, black	3	....	533	....
Coal	1	8	534	8
Shale, soft crumbly	3	4	538	....
Clay shale	5	....	543	....
Clay shale with hard bands	21	....	564	....
Clay shale with hard bands	18	....	582	....
Coal	3	6	585	6
Sand, clay, shale, mixed	12	6	598	....
Sand, clay, shale, mixed	2	....	600	....
Shale, black sandy	2	....	602	....
Coal	1	5	603	5
Clay and sandy shale mixed	5	7	608	....
Clay and sandy shale mixed	18	....	626	....
Clay shale	13	4	639	4
Coal	1	2	640	6
Shale, mucky	1	6	642	....
Shale, mucky	1	....	643	....
Sandstone, hard	9	....	652	....
Shale, black (No. 2 coal)	1	....	653	....
Coal	....	3	653	3
Shale, black	2	7	655	10
Coal mixed with sulphur	2	5	658	3

Record of a diamond-drill boring near Blue Mound—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pottsville—				
Fire clay	1	6	659	9
Clay shale	4	3	664	....
Sandstone	4	....	668	....
Sandstone and sand shale mixed. Flowing salt water at 670 feet	15	....	683	....
Clay shale with hard bands	7	6	690	6
Shale, black	2	3	692	9
Coal	....	6	693	3
Clay shale	1	9	695	....
Clay shale	12	....	707	....
Clay shale	3	....	710	....
Sandstone	6	....	716	....
Shale, black	3	....	719	....
Coal	....	8	719	8
Clay shale	2	4	732	....
Clay shale	14	....	736	....
Shale, dark	2	....	738	....
Clay shale	2	....	740	....
Coal	....	2	740	2
Clay shale	1	10	742	....
Coal	....	6	742	6
Clay shale	3	6	746	....
Shale, dark	3	....	749	....
Coal and sulphur	....	8	749	8
Sandstone and sand shale	10	4	760	....
Clay shale, dark	2	....	762	....
Clay shale, dark	3	....	765	....
Shale, black	7	....	772	....
Coal	....	8	772	8
Clay shale	3	4	776	....
Sandstone (No. 1 coal?)	3	....	779	....
Sand shale	10	....	789	....
Coal	3	....	792	....
Clay shale	1	....	793	....
Sandstone	14	....	807	....
Sandstone	11	....	818	....
Sand shale and clay shale mixed	6	....	823	....
Clay shale	12	....	835	....
Sandstone	5	....	840	....
Sandstone, hard	10	....	850	....

On the basis of the correlation made in Plate II, a rough similarity is apparent in the sections at Blue Mound and Assumption, with an interval between coals No. 5 and No. 2 in one locality of 145 feet and in the other 155, and an interval betwen No. 1 and No. 2 of 115 feet at Blue Mound and 131 feet 7 inches at Assumption. These latter figures are not greatly different from those given for the interval between No. 1 and No. 2 coals in the Springfield and Peoria region.

In Sangamon, Macon, and Christian counties No. 2 coal seems to be everywhere in two benches.

A thin coal about 30 to 40 feet below No. 2 is apparently widespread as far northward as District I in Marshall and Bureau counties, and is possibly present at La Salle.

Limestone in the Pottsville is rather uncommon except in the western part of the district between No. 1 and No. 2 coals. In District III from Greene County to Rock Island County a limestone is nearly everywhere found between the two coals, commonly within a few feet of the upper coal, so that the underclay of this coal rests upon the limestone. This relationship, however, is more common to the south than to the north as the interval increases northward. In Fulton County, No. 1 coal is commonly overlain by a dark, shaly, somewhat impure limestone that varies in thickness from 5 to 20 feet, which may be separated from the coal by ½ to 3 feet of dark shale. Between the limestone and No. 2 coal is an interval of about 35 to 40 feet.

Except in the southeastern portion of the district the Pottsville sediments rest on a thick limestone of Mississippian age and the base can be definitely placed. In Macon and adjacent counties the Pennsylvanian system seems to be underlain by rocks belonging to the Chester group of the Mississippian system. These strata resemble the rocks of the Pottsville formation in being largely sandstone and sandy shales, so that it is not always possible to determine the position of contact of the two systems. The Chester, however, contains some limestone members, and as limestones are generally lacking in the Pottsville, it is the custom in the interpretation of drilling records from the central and southern part of the State arbitrarily to place the base of the Pottsville at the top of 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 sandstone. The top of the formation is difficult to identify where No. 2 coal is absent or not reported; in the Springfield region it averages about 240 feet below No. 6 coal; in the Peoria region in one shaft it is 140

feet below No. 6; in Macon County it is about 200 feet below No. 6. In general there is a decrease in interval northward through the State with the greatest difference taking place near the boundary between Districts VII and IV.

David White[1] has studied the fossil plants found in the formations and regards the Illinois beds as corresponding in age to 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 No. 2 coal to the top of No. 6 coal. Shale predominates in this formation, and only lenticular sandstones and minor amounts of limestone and coal are present. The Carbondale includes all of the productive coal beds in Illinois, except the Rock Island or Seville (No. 1), the Danville or Streator (No. 7) coals, three beds below No. 2 mined locally in Gallatin County, and two or three beds, high in the Pennsylvanian system, mined locally in the southeastern part of the State. Its total thickness varies from about 240 feet at Springfield and in the southeastern part of the district, to about 150 to 175 feet in the northern and northwestern parts.

The coal beds of commercial thickness in the region are No. 2, No. 5, and No. 6. The significance of these numbers has been adequately explained in preceding bulletins of this series, as has also the system of geographic names used by the State and the U. S. Geological Surveys for the same coals. By this system No. 2 coal is called the Murphysboro, La Salle, or Colchester coal; No. 5 coal is called the Springfield or Harrisburg coal; and No. 6 the Herrin, Belleville, or Grape Creek coal. Similarly, No. 1 of the Pottsville formation has been designated the Rock Island or Seville coal, and No. 7 of the McLeansboro formation, the Danville or Streator coal. It has been regarded as advantageous by the State Geological Survey to continue the use of numbers as synonymous with place names in this series of bulletins, calling attention, however, to the synonymous nomenclature.

The area of District IV includes most of that part of the State lying along the Illinois valley, wherein exposures of coal beds are

[1]White, David, Paleontological work in Illinois in 1908: Ill. State Geol. Survey Bull. 14, p. 193, 1910.

found that furnished the basis for the Illinois valley section of the "Coal Measures" prepared by Worthen and presented in Volume III of the Geological Survey of Illinois (pages 3 to 6). In this region Worthen believed that he had identified ten beds of coal in a vertical thickness of about 600 feet. All were identified in the immediate vicinity of Illinois River except coal No. 4, which was seen only near Cuba in Fulton County. He numbered the coals from No. 1 upward, Nos. 1, 2, 5, and 6 corresponding to the numbers now being used for the respective beds. After investigations in the Fulton County region, Professor T. E. Savage states that the bed identified by Worthen as No. 4 is really No. 5, the original error being due to a decrease in the interval (undiscovered by Worthen) between No. 2 and No. 5 coals toward the west in Fulton County. Worthen's No. 3 coal has possibly not been identified with certainty by later investigators.

STRATA COMPRISING THE CARBONDALE FORMATION

The rock strata listed by Worthen[1] in the Carbondale portion of his section of the "Coal Measures" in central and northern Illinois are as follows:

	Thickness of stratum	Total thickness
	Feet	*Feet*
Coal (No. 6)	6	6
Fire clay passing into nodular limestone with fossils	3	9
Sandstone and sandy or argillaceous shale	35	44
Limestone, hard, bituminous	2	46
Shale, black	3	49
Coal (No. 5)	6	55
Fire clay, some places passing into argillaceous limestone	3	58
Shale and sandstone	20	78
Coal (No. 4)	3	81
Sandstone and sandy shale with dark blue and chocolate-colored bands at the base	80-100	181
Coal (No. 3)	3	184
Sandstone and sandy shales becoming argillaceous toward the base and inclosing nodules with fossil plants, insects, fishes, etc.	75	259
Coal (No. 2)	3	262

The stratigraphic units of the Carbondale in the Avon-Canton quadrangles as determined by T. E. Savage, are believed to be more accurate than those of Worthen, and are as follows:

[1]Worthen, A. H., Geological Survey of Illinois, Vol. III, pp. 5 and 6, 1868.

		Thickness		Total thickness	
		Ft.	*In.*	*Ft.*	*In.*
16.	Coal (No. 6, or Herrin)	4-6	..	6	..
15.	Shale, gray to yellow	6-8	..	14	..
14.	Shale, sandy, and thin sandstone layers and sandstone	13	..	27	..
	———Unconformity———				
13.	Shale, gray (Canton shale)	17	..	44	..
12.	Shale, blue to gray, calcareous; "clod"	1	8	45	8
11.	Limestone, nodular	..	8	46	4
10.	Shale, black	2	..	48	4
9.	Coal (No. 5, or Springfield)	5	3	53	7
8.	Clay	2	6	56	1
7.	Limestone, nodular	1	..	57	1
6.	Shale, gray	12	2	69	3
5.	Sandstone and sandy shale	25	..	94	3
4.	Shale, gray	47	..	141	3
3.	Shale, black, with layer of nodular septaria boulders of limestone (Horizon of Worthen's No. 3 coal)	3-6	..	147	3
2.	Shale	9-14	..	161	3
1.	Coal (No. 2, or Avon)	2	6	163	9

The formation in the Fulton County region, especially near Cuba, is broken by an unconformity between No. 5 and No. 6 coals, whereby the interval between the two coals is lessened to apparent contact in at last one place, with various distances separating the coal up to the usual interval of about 65 feet as found near Canton. This varying interval between the coals was apparently not noted by Worthen, so that No. 5 was erroneously called No. 4 where it was the greater distance below No. 6, and No. 5 where it was the lesser.

In the Peoria County region the Carbondale section apparently begins with the No. 2 (Blue Fly) coal bed which was worked at Pottstown and Orchard. This coal lies 190 to 200 feet below the top of the formation or 140 feet below No. 5 coal, which is about 30 feet more than the interval in the Fulton County region. In both Fulton and Peoria counties No. 2 coal is covered by "soapstone" followed by black shale probably containing "niggerheads" or boulders of septaria limestone. The correlation of the other members of the section is impossible with the data at hand. As in the Fulton County region, however, the lower part of the section is shale and the upper part up to the underclay of No. 5 coal is largely sandstone.

The succession between No. 5 and No. 6 coals in the Peoria region is very similar to that in the Fulton County area. The unconformity mentioned above in the description of the Fulton County

section is present in the Peoria area and in both regions the material resting upon the eroded surface is sandstone or sandy shale. Udden states[1] as follows:

"The surface separating this shale from the overlying sandstone is not always a straight line or even plane. There are many broad low combs in the lower surface of the sandstone which extend down into the shale. On close inspection of the bared bottom of overhanging parts of the sandstone, especially in places where it has a coarse texture, these combs are seen to have the forms of molds made in small channels, which were cut by rills into the mud bottom of the underlying shale. The largest of these channels noted on the old mud flats is 3 feet wide and about 9 inches deep, evidently a cut such as might have been made by the receding tide. To what extent the differences already mentioned in the thickness of the shale may be due to more extensive erosion at this level it is not possible to say, but it appears probable that some erosion had taken place."

In the Springfield region the average thickness of the Carbondale formation is about 243 feet, or about 50 feet more than in the Peoria region. No. 2 coal, at the base, is commonly in two beds, each ranging from 7 to 24 inches in thickness. They are separated by a few feet of dark shale. Above the coal there is about 10 to 15 feet of shale or shaly sandstone, upon which lies 25 to 35 feet of micaceous and somewhat argillaceous sandstone interbedded with layers of shale. From the top of the sandstone to the base of the Springfield (No. 5) coal the strata consist of a series of shale beds varying in color from gray to blue or black. At some places they appear to be slightly sandy; at others they contain thin beds of coal. In the Springfield boring a thin coal bed was encountered 56 feet above the base of the formation and a similar coal was found at nearly the same horizon in a drilling near Riverton. About 30 feet above this bed another thin coal was found in each hole, and still another 140 to 150 feet above the base of the formation.

The interval between No. 5 and No. 6 coals is much the same throughout the Springfield region. Above the No. 5 coal is commonly black "slate," with niggerheads and with irregular gray markings resembling fucoid impressions traversing the beds and appearing on the edges of the blocks as light-gray laminae intercalated between darker material. Locally in the Springfield region a layer of "clod" or calcareous shale containing much pyrite lies between the coal and the black shale. In Peoria and Fulton counties "clod" is found locally at the position of the limestone "cap rock" above the black slate. Overlying the "cap rock" commonly is a shale of varying

[1]Udden, J. A., Geology and mineral resources of the Peoria quadrangle: U. S. Geological Survey Bull. 506, p. 31, 1912.

thickness overlain in turn by sandstone which latter member is particularly conspicuous in the Peoria region, where in places it is exposed to a thickness of 55 to 60 feet. Between the sandstone and underlying strata is probably an erosional unconformity. A similar sandstone lies above No. 5 coal in places in the La Salle region, and west of the La Salle anticline possibly in places extends below the horizon of No. 5 within about 100 feet or less of No. 2 coal. In District I this sandstone has been designated the Vermilionville sandstone. In District IV the sandstone changes vertically somewhat abruptly into shale and fire clay, the latter forming the underclay of No. 6 coal. There is commonly 7 to 10 feet of this shale between the coal and the sandstone.

The thickness of the Carbondale formation apparently is somewhat more in Sangamon County than it is to either the east or the west. Its thickness of 240 feet near Springfield has already been compared with a thickness of 190 to 200 feet at Peoria. In Macon County there is about 190 feet of Carbondale sediments present, and at Bloomington between 132 and possibly 175 feet. No. 6 coal is apparently absent over much of McLean County so that the exact position of the top of the Carbondale is undeterminable.

No. 6 coal is not widespread in this district. In the Springfield area it is found as a thin coal 14 inches or less in thickness and at an average interval of 50 feet above No. 5 coal. The coal increases in thickness southward rather rapidly, so that at Auburn and Chatham it is 5 to 8 feet thick. In the Peoria and Fulton County region, also, it is 4 to 6 feet thick. Very locally at Springfield the coal thickens to 5 or 6 feet as in the shaft at Mechanicsburg. To the east and north the coal entirely plays out so that the exact position of the top of the Carbondale formation is indeterminable and No. 7 coal is the next bed of workable thickness above No. 5 coal. This relationship persists northward over much if not all of District I. The absence of No. 6 coal is thought to be due to an interval of erosion or nondeposition near the end of Carbondale time. The gap may be due to the same causes which produced the erosion unconformity already described between No. 5 and No. 6 coals in the Fulton and Peoria County region, sandstone deposition continuing for longer period in the central portion of the State than it did to the west. This seems to be in harmony with movements which apparently took place along the La Salle anticline at about the end of the Carbondale period, one effect of which would doubtless have been to make the adjacent portion of the coal basin unfavorably located for peat deposition. There is considerable State-wide evidence for believing that an emergence

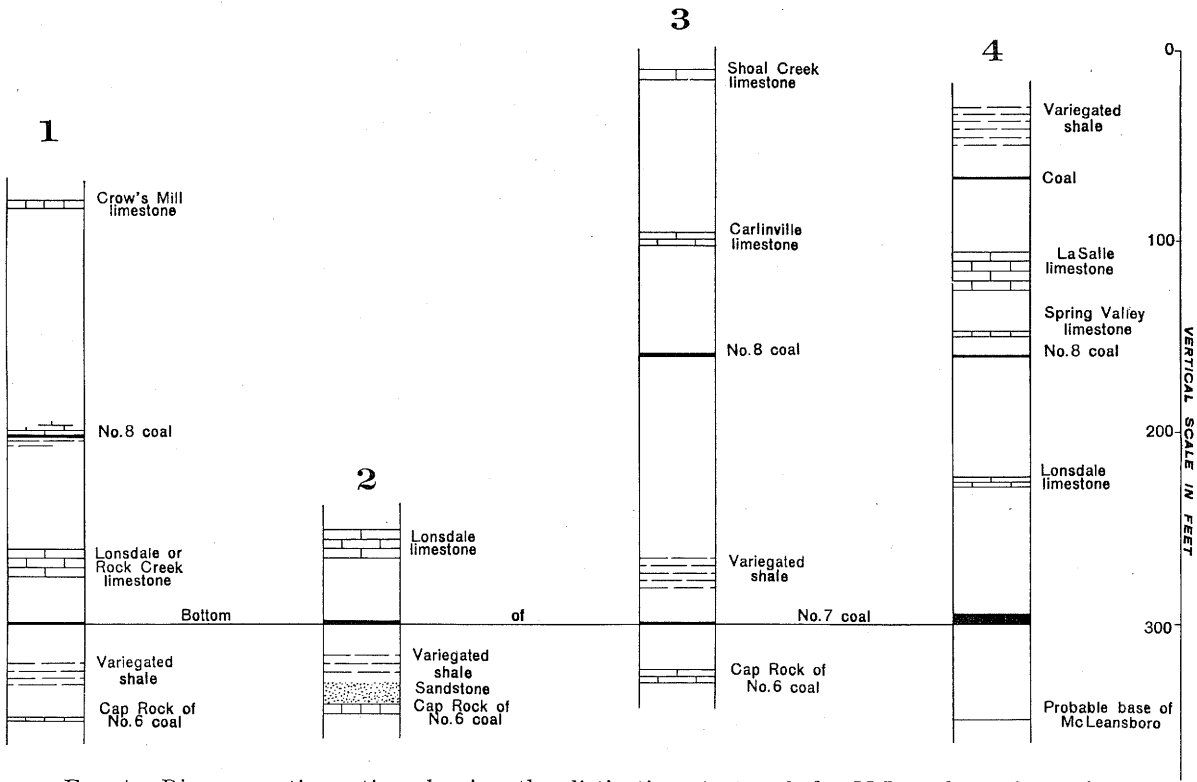

FIG 4.—Diagrammatic section showing the distinctive strata of the McLeansboro formation:
1. In District IV as a whole
2. In the Peoria region
3. In Macon County and District VII
4. In the northern part of District IV and in District I

of the sea bottom accompanied by erosion took place near the end of Carbondale time, but the exact position of the line of unconformity in the various parts of the State varies across the horizon of coal No. 6, in some places being above and in other places below or at the horizon of the coal. In southeastern Illinois and western Kentucky the line of this unconformity is thought to be marked by the base of the Anvil Rock sandstone, which lies near the base of the McLeansboro formation.

MCLEANSBORO FORMATION

GENERAL DESCRIPTION

The McLeansboro formation includes all of the "Coal Measures" strata above No. 6 coal. 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 line of outcrop of No. 6 coal, and in most of the district is covered by a variable thickness of glacial drift.

The formation consists of shale and minor amounts of sandstone, limestone, and coal. Although some of the coals above No. 6 are persistent in distribution, only No. 7 coal is anywhere sufficiently thick in this area to be of commercial value. In its barrenness of productive coals and in general age, the McLeansboro is similar to the Conemaugh formation of Pennsylvania.

DISTINCTIVE STRATA

The well differentiated distinctive strata of the McLeansboro formation in this region as a whole may be enumerated as follows (Fig. 4):

6. Crows Mill limestone; about 275 feet above No. 6 coal.
5. No. 8 coal, with limestone above and greenish-gray shale below; about 150 feet above No. 6 coal.
4. Lonsdale or Rock Creek limestone; about 75 feet above No. 6 coal and 30 to 40 feet above No. 7 coal.
3. No. 7 coal; averages about 50 feet above No. 6 coal.
2. Variegated shale between cap rock of No. 6 coal and No. 7.
1. A hard limestone cap rock overlying or a few feet above No. 6 coal.

In the Peoria region the following units may be observed (Fig. 4):

5. Lonsdale limestone; about 15 feet thick, 30 to 40 feet above No. 7 coal.
4. No. 7 coal; about 18 inches thick, 20 to 50 feet above No. 6 coal.
3. Variegated shale 8 feet and less in thickness; 18 to 40 feet above No. 6 coal.
2. Sandstone; 10 to 25 feet thick, 8 to 17 feet above No. 6 coal.
1. Limestone; about 5 feet thick, 2 to 4 feet above No. 6 coal.

In Macon County a section similar to that noted in District VII[1] to the south is recorded at Blue Mound, including the following distinctive horizons (Fig. 4):

6. Shoal Creek limestone; about 100 feet above the Carlinville limestone, and 300 feet above No. 6 coal.
5. Carlinville limestone; about 230 feet above No. 6 coal.
4. No. 8 coal; 150 to 180 feet above No. 6 coal.
3. Variegated shale; about 60 feet above No. 6 coal.
2. No. 7 coal.
1. Cap rock of No. 6 coal.

The section in the northern part of this district seems to be much like the section in District I where the following distinctive horizons may be recognized (Fig. 4):

7. Variegated shales; about 250 feet above No. 7 coal.
6. Coal; about 232 feet above No. 7 coal.
5. Limestone, La Salle; about 180 feet above No. 7 coal.
4. Limestone, Spring Valley; about 150 feet above No. 7 coal.
3. No. 8 coal; about 140 feet above No. 7 coal.
2. Lonsdale limestone; about 75 feet above No. 7 coal.
1. No. 7 coal, of commercial thickness; possibly about 50 feet above the base of the McLeansboro formation, No. 6 coal not being present.

The identification of the various strata of the McLeansboro formation as well as those of the earlier formations is accomplished by comparison of sections in adjacent drill holes and by a few exposures in the upper part of the section in the central part of the district. Similarity of interval between successive distinctive strata in various places is practically the only criterion of identification, as fossil studies have not as yet yielded index fossils for the various positions in "Coal Measures," as they may do if collections were systematically made and studied.

Identifications of strata on the basis of lithologic similarity and similarity in stratigraphic interval have been rather satisfactory in the southern part of the State where drilling is closely spaced, and the various formations are widespread at characteristic intervals. Comparison of sections in various parts of northern Illinois seems to indicate that the same method is applicable here likewise, but in all parts of the coal basin there is need for paleontologic verification of such identifications by the aid of fossil collections.

Because of the irregularity in the distribution of drilling, and geologic and other exploratory work, and because of the consequent

[1]Kay, Fred H., Coal Resources of District VII: Ill. Min. Investigations Bull. 11, p. 23, 1915.

lack of knowledge of conditions in Menard, Logan, and DeWitt counties, the southern part of the district, comprising Sangamon and Macon counties, is isolated from the northern and western part of the district including Schuyler, Fulton, Peoria, Tazewell, McLean, Woodford, and Livingston counties and the area included in District I. The section for Peoria and Fulton counties continues northward and in Marshall County merges into the section which is characteristic of District I as displayed in the La Salle region west of the La Salle anticline. At Sparland, No. 6 coal pinches out and is not present northward. No. 7 coal persists from the Peoria region into the La Salle region becoming thicker in that direction, and the Lonsdale limestone can be traced almost continuously from one district to the other. At Toluca, No. 6 coal is absent, but a limestone, possibly the cap rock of No. 6, below which is a black "slate," has been encountered in one drill hole, indicating a transition from the conditions in one area to those in the other. The following record of a drilling at Toluca illustrates the relationships.

Record of boring near Toluca, in the S. W. ¼ N. E. ¼ sec. 5, T. 29 N., R. 1 E.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Soil, black	1	....	1	....
Clay, brown	5	....	6	....
Clay, gray	6	....	12	....
Sand clay, brown	5	....	17	....
Sand (water)	8	....	25	....
Clay, gray and red	43	....	68	....
Limestone	3	....	71	....
Soapstone, light red	20	....	91	....
"Soapstone," pink	8	....	99	....
Limestone	3	....	102	....
Silt, black	3	....	105	....
Soapstone, light gray	8	....	113	....
"Soapstone," red	4	....	117	....
Limestone	7	6	124	6
"Soapstone," gray	5	6	130	....
Limestone	2	....	132	....
"Soapstone," dark	3	....	135	....
"Soapstone," gray	2	....	137	....
Clay, red	11	....	148	....
Limestone	7	....	155	....
Clay, red	1	....	156	....
"Soapstone," red	4	....	160	....

Record of boring near Toluca—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Clay, red	7	....	167	....
"Soapstone," gray	3	....	170	....
Clay, red	2	....	172	....
"Soapstone," gray	11	....	183	....
"Slate," black	2	....	185	....
"Soapstone," gray	1	....	186	....
Limestone	13	....	199	....
Clay, red	9	....	208	....
"Soapstone," dark	8	....	216	....
Limestone	5	....	221	....
"Soapstone," gray	14	....	235	....
Sandstone	14	....	249	....
"Soapstone," gray	14	....	263	....
"Soapstone," sandy	9	....	272	....
"Soapstone," gray	7	....	279	....
"Slate," black	3	....	282	....
"Soapstone," gray	6	....	288	....
Coal ("1st vein" or No. 7)	4	3	292	3
Fire clay	8	9	301	....
"Soapstone," gray	16	6	317	6
Limestone	1	6	319	....
"Slate," black	4	....	323	....
"Soapstone," gray	5	....	328	....
"Slate," black	14	....	342	....
Coal ("2d vein" or No. 5)	2	....	344	....
Fire clay	7	....	349	....
"Soapstone," gray	17	....	366	....
Fire clay	4	....	370	....
"Soapstone"	15	....	385	....
Sand shale	10	....	395	....
Sand shale	9	....	404	....
"Soapstone," sandy	90	....	494	....
"Soapstone," gray	5	....	499	....
Coal ("3d vein" or No. 2)	2	6	501	6
Fire clay	3	6	505	....

The succession of the Longwall District, which as has been stated, can be traced into the Peoria area along the Illinois valley, persists southward in the eastern part of District IV along the line of the Illinois Central Railroad at least at far as Bloomington. Accordingly, as in the Longwall District, the coals in the northern part of District IV are commonly known as "first," "second," and "third vein" coals, and,

as in the La Salle region, the "first vein" is No. 7 of the Illinois section, the "second vein," No. 5, and the "third vein" is No. 2. No. 6 coal, as has been stated, is absent in this part of the State.

Between Bloomington and the south boundary of the district, the section changes with the thinning of No. 7 coal, and with the intercalation of No. 6 coal and its cap-rock limestone between coals No. 7 and No. 5. The stages of this transition have not been determined, as the details of the section between Bloomington and Decatur are not well known, very little drilling having been done in that part of the district. Not improbably it is very similar to the change that takes place in the section along the Illinois valley between Peoria and the Longwall District.

In the following paragraphs each of the distinctive strata of District IV in the McLeansboro formation as previously listed, will be described in some detail.

1. *Limestone above No. 6 coal.*—No. 6 coal is of workable thickness in this district only in Fulton, Schuyler, and Peoria counties. In most of the area it is absent. Where this coal is present it has a persistent limestone cap rock which possibly has a wider distribution than the coal itself. In the Peoria region this cap rock ranges in thickness from 3 inches to 4 feet and averages a little more than 2 feet. In places it is absent from the section. A similar limestone is reported over the No. 6 coal in Springfield region. A black shale commonly separates the coal from the limestone in all regions, but in places in the Peoria region this shale and even the limestone and some of the coal is replaced by a variable sandy deposit known among the miners as "white top." In the northern part of the State a similar material is found associated with No. 5 coal, particularly at La Salle and Cherry.

2. *Variegated shale below No. 7 coal.*—Savage reports a persistent bed of variegated calcareous shale, red, blue, greenish, chocolate-colored, and mottled, occupying part of the section between the cap rock of No. 6 coal and No. 7 coal in the Springfield region. Reddish shales at about the same horizon have been noted by Savage in the Canton region and by Udden in the Peoria region. It is noteworthy that similar variegated shales are remarkably persistent in District IV at a higher horizon, namely, about 50 feet above No. 6 coal and as a rule a short distance above rather than below the horizon of No. 7 coal. Reddish shales do not occur in the northern part of the district or in District I nearer than about 40 feet above No. 7 coal, but above that level are rather common.

3. *No. 7 coal.*—No. 7 coal is one of the three persistent coal beds of this district. It is thin to the south and southwest, averaging only

2½ inches in thickness in the Springfield quadrangle,[1] and in places represented only by a thin bed of black shale. In the Peoria quadrangle it averages 1 foot 5 inches in thickness, and Savage reports an average thickness of 12 to 18 inches in the Avon and Canton quadrangles. North from Bloomington and Chillicothe the coal becomes of workable thickness, and it has been mined at various places in the northern part of the State, most notably at Streator. This coal will be described in greater detail on later pages.

4. *Lonsdale limestone.*—The Lonsdale limestone is one of the widely distributed limestones in the "Coal Measures" of northern Illinois. It has not been identified south of Sangamon County, but it occupies a stratigraphic position similar to that of certain limestones found in Randolph and Perry counties a short distance above the coal identified as No. 7. The limestone has been traced from Fulton County northward to Bureau County, is probably represented by one of the several limestones in the upper part of the Pennsylvanian system in the La Salle region, and has been tentatively correlated with the limestone outcrop along Vermilion River between Streator and Pontiac. It is believed to be the same as the Rock Creek limestone of the Springfield region.[2]

This limestone was first described by Worthen[3] from the old Lonsdale quarries in the Peoria region. Udden[4] describes it as consisting of a lower 5 feet of firmly cemented, largely organic limestone in beds varying in thickness from 6 inches to 18 inches, and in character from typical crinoidal limestone to calcareous mud-lump breccia; and an upper bed 15 feet thick of slightly argillaceous more flaggy rock, in which concretionary structures can nearly always be detected.

In the Peoria region this limestone lies 40 to 50 feet above No. 7 coal; in the Canton region about 60 feet above the coal; in the Springfield region (supposing it to be the same as the Rock Creek limestone), about 45 feet; in the Streator region about 70 feet; and at Bloomington possibly about 70 feet. The Lonsdale limestone has not been definitely identified in the southeast part of the district nor generally in the southern part of the State.

5. *No. 8 coal.*—No. 8 coal, although too thin to be of commercial importance, has a persistence comparable to that of any coal beds of the State. It can be traced throughout Districts VII, VI, and probably V, practically to Ohio River. It is commonly between 12 to 18 inches thick, but locally increases to 30 inches. Locally it is absent. It is gen-

[1] U. S. Geological Survey Folio 188, p. 5.
[2] U. S. Geological Survey Folio 188, p. 6.
[3] Worthen, A. H., Geological Survey of Illinois Vol. 5, p. 238, 1873.
[4] Udden, J. A., Geology and mineral resources of the Peoria quadrangle: U. S. Geological Survey Bull. 506, pp. 39-40, 1912.

erally overlain by black shale. This thin coal lies approximately halfway between No. 6 coal and the Carlinville limestone. The various intervals between this coal and No. 7 in District IV may be observed by inspection of the following table:

TABLE 1.—*Interval between No 8 and No. 7 coals in District IV compared with the range of interval in District VII*

Locality	Interval *Feet*
Springfield	77
Niantic	100
Blue Mound	140
Decatur	130+
Lovington	150
Assumption	130
Divernon	120
La Salle	147?
Saybrook	169
District VII	150-180

6. *Carlinville limestone.*—The Carlinville limestone is one of the most widely distributed beds in the "Coal Measures" of Illinois. It has been traced from the Indiana State line in Gallatin County northeast to Carlinville, Macoupin County, and is probably the same as the Crows Mill limestone of the Springfield region and the La Salle limestone of the La Salle region.

In the type localities this limestone is, according to Udden[1], "generally bluish gray, compact, close-textured, and very hard, breaking into irregular, splintery pieces. On weathering it assumes a rusty color. It averages about 7 feet in thickness. There are two features that are characteristic of this limestone, one a blotchy appearance and the other its tendency to weather into seams two and one-half or three inches in thickness."

The various intervals between this limestone and No. 6 and No. 7 coal, so far as either or both are present, is shown in the accompanying table.

TABLE 2.—*Intervals between the Carlinville limestone and No. 6 and No. 7 coals*

Locality	Interval To No. 6 coal *Feet*	To No. 7 coal *Feet*
Macoupin County	200-220	200±
Springfield (Crows Mill limestone)	210-215	160
Divernon	215±	160
Niantic	190	175
Blue Mound	225	190
Maroa	225	200
Decatur	190	180

[1]Udden, J. A., Shoal Creek limestone; Illinois State Geological Survey Bull. 8, p. 119, 1908.

Locality	Interval To No. 6 coal	To No. 7 coal
	Feet	*Feet*
Lovington (Shoal Creek limestone?)	300	270
Assumption	...	220
Tolnca	190±	170
Saybrook	290?	180
District VII		
(Central and southern parts)	275-325	...
(Northern part)	200-275	...

As in the case of the interval between the No. 7 coal and the Lonsdale limestone and No. 8 coal, there is a general decrease in interval in the Sangamon County region in passing from adjacent regions to the east and southeast, and possibly to the northwest.

The equivalency of the Carlinville and La Salle limestones was postulated as probable by Worthen,[1] who says:

"I have been inclined to regard this limestone as the equivalent of that at Carlinville, which it resembles, both in its lithologic character and in the specific character of its embedded fossils. * * * It is rather more argillaceous here than in Macoupin County, but otherwise it bears a close resemblance to that rock, and its position is about where that limestone, if present here, should be found."

While investigations by the present Survey have yielded no definite evidence from fossil collections of the correlation of the two limestones, they indicate the probable correctness of Worthen's determination; at least, they do not throw any doubt upon it.

7. *Higher distinctive horizons.*—Erosion has cut off the Pennsylvanian strata in the district shortly above the horizon of the Carlinville limestone. Possibly in Macon, Dewitt, and southeastern McLean counties, strata as high as No. 9 coal and the Shoal Creek limestone are preserved where the rock surface is highest. Such is not known to be the case, however. Both of these members are possibly present very locally in the La Salle region.

The New Haven limestone, which is fairly widespread in southern Illinois within the area surrounded by its outcrop, lies about 200 to 250 feet above the Carlinville limestone, and apparently outcrops near the north boundary of District VII between Assumption and Lovington on the south and southeast, and Decatur on the north.

According to the old classification of Worthen whereby the Pennsylvanian strata in Illinois were separated into lower and upper "Coal Measures" at the horizon of No. 9 coal, the upper measures are lacking in this district except possibly for a narrow belt extending northward along the east boundary

[1]Geological Survey of Illinois, Vol. 7, p. 48.

CHEMICAL VALUE OF COALS IN DISTRICT IV

A detailed report on the chemical character of Illinois coals has been published as Bulletin 3[1] of this series, so that a discussion of the quality of the coals in this district is not necessary. However, for convenience, tables 3, 4 and 5 are here given. Tables 3 and 4 relate only to the coals in the counties treated in this report. Table 5, which shows the average district analyses of coals, is presented for ease of general comparison of the District IV coals with those of the other districts. In Plate IV the same material as is given in table 5 is presented in graphic form.

A very brief statement of the meaning of each of the several columns, which give the results of analyses in tables 3, 4 and 5, will doubtless be of service in rendering these results more intelligible, and therefore of greater usefulness to the average reader unfamiliar with the technology of coal.

The "Proximate analysis" columns group the compounds which either make up the coal or are derived from it, into water, ash, volatile matter, and fixed carbon, the last two comprising the combustible matter. A recalculation of the results of each analysis is given on the second line in most cases, showing percentage of the various constituents on the hypothetical basis of no moisture in the coal.

The moisture content of coal though unavoidable is detrimental. Not only does the water displace its own weight of combustible matter, but in addition it absorbs heat during burning, 100 B.t.u's per pound being a common figure for ordinary bituminous coal of average moisture content. Obviously, other factors being equal, a coal of the lowest possible moisture content should be purchased.

The ash in coal (chiefly compounds of silica, alumina, lime, and iron, together with smaller quantities of magnesia, titanium, and alkali compounds) is another harmful constituent. Not only does it displace its own weight of heat-forming compounds, and decrease the efficiency of combustion just as does the moisture content, but in addition any increase in ash percentage means a corresponding increase in the cost of handling the coal, by making both freight costs and costs of disposition of the refuse greater. Furthermore, certain types of ash contain such high percentages of iron and alumina that they fuse easily and cause clinkering trouble in furnaces.

The "volatile matter" and "fixed carbon" columns give the relative amounts of gaseous and solid combustible matter. They are, of course, the heat-producing constituents. For domestic use a low-volatile coal is to be preferred because the ordinary domestic stoves and furnaces are capable of utilizing only a small proportion of the volatile matter. However, modern steam-generating appliances such as are used industrially are so constructed as to take care of the gases satisfactorily and either low- or high-volatile coal can be used with equal efficiency.

[1]Parr, S. W., a chemical study of Illinois coals: Ill. Coal Mining Investigations Bull. 3, 1916. This bulletin is out of print, but the analyses it contains have been reprinted in State Geological Survey Bulletin 29, in a paper by S. W. Parr on "The Purchase and Sale of Illinois Coal under Specifications."

Sulphur is present generally in the form of pyrite (iron sulphide.) It is especially deleterious in the manufacture of coke and gas, and if associated with an ash of high lime and iron content it may help to cause clinkering. Otherwise it is not particularly harmful, for as a rule it displaces a negligible amount of combustible material, and has some virtue in that it does not absorb heat as do water and ash, but will even produce about a third as much heat as does carbon.

The "B.t.u." column gives the calorific (heat) values of the coals in British thermal units per pound of coal. These values indicate the proportional heating power of the coals and are therefore extremely important as a means of comparison. In their calculation, account is taken of the ash and moisture present, as well as the combustible matter.

"Unit coal," on the contrary, takes account only of the pure coal substance, free from ash, moisture, sulphur, or other impurities. Since the "pure coal" is essentially the same for any single mine from year to year, the "unit-coal" figure will remain practically unchanged; the "B.t.u." figure, however, will vary in proportion to the variations from place to place in the mine in the amount of ash, sulphur, and moisture present, and therefore for the average practical user, up-to-date B.t.u. values will afford a more satisfactory means of comparison of the coals than will the "unit-coal" values, useful though they may be for certain purposes.

TABLE 3—*Analyses of mine samples from District IV*
Not exactly indicative of commercial output

Lab. No. (a	File No. (b	Date of analysis (c	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
5229	1602	7/12	Christian	1	11.27	38.68	40.55	9.50	2.07	.33	11445	.....
	C21				Dry	43.59	45.70	10.71	2.33	.37	12898	14666
5230	1602	7/12	Christian	1	11.52	38.78	41.01	8.69	2.42	.97	11648	.....
	C21				Dry	43.83	46.35	9.82	2.73	1.10	13163	14707
5231	1602	7/12	Christian	1	11.13	39.21	41.26	8.40	2.56	.61	11715	.....
	C21				Dry	44.12	46.43	9.45	2.88	.69	13183	14779
5205	1602	7/12	Christian	2	12.07	39.36	41.91	6.66	3.74	.07	11776	.....
	C21				Dry	44.77	47.66	7.57	4.26	.09	13393	14730
5206	1602	7/12	Christian	2	12.53	38.00	40.62	8.25	3.67	.31	11389	.....
	C21				Dry	44.12	46.44	9.44	4.22	.35	13020	14641
5207	1602	7/12	Christian	2	14.30	39.54	40.30	5.86	2.00	.24	11609	.....
	C21				Dry	46.14	47.02	6.84	2.33	.28	13544	14702
1869	1602	10/08	Christian	2	11.54	36.65	42.89	8.92	3.87	.....	11631	.....
					Dry	41.42	48.50	10.08	4.38	.....	13148	14912
12469	0328	4/21	Fulton	1	11.38	38.66	39.51	10.45	4.52	.87	11436	.....
					Dry	43.62	44.58	11.80	5.10	.98	12905	14979
12470	0328	4/21	Fulton	1	11.42	38.17	40.07	10.34	4.76	.45	11409	.....
					Dry	43.09	45.24	11.67	5.37	.51	12880	14934
12471	0328	4/21	Fulton	1	10.84	38.42	40.91	9.83	5.61	.54	11554	.....
					Dry	43.09	45.88	11.03	6.29	.61	12959	14939

TABLE 3—*Analyses of mine samples from District IV*—Continued

Lab. No. [a]	File No. [b]	Date of analysis [c]	County	Coal bed	Proximate analysis of coal. 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free.				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
1858	0328	9/08	Fulton	1	17.21	37.49	38.69	6.61	3.90	.....	11147	.....
					Dry	45.28	46.73	7.99	4.71	.....	13464	14904
2753	1422	.....	Fulton	2	14.87	35.80	43.88	5.45	.....	.....	11641	.....
					Dry	42.06	51.54	6.40	3.69	.....	13674	14083
12442	0102	4/21	Fulton	5	15.43	33.62	39.47	11.48	2.50	1.41	10389	.....
					Dry	39.76	46.67	13.57	2.66	1.67	12285	14473
12443	0103	4/21[c]	Fulton	5	14.43	34.60	39.09	11.88	2.82	2.45	10320	.....
					Dry	40.43	45.69	13.88	3.29	2.86	12061	14297
12444	0103	4/21	Fulton	5	15.00	33.10	37.31	14.59	3.38	2.86	9834	.....
					Dry	38.94	43.89	17.17	3.98	3.36	11569	14300
12445	0103	4/21	Fulton	5	14.69	34.07	40.18	11.06	2.83	1.75	10383	.....
					Dry	39.94	47.09	12.97	3.32	2.05	12172	14266
12446	0103	4/21	Fulton	5	14.52	34.46	37.64	13.38	2.91	2.74	10045	.....
					Dry	40.31	44.04	15.65	3.40	3.21	11752	14261
12447	0103	4/21	Fulton	5	14.75	33.18	38.89	13.18	3.70	1.54	9869	.....
					Dry	38.92	45.62	15.46	4.34	1.81	11577	14298
12448	0103	4/21	Fulton	5	14.28	34.93	38.76	12.03	2.56	1.98	10329	.....
					Dry	40.75	45.22	14.03	2.99	2.31	12061	14316
12472	0104	4/21	Fulton	5	15.32	35.12	38.05	11.51	2.59	1.41	10482	.....
					Dry	41.48	44.93	13.59	3.06	1.66	12379	14617
12473	0104	4/21	Fulton	5	15.09	13.37	39.41	10.13	2.68	1.79	10741	.....
					Dry	41.66	46.41	11.93	3.16	1.66	12650	14631
12474	0104	4/21	Fulton	5	15.56	35.68	38.92	9.84	2.43	1.33	10753	.....
					Dry	42.26	46.09	11.65	2.88	1.58	12735	14668
12475	0104	4/21	Fulton	5	14.56	35.37	38.98	11.09	2.72	1.38	10581	.....
					Dry	41.40	45.62	12.98	3.19	1.62	12384	14512
12476	0104	4/21	Fulton	5	15.39	33.82	38.77	12.02	3.40	1.67	10338	.....
					Dry	39.97	45.82	14.21	4.02	1.97	12219	14565
12477	0104	4/21	Fulton	5	15.66	34.65	37.56	12.13	2.93	1.88	10242	.....
					Dry	41.08	44.54	14.38	3.47	2.23	12144	14583
12439	0111	4/21	Fulton	5	13.37	36.03	39.03	11.57	3.06	1.46	10787	.....
					Dry	41.59	45.06	13.35	3.52	1.69	12452	14670
12440	0111	4/21	Fulton	5	14.44	34.71	38.58	12.27	2.17	1.80	10578	.....
					Dry	40.57	45.09	14.34	2.54	2.10	12364	14683
12441	0111	4/21	Fulton	5	14.96	33.65	39.96	11.43	4.32	1.11	10502	.....
					Dry	39.57	46.99	13.44	5.08	1.30	12352	14616

a) The analyses that have "US" laboratory numbers were made by either the U. S. Bureau of Mines or the U. S. Geological Survey, as indicated in later footnotes which make reference to their place of publication.

b) Analyses having the same file number are for a single mine. It should be remembered that as much dependence can not be placed on a single analysis from a given mine as may be placed on a group from one mine.

Analyses having "C" file numbers are republished from State Geological Survey Bulletin 29, and Illinois Mining Investigations Bulletin 3, and belong to a series made by J. M. Lindgren under the general supervision of Professor S. W. Parr of the University of Illinois, for those bulletins.

c) The Fulton County analyses that have April, 1921, as the date of analysis, were made on samples recently collected by or under the supervision of H. E. Culver of the Survey staff.

TABLE 3—*Analyses of mine samples from District IV*—Continued

Lab No.[a]	File No.[b]	Date of analysis[c]	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free.				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
5345	0115 C30	8/12	Fulton	5	16.36	33.91	38.19	11.54	2.93	1.27	10186	.....
					Dry	40.54	45.66	13.80	3.50	1.51	12179	14431
5346	0115 C30	8/12	Fulton	5	16.33	35.50	37.01	11.16	2.89	1.84	10220	.....
					Dry	42.42	44.23	13.35	3.45	2.20	12213	14389
5347	0115 C30	8/12	Fulton	5	15.85	36.12	38.12	9.91	3.36	1.47	10494	.....
					Dry	42.92	45.30	11.78	4.00	1.75	12471	14386
5293	0127 C29	8/12	Fulton	5	17.13	36.23	34.44	12.20	3.03	1.79	9846	.....
					Dry	43.72	41.55	14.73	3.66	2.16	11882	14252
5297	0127 C29	8/12	Fulton	5	16.59	35.98	37.20	10.23	4.07	1.77	10271	.....
					Dry	43.14	44.61	12.25	4.88	2.12	12314	14354
5300	0127 C29	8/12	Fulton	5	15.41	35.67	39.04	9.88	3.31	.52	10579	.....
					Dry	42.16	46.15	11.69	3.92	.61	12505	14443
12459	0134	4/21	Fulton	5	14.57	35.24	39.58	10.61	2.89	1.00	10562	.....
					Dry	41.25	46.33	12.42	3.38	1.17	12363	14391
12460	0134	4/21	Fulton	5	16.16	35.65	37.89	10.30	2.50	1.56	10422	.....
					Dry	42.52	45.19	12.29	2.98	1.86	12431	14434
12461	0134	4/21	Fulton	5	13.35	37.84	39.86	8.95	2.22	1.77	10843	.....
					Dry	43.67	46.00	10.33	2.56	2.04	12514	14150
12462	0134	4/21	Fulton	5	15.86	35.20	37.32	11.62	3.49	1.31	10198	.....
					Dry	41.84	44.35	13.81	4.15	1.56	12120	14380
12463	0134	4/21	Fulton	5	14.34	35.09	36.72	13.85	3.84	2.47	9944	.....
					Dry	40.96	42.87	16.17	4.48	2.89	11609	14217
12464	0134	4/21	Fulton	5	14.62	36.18	39.21	9.99	2.43	1.49	10719	.....
					Dry	42.38	45.92	11.70	2.85	1.74	12555	14465
5342	0728 C32	8/12	Fulton	5	13.66	38.46	37.06	10.82	3.64	1.26	10689	.....
					Dry	44.54	42.92	12.54	4.22	1.46	12379	14462
5343	0728 C32	8/12	Fulton	5	14.53	37.46	38.35	9.66	3.18	1.60	10804	.....
					Dry	43.83	44.87	11.30	3.72	1.87	12641	14525
5344	0728 C32	8/12	Fulton	5	15.80	35.84	37.67	10.69	3.00	1.79	10460	.....
					Dry	42.56	44.74	12.70	3.57	2.12	12423	14520
5292	0811 C28	8/12	Fulton	5	17.39	37.00	35.69	9.92	2.74	1.14	10273	.....
					Dry	44.79	43.20	12.01	3.28	1.36	12435	14416
5295	0811 C28	8/12	Fulton	5	16.33	36.27	36.58	10.82	3.40	1.94	10246	.....
					Dry	43.34	43.72	12.94	4.06	2.32	12247	14371
5299	0811 C28	8/12	Fulton	5	16.33	36.75	38.02	8.90	2.59	1.02	10604	.....
					Dry	43.92	45.44	10.64	3.10	1.22	12674	14421
12436	0814	4/21	Fulton	5	15.88	33.96	38.75	11.41	4.38	.92	10330	.....
					Dry	40.37	46.07	13.56	5.21	1.10	12280	14569
12437	0814	4/21	Fulton	5	16.68	35.46	37.90	9.96	3.82	.61	10464	.....
					Dry	42.56	45.49	11.95	4.58	.74	12559	14579
12438	0814	4/21	Fulton	5	14.53	35.68	38.23	11.56	3.45	1.00	10608	.....
					Dry	41.74	44.73	13.53	4.04	1.17	12411	14679
1404	0832	4/08	Fulton	5	15.09	35.39	38.89	10.63	3.21	.....	10573	.....
					Dry	41.68	45.80	12.52	3.79	.....	12450	14447
5283	1116 C31	8/12	Fulton	5	15.18	37.17	35.17	12.48	3.45	1.70	10201	.....
					Dry	43.82	41.45	14.73	4.07	2.00	12026	14441

TABLE 3—*Analyses of mine samples from District IV*—Continued

Lab. No. (a	File No. (b	Date of analysis (c	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free. Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	CO_2	B. t. u.	Unit coal
5284	1116	8/12	Fulton	5	16.94	35.68	37.15	10.23	2.98	1.31	10314	.....
	C31				Dry 42.95		44.73	12.32	3.59	1.57	12418	14446
5285	1116	8/12	Fulton	5	18.42	34.98	37.66	8.94	2.33	.86	10270	.....
	C31				Dry 42.88		46.15	10.97	2.85	1.06	12587	14371
5296	1116	8/12	Fulton	5	16.82	37.28	33.45	12.45	2.84	1.69	10580	.....
	C31				Dry 44.81		40.23	14.96	3.42	2.02	12038	14479
5298	1116	8/12	Fulton	5	16.52	37.17	36.54	9.77	3.91	.81	10394	.....
	C31				Dry 44.52		43.78	11.70	4.69	.97	12451	14409
5341	1116	8/12	Fulton	5	17.37	35.71	37.86	9.06	2.34	1.14	10420	.....
	C31				Dry 43.22		45.82	10.96	2.83	1.38	12610	14398
1856	1217a	9/08	Fulton	5	15.44	35.88	38.35	10.33	3.52	.....	10711	.....
					Dry 42.42		45.36	12.22	4.17	.....	12666	14673
4387	1220	8/11	Fulton	5	12.03	36.30	39.67	12.00	3.35	.72	10779	.....
					Dry 41.27		45.08	13.65	3.81	.82	12254	14652
4388	1220	8/11	Fulton	5	14.04	36.14	39.28	10.54	3.46	.56	10721	.....
					Dry 42.04		45.69	12.27	4.02	.65	12472	14627
2651	1220a	8/09	Fulton	5	14.35	34.48	36.98	14.19	4.44	.....	10324	.....
					Dry 40.25		43.18	16.57	5.19	.....	12053	14771
1796	0521	9/08	Knox (d	5?	14.55	38.25	40.37	6.83	4.31	.....	11207	.....
					Dry 44.75		47.26	7.99	5.05	.....	13113	14528
1797	0521	9/08	Knox	5?	14.54	37.73	40.57	7.16	4.47	.....	11187	.....
					Dry 44.15		47.46	8.39	5.24	.....	13090	14578
1798	1132	9/08	Knox	5?	14.45	36.74	38.76	10.05	2.23	.....	10820	.....
					Dry 42.95		45.31	11.74	2.60	.....	12645	14475
2769	0622	.....	Knox	6?	17.94	33.99	39.47	8.60	2.60	.....	10367	.....
					Dry 48.10		41.42	10.48	3.16	.....	12632	14353
2756	1336	.....	Knox	?	13.30	41.17	38.85	6.68	3.15	.....	11603	.....
					Dry 47.85		44.81	7.71	3.63	.....	13383	14721
5263	0730	8/12	Logan	5	14.64	37.87	35.56	11.93	3.60	1.10	10400	.....
	C33				Dry 44.36		41.66	13.98	4.22	1.28	12183	14497
5264	0730	8/12	Logan	5	13.98	36.86	37.98	11.18	3.14	1.43	10549	.....
	C33				Dry 42.84		44.16	13.00	3.65	1.67	12264	14391
5265	0730	8/12	Logan	5	13.99	36.85	38.17	10.99	3.26	1.32	10519	.....
	C33				Dry 42.85		44.37	12.78	3.79	1.53	12230	14313
US 2881(e	0730	.....	Logan	5	14.77	32.90	39.75	12.58	3.95	.....	10406	.....
US 2882(e	0730	.....	Logan	5	15.52	32.27	39.86	12.35	3.65	.....	.....	.....
US 3003(e	0730	.....	Logan	5	15.68	32.41	39.82	12.09	3.51	.....	10215	.....
720	0730	9/07	Logan	5	14.80	.....	.....	11.76	3.03	.....	10586	.....
					Dry		.....	13.81	3.56	.....	12426	14626
1889	1514	10/08	Logan	5	11.83	36.45	40.92	10.80	2.98	.....	10912	.....
					Dry 41.33		46.42	12.25	3.38	.....	12376	14261

d) The Knox County analyses were not included in making the averages for Table 4 because of the uncertainty of identification of the coals in that area.

e) U. S. Geological Survey Bull. 322, p. 103, 1908.

TABLE 3—*Analyses of mine samples from District IV*—Continued

Lab. No. [a]	File No. [b]	Date of analysis [c]	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
5426	1905 C100	8/12	McLean	2	10.13	45.00	35.92	8.95	3.27	.74	11710	.....
					Dry	50.07	39.97	9.96	3.59	.82	13029	14723
5427	1905 C100	8/12	McLean	2	11.34	40.05	39.18	9.43	3.18	.90	11394	.....
					Dry	45.17	44.19	10.64	3.58	1.01	12851	14643
5428	1905 C100	8/12	McLean	2	10.61	41.87	35.94	11.58	3.79	.92	11225	.....
					Dry	46.84	40.21	12.95	4.24	1.03	12557	14752
5429	1905 C100	8/12	McLean	2	12.31	42.17	38.03	7.49	2.69	.94	11636	.....
					Dry	48.09	43.37	8.54	3.07	1.07	13270	14722
5430	1905 C100	8/12	McLean	2	12.00	42.00	37.96	8.04	2.37	1.23	11634	.....
					Dry	47.73	43.14	9.13	2.70	1.40	13220	14759
5433	1905 C100	8/12	McLean	2	11.27	42.17	39.27	7.29	2.91	1.12	11784	.....
					Dry	47.53	44.25	8.22	3.28	1.26	13279	14684
1748	1905	8/08	McLean	2	12.02	40.86	38.21	8.91	2.96	.....	11419	.....
					Dry	46.44	43.43	10.13	3.36	.....	12980	14635
1749	1905	8/08	McLean	2	12.56	39.44	35.70	12.30	4.15	.....	10754	.....
					Dry	45.10	40.84	14.06	4.74	.....	12299	14591
US 3044[f]	0100	.....	McLean	5	10.25	35.88	40.11	13.76	2.80	.....	11149	.....
US 3045[f]	0100	.....	McLean	5	9.88	35.99	38.22	15.91	3.15	.....	.....	.....
5431	1905 C100	8/12	McLean	5	12.88	38.84	35.80	12.48	3.60	1.17	10601	.....
					Dry	44.58	41.09	14.33	4.14	1.35	12168	14544
5432	1905 C100	8/12	McLean	5	13.34	38.39	36.72	11.55	3.59	1.31	10743	.....
					Dry	44.30	42.37	13.33	4.14	1.51	12397	14629
5434	1905 C100	8/12	McLean	5	13.73	36.79	36.14	13.34	3.99	1.19	10399	.....
					Dry	42.64	41.89	15.47	4.62	1.30	12054	14639
1847	1103	9/08	McLean	6?	14.15	37.00	37.23	11.62	2.42	.....	10719	.....
					Dry	43.08	43.38	13.54	2.82	.....	12485	14607
5200	1114 C42	7/12	Macon	5	13.52	36.72	39.66	10.10	4.23	.09	10646	.....
					Dry	42.46	45.86	11.68	4.95	.11	12443	14405
5201	1114 C42	7/12	Macon	5	13.62	37.72	40.34	8.32	3.39	.00	11046	.....
					Dry	43.68	46.70	9.62	3.93	.00	12788	14403
5202	1114 C42	7/12	Macon	5	14.36	38.06	39.35	9.33	3.87	.19	10963	.....
					Dry	43.88	45.37	10.75	4.46	.22	12638	14447
1569[a]	1114	6/08	Macon	5	13.91	37.00	39.33	9.76	3.29	.....	10804	.....
					Dry	42.95	45.72	11.33	3.82	.....	12549	.....
5244	W1212 C41	7/12	Macon	5	14.76	35.46	38.08	11.70	3.24	.90	10390	.....
					Dry	41.60	44.67	13.73	3.81	1.06	12189	14443
5245	W1212 C41	7/12	Macon	5	14.54	36.33	38.01	11.12	3.47	.68	10465	.....
					Dry	42.51	44.47	13.01	4.06	.79	12244	14385
5346	W1212 C41	7/12	Macon	5	14.14	36.21	38.07	11.58	3.24	1.12	10493	.....
					Dry	42.18	44.34	13.48	3.77	1.31	12210	14433
1874	W1212	10/08	Macon	5	14.07	37.10	36.66	10.17	3.68	.....	10780	.....
					Dry	43.19	43.99	11.82	4.28	.....	12545	14470

[f]) U. S. Bureau of Mines Bull. 22, Part I, p. 85, 1913.

TABLE 3—*Analyses of mine samples from District IV*—Continued

Lab. No.[a]	File No.[b]	Date of analysis[c]	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free.				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
2804	1332	12/09	Macon	6	15.42 Dry	39.68 41.96	44.05 46.57	10.85 11.47	4.25 4.50	.....	11814 12492	 14396
1411	1814	4/08	Peoria	2	12.05 Dry	40.49 46.03	37.88 43.07	9.58 10.90	3.94 4.48	.....	11316 12866	 14698
1409	1224	4/08	Peoria	5	13.45 Dry	34.81 40.22	37.32 43.12	14.42 16.66	3.09 3.58	.....	10398 12014	 14636
US22982[g]	1510	.....	Peoria	5	15.03	34.56	39.05	11.36	2.64	.....	10490	.....
US22983[g]	1510	.....	Peoria	5	15.41	33.87	38.85	11.87	2.88	.....	10386	.....
US22984[g]	1510	.....	Peoria	5	15.51	34.77	38.68	11.03	2.62	.....	10489	.....
US22985[g]	1510	.....	Peoria	5	15.57	34.08	38.18	12.17	3.42	.....	10283	.....
5289	1610 C25	8/12	Peoria	5	14.23 Dry	36.65 42.73	37.04 43.18	12.08 14.09	3.39 3.96	1.55 1.81	10483 12220	 14553
5290	1610 C25	8/12	Peoria	5	14.54 Dry	37.41 43.77	37.32 43.67	10.73 12.56	3.27 3.82	1.18 1.38	10705 12526	 14625
5291	1610 C25	8/12	Peoria	5	16.00 Dry	36.46 43.41	37.28 44.38	10.26 12.21	3.65 4.35	.90 1.07	10583 12598	 14664
2642	1610	7/09	Peoria	5	16.16 Dry	35.41 42.23	39.52 47.14	8.91 10.63	2.38 2.84	.....	10895 12995	 14644
1410	1610	4/08	Peoria	5	14.73 Dry	35.92 42.13	36.74 43.09	12.61 14.78	3.38 3.97	.....	10451 12257	 14619
5303	1612 C26	8/12	Peoria	5	16.00 Dry	36.06 42.93	37.54 44.69	10.40 12.38	2.90 3.46	1.27 1.51	10515 12518	 14773
5304	1612 C26	8/12	Peoria	5	14.23 Dry	37.41 43.62	37.36 43.56	11.00 12.82	3.14 3.66	2.17 2.53	10573 12327	 14433
5305	1612 C26	8/12	Peoria	5	14.76 Dry	35.95 42.18	35.34 41.46	13.95 16.36	3.19 3.74	2.00 2.34	10173 11935	 14636
US21032[g]	1626	.....	Peoria	5	15.66	34.74	40.38	9.22	2.64	.....	10798	.....
US21033[g]	1626	.....	Peoria	5	15.38	34.51	39.48	10.63	2.75	.....	10645	.....
US21034[g]	1626	.....	Peoria	5	15.34	34.25	40.80	9.61	3.11	.....	10741	.....
1403	1626	4/08	Peoria	5	14.29 Dry	34.79 40.60	37.67 43.94	13.25 15.46	2.71 3.16	.....	10365 12094	 14493
2644	1814	8/09	Peoria	5	15.41 Dry	35.33 41.77	38.57 45.59	10.69 12.64	3.60 4.25	.....	10677 12622	 14697
2643	1926	8/09	Peoria	5?	15.34 Dry	34.92 41.25	37.62 44.44	12.12 14.31	2.85 3.37	.....	10497 12385	 14685
2637	0424	7/09	Peoria	6	17.16 Dry	35.66 43.05	38.11 46.00	9.07 10.95	2.78 3.36	.....	10465 12633	 14371
2640	0103	7/09	Peoria	7	14.54 Dry	34.01 39.79	37.07 43.38	14.38 16.83	3.05 3.57	.....	10155 11881	 14493

g) U. S. Bureau of Mines Bull. 123, p. 35, 1918.

TABLE 3—*Analyses of mine samples from District IV*—Continued

Lab. No. (a	File No. (b	Date of analysis (c	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free.				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
5187	0317 C40	7/12	Sangamon	5	14.82 Dry	37.18 43.65	38.22 44.87	9.78 11.48	4.30 4.52	.72 .84	10683 12541	1448
5188	0317 C40	7/12	Sangamon	5	16.05 Dry	35.58 42.38	38.04 45.32	10.33 12.30	4.18 4.98	.17 .20	10413 12404	1447
5189	0317 C40	7/12	Sangamon	5	14.31 Dry	37.31 43.54	38.20 44.58	10.18 11.88	4.21 4.91	.90 1.05	10655 12434	1425
5166	0436 C39	7/12	Sangamon	5	13.38 Dry	37.20 42.95	36.40 42.03	13.01 15.02	4.78 5.52	.96 1.10	10338 11934	1443
5167	0436 C39	7/12	Sangamon	5	13.35 Dry	36.64 42.27	37.12 42.85	12.89 14.88	4.80 5.53	.84 .97	10348 11942	1442
5168	0436 C39	7/12	Sangamon	5	13.19 Dry	38.44 44.28	36.47 42.00	11.90 13 72	4.61 5.31	1.05 1.20	10513 12110	1439
5128	0913 C37	7/12	Sangamon	5	14.08 Dry	37.38 43.51	37.56 43.71	10.98 12.78	3.97 5.17	.38 .49	9471 12337	1449
5129	0913 C37	7/12	Sangamon	5	13.86 Dry	37.11 43.08	39.05 45.34	9.98 11.58	2.57 4.07	.52 .61	10726 12451	1436
5118	1010 C36	7/12	Sangamon	5	16.05 Dry	35.82 42.66	37.14 44.25	10.99 13.09	3.55 4.22	.67 .80	10330 12306	1447
5119	1010 C36	7/12	Sangamon	5	15.53 Dry	36.36 43.04	38.05 45.05	10.06 11.91	3.86 4.57	.55 .66	10522 12457	1445
5120	1010 C36	7/12	Sangamon	5	14.45 Dry	37.46 43.79	38.27 44.73	9.82 11.48	3.59 4.19	.55 .65	10704 12512	1442
5196	1503 C38	7/12	Sangamon	5	14.25 Dry	37.25 43.44	37.07 43.24	11.43 13.32	4.76 5.55	.98 1.15	10414 12147	1438
5197	1503 C38	7/12	Sangamon	5	14.10 Dry	38.74 45.09	37.66 43.85	9.50 11.06	3.86 4.50	.75 .87	10790 12564	1441
5198	1503 C38	7/12	Sangamon	5	14.44 Dry	38.22 44.67	37.68 44.04	9.66 11.29	3.79 4.43	.63 .73	10746 12549	1443
5199	1503 C38	7/12	Sangamon	5	14.08 Dry	38.05 44.28	35.30 41.09	12.57 14.63	5.87 6.83	.60 .69	10228 11903	1436
5130	2421 C74	7/12	Sangamon	6	15.22 Dry	38.23 45.09	37.36 44.07	9.19 10.84	4.38 5.17	.38 .45	10579 12478	1430
5131	2421 C74	7/12	Sangamon	6	13.10 Dry	38.86 44.72	37.25 42.86	10.79 12.42	5.08 5.86	.41 .47	10592 12187	1426
5132	2421 C74	7/12	Sangamon	6	14.43 Dry	38.14 44.58	37.07 43.32	10.36 12.10	4.77 5.58	.40 .47	10495 12265	1429
5115	2515 C75	8/12	Sangamon	6	14.97 Dry	36.90 43.39	38.36 45.12	9.77 11.49	3.53 4.16	.59 .67	10598 12466	1436
5116	2515 C75	8/12	Sangamon	6	14.51 Dry	37.60 43.98	39.69 46.43	8.20 9.59	3.44 4.02	.22 .25	10911 12763	1437
5117	2515 C75	8/12	Sangamon	6	12.98 Dry	38.23 43.94	38.92 44.72	9.87 11.34	4.32 4.96	.56 .65	10845 12463	1436

TABLE 3.—*Analyses of mine samples from District IV*—Concluded

Lab. No. [a]	File No. [b]	Date of analysis [c]	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free				Sulphur	CO_2	B. t. u.	Unit coal
					Moisture	Volatile matter	Fixed carbon	Ash				
9708	0136	11/16	Schuyler	2	12.73	37.56	41.88	7.83	4.77	.....	11621	.....
					Dry	43.04	47.99	8.97	5.46	.....	13316	14924
9709	0136	11/16	Schuyler	2	12.34	38.11	42.29	7.26	4.32	.....	11841	.....
					Dry	43.48	48.24	8.28	4.92	.....	13507	15011
1812	0819	9/08	Schuyler	6	12.99	37.28	38.62	11.11	3.75	.....	11057	.....
					Dry	42.84	44.40	12.76	4.31	.....	12709	14827
5277	0906a C27	7/12	Tazewell	5	14.71	37.46	38.57	10.26	3.51	1.15	10801	.....
					Dry	40.06	44.03	11.91	4.07	1.33	12516	14500
5278	0906a C27	7/12	Tazewell	5	13.88	37.58	40.01	8.53	2.55	.95	11076	.....
					Dry	43.64	46.45	9.91	2.96	1.10	12860	14499
5281	0906a C27	8/12	Tazewell	5	15.56	37.60	36.70	10.14	3.23	1.50	10552	.....
					Dry	44.53	43.46	12.01	3.83	1.78	12496	14488
1412	0407	4/08	Tazewell	6	14.30	36.74	39.11	9.85	3.34	.....	10875	.....
					Dry	42.87	45.64	11.49	3.90	.....	12690	14562
1413	0906a	4/08	Tazewell	6	14.35	36.95	38.04	10.66	3.02	.....	10709	.....
					Dry	43.14	44.41	12.45	3.53	.....	12504	14482

a) The analyses that have "US" laboratory numbers were made by either the U. S. Bureau of Mines or the U. S. Geological Survey, as indicated in following footnotes which make reference to their place of publication.

b) Analyses having the same file number are for a single mine. It should be remembered that as much dependence can not be placed on a single analysis from a given mine as may be placed on a group from one mine.

Analyses having "C" file numbers are republished from State Geological Survey Bulletin 29, and Illinois Mining Investigations Bulletin 3, and belong to a series made by J. M. Lindgren under the general supervision of Professor S. W. Parr of the University of Illinois, for those bulletins.

c) The Fulton County analyses that have April, 1921, as the date of analysis, were made on samples collected by or under the supervision of H. E. Culver of the Survey staff.

TABLE 4.—*Average analytical and heat values for No. 1, No. 2, No. 5, No. 6 and No. 7 coals by counties and for the district*

No. of analyses	No. of mines	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free				Sulphur	CO_2	B. t. u.	Unit coal
				Moisture	Volatile matter	Fixed carbon	Ash				
				NO. 1 COAL							
3	1	Christian	1	11.31	38.89	40.94	8.86	2.35	.64	11603	.....
				Dry 43.85	46.16	9.99	2.65	.72	13081	14717	
4	1	Fulton	1	12.71	38.19	39.79	9.31	4.70	.62	11387	.....
				Dry 43.77	45.61	10.62	5.37	.70	13052	14939	
7	2	Average	1	12.11	38.49	40.29	9.12	3.69	.63	11479	.....
				Dry 43.80	45.84	10.35	4.20	.71	13065	14844	
				NO. 2 COAL							
4	1	Christian	2	12.61	38.39	41.43	7.42	3.32	.21	11601	.....
				Dry 44.11	47.41	8.48	3.80	.24	14276	14746	
1	1	Fulton	2	14.87	35.80	43.88	5.45	.....	.....	11641	.....
				Dry 42.06	51.54	6.40	3.69	.....	13674	14083	
8	1	McLean	2	11.53	41.45	37.53	9.25	3.17	.98	11445	.....
				Dry 47.12	42.43	10.45	3.57	1.10	12936	14686	
1	1	Peoria	2	12.05	40.49	37.88	9.58	3.94	.....	11316	.....
				Dry 46.03	43.07	10.90	4.48	.....	12866	14698	
2	1	Schuyler	2	12.54	37.81	42.09	7.55	4.55	.....	11731	.....
				Dry 43.26	48.12	8.63	5.19	.....	13412	14968	
16	5	Average	2	12.16	39.92	39.49	8.36	3.44	.72	11524	.....
				Dry 45.50	44.99	9.50	3.89	.81	13122	14701	
				NO. 5 COAL							
48	14	Fulton	5	15.36	35.04	38.00	10.90	3.13	1.48	10421	.....
				Dry 41.95	44.90	13.14	3.68	1.70	12295	14465	
8	2	Logan	5	14.40	35.09	38.87	11.71	3.39	1.28	10512	.....
				Dry 42.85	44.15	13.16	3.72	1.49	12296	14418	
5	2	McLean	5	12.02	37.18	37.40	13.41	3.43	1.22	10723	.....
				Dry 43.84	41.78	14.38	4.30	1.39	12206	14572	
8	2	Macon	5	14.14	36.83	38.69	10.26	3.55	.50	10698	.....
				Dry 42.56	45.14	11.93	4.14	.58	12451	14427	
18	6	Peoria	5	15.09	35.39	38.17	11.34	3.04	1.51	10536	.....
				Dry 42.33	43.98	13.69	3.71	1.77	12372	14616	
15	5	Sangamon	5	14.35	37.30	37.57	10.78	4.16	.59	10555	.....
				Dry 43.55	43.86	12.59	4.86	.69	12323	14415	
3	1	Tazewell	5	14.72	37.55	38.43	9.64	3.09	1.20	10810	.....
				Dry 42.74	44.65	11.28	3.62	1.40	12624	14496	
105	37	Average	5	14.83	35.73	38.05	11.07	3.33	1.24	10497	.....
				Dry 42.43	44.49	13.01	3.95	1.43	12326	14474	

TABLE 4—Concluded

No. of analyses	No. of mines	County	Coal bed	Proximate analysis of coal 1st: "As recd," with total moisture. 2nd: "Dry" or moisture free. Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	CO_2	B. t. u.	Unit coal
				NO. 6 COAL							
1	1	Macon	6	15.42	39.68	44.05	10.85	4.25	.....	11814	.....
				Dry	41.96	46.57	11.47	4.50	.....	12492	14396
1	1	Peoria	6	17.16	35.66	38.11	9.07	2.78	.....	10465	.....
				Dry	43.05	46.00	10.95	3.36	.....	12633	14371
6	2	Sangamon	6	14.20	37.99	38.11	9.70	4.26	.42	10671	.....
				Dry	44.28	44.42	11.30	4.96	.49	12437	14329
1	1	Schuyler	6	12.99	37.28	38.62	11.11	3.75	.....	11057	.....
				Dry	42.84	44.40	12.76	4.31	.....	12709	14827
2	2	Tazewell	6	14.33	36.85	38.58	10.26	3.18	.....	10297	.....
				Dry	43.01	45.03	11.97	3.72	.....	12597	14522
11	7	Average	6	14.49	37.66	38.78	9.97	3.88	.42	10813	.....
				Dry	43.60	44.87	11.54	4.49	.49	12514	14418
				NO. 7 COAL							
1	1	Peoria	7	14.54	34.01	37.07	14.38	3.05	.....	10155	.....
				Dry	39.79	43.38	16.83	3.57	.....	11881	14493

TABLE 5.—*Average analyses of Illinois coals by districts*

(Figures are for coal as received)

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

District	Coal bed	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	B. t. u.	Number of samples averaged
LaSalle	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 [a]	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	38.29	38.75	9.98	2.93	11143	18 from 2 mines
Danville: Danville coal	7	12.99	38.29	38.75	9.98	2.93	11143	18 from 2 mines

a) The difference in the average analysis here given from that given in Table 4 is explained by the fact that (1) a somewhat larger area is covered by Table 4, and (2) more analyses have been used in arriving at the Table 4 average, some of them from the United States laboratories, and others made very recently.

STRUCTURE

The structure of the several counties covered by this report is discussed in some detail by county units in Part II. For the convenience of those interested in the structure of District IV as a whole, Plates I and III have been prepared.

On the map, Plate I, structure contours on the top of No. 5 coal show the lay of the rock in the area as closely as it can be determined from a study of outcrops and available drill and shaft records. The locations of all the active shipping mines in the district and of such other mines and borings as gave information useful in the preparation of the map, are also shown, as well as the position of the outcrop of No. 5 coal.

Plate III consists of three structure sections, two approximately east and west and one north and south across the district.

The numbered red lines on the map, Plate I, are structure contours on No. 5 coal. Any given contour connects all known points where the elevation of No. 5 coal is the same and the numbers on the lines state that elevation. In Plate I, the contour interval used west of Illinois River is 25 feet, which means that between any two adjacent contours the coal bed dips more or less uniformly from the higher elevation to the lower. East of the Illinois the interval is 50 feet, and a fifty-foot change in elevation from one contour to the next is implied.

Study of the structure shown on the map shows that the general regional dip is to the southeast, from 650 feet above sea level in south-central Knox County to only 50 feet above sea level in southeastern Mason County.

This regional dip in the direction of the major synclinal basin that roughly parallels the La Salle anticline. In Eastern McLean County is found the only exception to the general regional dip—there the strata are beginning to rise, as shown by the No. 5 coal contours, to form the west flank of the La Salle anticline.

It will be noticed that the contours are more irregular in Peoria, Fulton, and Sangamon counties than in the remainder of the area. This difference does not mean that in those counties dips are more variable than they are elsewhere; in all probability irrgularities of the same sort characterize the whole district, but outside the counties mentioned, well logs and outcrops are so few and scattered that it was not possible to work out details of structure.

PART II.—COUNTY REPORTS

INTRODUCTION

The detailed description of the geological conditions in the district as affecting mining is thought to be most conveniently presented by the county unit. County reports are therefore presented in alphabetical order in the following pages.

A complete list of shipping mines in District IV for the year 1920 is given herewith as table 6.

TABLE 6.—*List of shipping mines in District IV, 1920*

Map No.	Name of company	No. or name of mine	Location					Surf. elev.	Depth to No. 5 coal[a]	Alt. of top of coal	No. of coal	Thickness		Production 1917[b]	Production 1920[b]
			¼	¼	Sec.	T. N.	R.								
	Fulton County								*Feet*			*Ft.*	*in.*		
1	Alden Coal Co.	No. 5	Cent.	N½	2	8	4 E.	745	185	560	5	4	4	120,020	4,826
2	Alden Coal Co.	No. 6	NW	SW	27	8	4 E.	762	190	572	5	4	3	127,839	115,105
3	Alden Coal Co.	No. 8	Cen.	SE	3	8	4 E.	680 ±	70	610	5	4	0	163,876	143,979
4	Big Creek Coals, Inc.	No. 2	SE	SW	16	6	4 E.	578	.....	578	5	5	0	300,127	238,400
5	E. G. Bader	Eclipse	NW	SE	14	3	1 E.	.....	.....	.....	.....	.....		.....	21,259
6	Big Creek Coal Co. (abandoned)	No. 3	SE	NE	20	6	3 E.	683	55	628	5	5	2	113,717	.....
7	Big Creek Coals, Inc.	No. 4	NE	SE	22	6	4 E.	637?	82	555?	5	5	6	207,007	158,390
8	Big Six Coal Co.	Big Six	NE	NW	31	8	3 E.	.....	drift	635 ±	5	4	0	.....	.....
9	Binzel Coal Co.	No. 1 (Binzel)	NW	SE	4	8	4 E.	660 ±	41	620	5	4	8	.....	36,953
10	Canton Coal Co.	No. 1	NW	SW	34	8	4 E.	740	180	560	5	4	1	.....	154,973
11	Coal Creek Mining Co.	Parrville	NW	SW	30	8	3 E.	.....	drift	638	5	4	0	41,930	24,035
12	Cripple Creek Coal Co.	No. 1	SW	SW	24	6	3 E.	.....	drift	.....	5	4	8	.....	200,338
13	Cripple Creek Coal Co.	No. 2	SW	SW	24	6	3 E.	.....	drift	.....	5	.....		.....	
14	Eagle Mining Co.	Eagle	SE	SE	32	7	4 E.	683	103	580	5	4	10	128,085	91,021
15	Genuine Norris Coal Mining Co.	Genuine Norris	SE	SE	34	8	4 E.	735	180	555	5	4	1	66,129	.....
16	Maplewood Coal Co.	No. 1	SE	NW	11	8	4 E.	720	122	598	5	4	2	78,441	77,503
17	Maplewood Colliery Co.	No. 2	NW	SE	15	8	4 E.	760	146	614	5	4	2	132,053	60,250
18	Middleton Coal Co.	Middleton	NE	SW	33	7	4 E.	660	60	600	5	4	8	.....	35,957
19	Monmouth Coal Co.	No. 1	NW	NW	11	7	4 E.	705 ±	142	563 ±	5	4	6	172,413	136,304
20	National Coal Mining Co.	National	SE	SW	5	8	4 E.	710	105	605	5	4	0	150,074	155,551
21	Rawalt Coal Co.	Rawalt	NE	NE	36	7	4 E.	655	76	579	5	4	8	.....	20,667
22	Shuler and Long	Parrville	NW	NW	31	8	3 E.	.....	.....	.....	.....	.....		.....	7,021
23	Silver Creek Colliery Co.	No. 1	SW	SE	4	8	4 E.	675	41	634	5	4	0	279,708	186,798
24	Simmons Coal Co.	Simmons	SW	SW	14	7	4 E.	682	121	561	5	4	6	137,674	88,216
25	Spoon River Colliery Co.	Ellisville: No. 1	NE	SW	28	8	2 E.	.....	36[c]	.....	1	4	6	102,239	78,405
26	Star Coal Co.	Fiatt: No. 1	NW	SW	28	7	3 E.	687	56	631	5	4	10	37,000	41,721
27	Star Coal Co.	No. 3	NW	SE	20	6	3 E.	659	26	633	5	4	11	147,278	64,449
	Logan County														
1	Citizens Coal Mining Co.	Citizens	SW	NW	32	20	2 W.	590	266	324	5	5	0	177,849	155,223
2	Latham-Lincoln Mining Co.	Latham	SE	NE	30	20	2 W.	600 ±	280	320 ±	5	.....		256,642	239,877
3	Lincoln Mining Co. (abandoned)	No. 1	SE	NE	36	20	3 W.	587	280	307	5	5	0	162,020	.....

(a) Unless otherwise specified.
(b) For the fiscal year; as reported to the Department of Mines and Minerals and published in the annual coal reports.
(c) No. 1 coal.

TABLE 6.—*List of shipping mines in District IV, 1920*—Continued

Map No.	Name of company	No. or name of mine	Location					Surf. elev.	Depth to No. 5 coal(a)	Alt. of top of coal	No. of coal	Thickness		Production 1917(b)	Production 1920(b)
			¼	¼	Sec.	T. N.	R.								
	Macon County								*Feet*			*Ft.*	*in.*		
1	Decatur Coal Co.	No. 2	NE	NW	14	16	2 E.		610			4	0	73,937	90,504
2	Macon County Coal Co.	No. 1	W½	SW	14	16	2 E.	685 ±	555	130	5	4	3	180,105	121,904
3	Niantic Carbon Coal Co.	Niantic	SW	NW	12	16	1 W.	603 ±	360	243	5	5	6	4,962	6,412
	McLean County														
1	McLean County Coal Co.	McLean Co.	NW	SE	5	23	2 E.	785	375	410	5	4	6		
2	C. H. H. Fisher, Receiver	Colfax: No. 1	SE	SE	3	24	5 E.	750	513(d	272	2	3	6	77,083	43,357
									406(e	344	6?	5	5	12,329	
	Menard County														
1	Union Fuel Co.	No. 4: Athens	SW	NW	36	18	6 W.	605	203	402	5	5	8	155,878	99,114
	Peoria County														
1	Clark Coal and Coke Co.	Empire: No. 2	SW	SE	10	8	7 E.	650 ±	181	469	5	4	0	232,594	243,559
2	Collier Cooperative Coal Co.	No. 1	SE	NE	26	8	7 E.	635 ±	106	529	5	4	3	61,314	41,360
3	Crescent Coal Co.	No. 1	SE	NW	12	8	7 E.	470	196	274	5	4	6	158,340	138,575
4	East Mapleton Coal Co.	No. 1	SW	SE	19	7	7 E.	472	22¼ (drift)	450 ±	5	4	6	28,454	
5	East Mapleton Coal Co.	East	NE	SE	20	7	7 E.	450 ±	drift	450 ±	5	5	0		
6	John A. Hoffman	Blue Fly	NW	SW	36	9	7 E.	465	106(d	359	2	2	6		
7	Lancaster Coal Co.	No. 1: Kingston	SW	NE	27	7	6 E.		drift		5	4	5	26,122	23,209
8	Leitner Coal Co.	Leitner	NW	NW	12	7	7 E.	460?	17 (drift)	443	5	4	8	27,619	27,597
9	Logan Coal Co.	No. 1	NE	SE	10	8	6 E.	735?	236?	499?	5			118,466	101,708
10	M. E. Case Coal Co.	Walben: No. 1	SE	NW	1	7	7 E.	487	16 (drift)	471	5	4	2	221,254	105,505
11	Newsam Bros.	Glasford: No. 4	NE	NE	28	7	6 E.	615?	148?	467?	5	4	6	110,587	112,311
12	Newsam Bros.	LaMarsh: No. 5	NE	NE	8	7	7 E.				5	4	6		55,262
13	Warsaw Coal Co.(f)	Warsaw	NE	NW	24	9	6 E.	625			5	4	4	94,256	70,488
14	Wolschlag Cooperative Coal Co.	Wolschlag	NE	SW	36	8	7 E.				5			273,315	131,661
	Sangamon County														
1	Bissell Coal Co.	Bissell	NW	SW	8	16	4 W.	568	235	334	5	5	6	20,657	153,934
2	Chicago-Springfield Coal Co.	C-S	SW	NW	12	16	5 W.	565	230	335	5	6	2	347,523	182,082
3	Chicago, Wilmington & Franklin Coal Co.	Thayer	SW	SW	34	13	6 W.	648	300	348	6	7	0		568,001

(d) No. 2 coal.

(e) Identification of coal uncertain; possibly No. 6.

(f) In the SW. ¼ of this section, the Warsaw Coal Company has two drift mines, No. 3 and No. 4, which are run as one mine, the tipple being in the NW. ¼.

TABLE 6.—*List of shipping mines in District IV, 1920*—Concluded

Map No.	Name of company	No. or name of mine	Location					Surf. elev.	Depth to No. 5 coal[a]	Alt. of top of coal	No. of coal	Thickness		Production 1917[b]	Production 1920 [b]
			¼	¼	Sec.	T. N.	R.								
									Feet			*Ft.*	*in.*		
4	Citizens Coal Mining Co	"A"	NW	NW	32	16	5 W.	590 ±	207	383 ±	5	5	4	60,458	171,331
5	Citizens Coal Mining Co	"B"	SW	SE	31	16	5 W.	605 ±	204	401 ±	5	5	9	235,947	193,020
6	Dawson Coal Mining Co	Dawson	NW	NW	8	16	3 W.	597	250	347	5	5	2	58,507	106,941
7	Illinois Coal & Coke Corporation	No. 400	SW	SW	14	16	5 W.	582	244	338	5	5	9	219,513	199,527
8	Lincoln Park Coal & Brick Co	Lincoln Park	SE	SW	21	16	5 W.	569	204	365	5	5	9	98,846	101,331
9	Madison Coal Corporation	No. 6	NE	SW	21	13	5 W.	610 ±	330	280	6	...	...	.....	777,561
10	Panther Creek Mines, Inc	Panther Creek	NE	NE	35	14	6 W.	.....	.....	.....	6	...	...	.....	318,752
11	Peabody Coal Co	No. 5	SW	NE	12	13	5 W.	628	322	306	6	6	0	.....	183,238
12	Peabody Coal Co	No. 6	SE	SE	36	17	5 W.	550	198	352	5	6	0	429,721	379,052
13	Peerless Coal Co	Peerless	NW	SW	13	16	5 W.	580	223	357	5	5	10	450,455	420,061
14	Sangamon Coal Co	Sangamon: No. 2	NE	NE	26	16	5 W.	592?	250?	342?	5	5	10	330,339	348,602
15	Sangamon Coal Co	No. 3	SE	NW	8	17	5 W.	602	206	396	5	6	1	25,082	36,803
16	Sangamon County Mining Co	Jefferson	NW	SW	1	15	5 W.	582	240	342	5	5	9	84,313	224,422
17	Spring Creek Coal Co	Spring Creek	NW	SE	19	16	5 W.	.....	.....	.....	5	...	...	143,463	196,496
18	Springfield Cooperative Coal Co	Cooperative	NW	NW	23	16	5 W.	585	245	340	5	...	...	191,800	164,730
19	Springfield District Coal Mining Co	Cora: No. 51	SW	SE	27	17	5 W.	530	145	385	5	...	...	197,698	145,104
20	Springfield District Coal Mining Co	No. 52	NW	SE	10	16	4 W.	550	232	318	5	5	11	500,517	323,621
21	Springfield District Coal Mining Co	Woodside: No. 53	NW	SW	3	15	5 W.	600	245	355	5	6	6	296,983	278,081
22	Springfield District Coal Mining Co	No. 54 (Black Diamond)	SW	SE	15	13	6 W.	603	244	359	6	...	...	.....	350,190
23	Springfield District Coal Mining Co	No. 55	SW	NW	9	15	5 W.	607	250	357	5	5	11	320,295	276,768
24	Springfield District Coal Mining Co	Capital: No. 57	NE	NW	35	16	5 W.	598	220	378	5	6	0	213,201	161,760
25	Union Fuel Co	No. 2	SE	NE	6	15	4 W.	575 ±	220	350	5	5	8	180,711	141,065
26	Union Fuel Co	No. 3	NE	NE	10	13	6 W.	628	264	364	6	6	8	.....	168,873
27	Union Fuel Co	No. 5	SE	NW	17	17	4 W.	590	267	323	5	5	8	.....	14,193
28	West End Coal Co	West Shaft	SE	NE	29	16	5 W.	530	145	385	5	5	10	283,673	231,060
	Tazewell County														
1	Groveland Coal Mining Co	No. 1	SW	NW	7	25	4	535?	85	450?	5	4	4	217,491	201,370
2	Groveland Coal Mining Co	No. 2	NE	NE	18	25	4	614	165	449	5	4	4	.....	568,001
3	Johnston City Big Muddy Coal and Mining Co	No. 3	NW	NW	6	24	4	600	205	395	5	4	8	.....	21,007
4	Lake Erie Mining Co	Lake Erie	NW	NE	6	25	4	.....	.....	.....	5	4	4	27,883	88,007
5	Tazewell Coal Co	Tazewell	SW	NW	6	24	4	580	162	418	5	4	8	146,627	112,540
6	Ubben Coal Co	Ubben	SE	SW	1	24	5	540	100	440	5	4	10	29,900	36,696

CASS COUNTY

Production and Mines

Production in tons, year ended June 30, 1920	4,233
Average annual production, 1916 to 1920	1,858
Total production, 1881 to 1920	155,785

The production in 1920 came from four local mines, two along the Illinois valley bluff near Beardstown, one at Chandlerville, and one at Ashland. These mines are all small, so that the resources of this county are essentially untouched.

Coal-bearing Rocks

All of Cass County is underlain by "Coal Measures" strata except for the area between Illinois River and its valley bluff, and in the lower part of the Sangamon valley, below Chandlerville, where the "Coal Measures" have been entirely eroded, so as to expose the underlying Mississippian limestone.

Since the line of outcrop of No. 5 coal nearly coincides with the eastern boundary of the county, it is believed that most of the area is underlain by Pennsylvanian strata older than No. 5 coal, that is by strata of lower Carbondale and Pottsville age. These formations contain at least one and probably two beds of coal neither of which, apparently, is more than three feet thick. The most widespread of these coals is the No. 2 (Colchester, Murphysboro, or La Salle "Third Vein") coal which outcrops along the Illinois and Sangamon valley bluffs between Bluff Springs and Chandlerville, and has been mined at Virginia at a depth of about 200. It is probably this same bed which at one time was mined at Ashland at a depth of 205 feet.[1] As the identity of this coal is not determined, and as it may be younger than No. 2, it may be the same as a bed encountered in a drill hole just south of Springfield, between 50 and 60 feet below No. 5 (Springfield) coal.

The character of the strata with which the coals are interbedded is not well known. Worthen[2] reports the following succession taken at an old shaft near Bluff Springs:

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[1]Third Biennial Report of the Bureau of Labor Statistics, p. 506, 1884.
[2]Geological Survey of Illinois. Vol. 4. p. 165, 1870.

Section of Pennsylvanian strata near Bluff Springs, Cass County

		Thickness *Feet*	Depth *Feet*
1.	Soil (loess)	15	15
2.	Sandstone, brownish, with plant impressions	13	28
3.	Limestone ("blue rock")	2	30
4.	Clay shale ("soapstone")	12	42
5.	Coal	3	45
6.	Fire clay, very hard	4	49

The sandstone, No. 2 of the above section, can be traced along the bluff northeastward nearly to Chandlerville, and it is present in the shaft at Virginia with a thickness of 70 feet, as may be noted in the following drill record of a coal prospect at that place.

Record of a boring for coal at Virginia, Cass County, Illinois[1]

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Quaternary system—				
Pleistocene and Recent—				
Soil, and clay, brown	7	....	7	....
Clay, yellow	2	6	9	6
Clay, blue	29	8	39	2
Hardpan	28	....	67	2
Forest bed (ancient soil)	3	....	70	2
Hardpan	44	10	115	....
Pennsylvanian system—				
Sandstone	71	11	186	11
Limestone, hard	1	1	188	....
Shale, black	2	6	190	6
Shale, clay	10	3	200	9
Coal (No. 2) (base of Pottsville)	3	6	204	3
Fire clay	3	....	207	3
Shale, black	....	3	207	6
Shale, clay	7	6	215	....
Clay, "potter's"	13	....	228	....
Coal	....	2	228	2
Sandstone and shale	6	1	234	3
Coal	....	3	234	6
Sandstone and shale	6	9	241	3
Coal	....	8	241	11
Sandstone and shale (Horizon of No. 1)	16	4	258	3
Coal	....	3	258	6
Sandstone	2	9	261	3
Coal	....	2	261	5
Sandstone and shale	3	9	265	2
Clay shale	4	....	269	2

[1]Geological Survey of Illinois, Vol. 7, p. 15, 1883.

Record of a boring for coal at Virginia, Cass County—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Sandstone	7	5	276	6
Rock, hard siliceous	2	....	278	7
Clay shale	2	6	281	1
Rock, hard siliceous	3	6	284	7
Shale, hard green	2	10	287	5
Mississippian system—				
St. Louis and Warsaw—				
Shale, hard green	2	10	287	5
Limestone	9	1	296	6
Sandstone	1	8	298	2
Limestone	62	4	360	6
Sandstone	8	....	368	6
Limestone, gray	1	....	369	6
Sandstone	2	....	371	6
Limestone	2	3	373	9
Sandstone	18	....	391	9
Keokuk—				
Clay shale, drab	6	6	398	3
Shale, sandy	5	3	403	6
Limestone, shaly	4	1	407	7
Quartz band	....	4	407	11
Limestone, shaly	3	8	411	7
Shale, clay	....	6	412	1
Limestone, shaly	16	9	428	10
Flint band, yellow	....	1	428	11
Shale, clay	3	7	432	6
Limestone, hard gray	4	1	436	7
Limestone, shaly	6	2	442	9
Shale, with bryozoans	2	2	444	11
Limestone, shaly	4	7	449	6

The correlation of the coal mined at Bluff Springs and Virginia is based upon comparisons made by Worthen,[1] who points out the similarity of this coal to the coal mined and outcropping at Exeter, Scott County. Observations by the writer in Scott County indicate that the coal at Exeter and Alsey is the same coal as that mined near Roodhouse and Whitehall in Greene County and at Upper Alton in Madison County, and is to be correlated with the No. 2 coal. This coal in southwestern Illinois has a roof of black paper-shale, commonly called "slate" which has a variable thickness up to about 20 feet; but in certain areas, especially toward the north, gray shale or "soapstone" lies between the coal and "slate." About 5 feet below the coal

[1]Worthen, A. H. Geological Survey of Illinois, Vol. 4, p. 173.

is a bed of limestone 2 to 5 feet thick, known locally as the "sump rock." These relationships render the identification of the No. 2 coal very definite throughout the southwestern part of the coal basin, so that there is not much doubt as to the correlation of the coal at Bluff Springs, provided it is the same as the coal at Exeter.

Dip of the Rocks

In Cass County the coal-bearing strata dip at a low angle to the east, at the rate of 8 to 10 feet per mile. Thus, coal which outcrops along the bluff east of Beardstown is at a depth of about 200 feet at Virginia and, provided the coal formerly mined at Ashland is No. 2, possibly 50 feet lower at Ashland. Because of the eastward dip, younger and younger rocks underlie the glacial material in that direction, so that the outcrop of the No. 5 or Springfield coal nearly coincides with the east line of the county.[1] Whether or not there are large irregularities or significant interruptions in the general eastward dip is not known. In general it is believed unlikely that there are any irregularities in the "lay" of the coal that will seriously interfere with mining.

No. 2 Coal

The principal coal of Cass County is undoubtedly the No. 2 bed, which underlies all the county east of Illinois valley, probably crossing the Sangamon valley near Chandlerville. This coal is commonly between 3 and 3½ feet in thickness, and elsewhere possesses great regularity in thickness and in physical characteristics, though very little is known as to its physical characteristics in this county. It is probable, however, that the coal has the usual gray shale or black "slate" roof found above No. 2 coal in adjacent counties to the south and west, a description of which is given in some detail in the chapter assigned to the resources of Fulton County. An analysis of No. 2 coal made from a sample collected in Schuyler County may also be found in the same section.

Because this coal is relatively so thin and its area of outcrop so small that mining by drift or slope entrance is practicable in only a small part of the county, the development of the coal resources in Cass County is probably not a matter of immediate concern. Diamond drilling should precede future development, as the data available are entirely too meager to justify undertaking mining operations.

As the rock surface below the drift is more or less irregular, it is not improbable that isolated and local areas of No. 5 coal may be

[1] Shaw, E. W., and Savage, T. E., U. S. Geological Survey Geol. Atlas: Tallula-Springfield Folio (No. 188), Areal geology sheet, 1913.

present in places in the eastern part of the county, west of the principal line of outcrop.

The correlation of the coal found between Ashland and Prentice in Morgan County, as shown in the record of drilling near Prentice given below, is uncertain.

Drilling near Prentice, Morgan County

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Pennsylvanian system—				
"Slate," rotten black	2	6	2	6
Coal	....	2	2	8
Fire clay	12	4	15	....
Shale	1	....	16	....
Coal	....	2	16	2
Fire clay	1	3	16	5
Sandstone and shale	16	7	34	....
Shale, with bands of ironstone	56	....	90	....
"Slate," black (fossiliferous)	3	10	93	10
Sandstone, soft	15	....	108	10
Shale	14	....	122	10
Limestone	1	....	123	10
"Slate"	2	....	125	10
Coal (No. 2?)	2	10	128	8
Fire clay	6	....	134	8

The stratigraphic succession is more suggestive of strata associated with No. 2 than with any other coal, but such a correlation would possibly give an unusual altitude to the coal at this place.

No analyses of the coal in Cass County are available.

CHRISTIAN COUNTY

Only the northern part of Christian County from Edinburg northward is included in the area of this report. The Greenwood Coal Company at this place mines No. 5 coal. This is the farthest south that this coal is worked in the central part of the State.

COAL-BEARING ROCKS

The geology of Christian County has been adequately discussed in Illinois Mining Investigations Bulletin 11, Coal Resources of District VII, and no additional data can be added relative to the coal in the northern part of the county. However, the following paragraphs may fitly be quoted from Bulletin 11:

"The coals below No. 6 are lenticular and hence less easily traceable. Moreover, the interval between the beds, especially between No. 5 and No. 6 coals, varies considerably in short distances, thus adding to the difficulty of correlation. For example, the interval between No. 6 coal 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 eight diamond drill holes in the townships mentioned. It is probable that it should be called No. 5 coal 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 No. 5 and No. 6 coals 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., No. 5 and No. 6 coals are of about equal importance. In a majority of the holes the roof of No. 5 coal 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 No. 5 coal is mined. Near Edinburg and Sharps the cap-rock is absent.

"* * * Three main horizons appear to exist below No. 5 coal. Owing to the lenticular nature of the coal it is not believed that all three horizons contain commercial coals throughout the county. * * * The lenticular character of (these) coal beds 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 * * * a few holes should be continued from 250 to 300 feet below No. 6 coal in order to test all the possibilities of the area."[1]

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[1]Kay, Fred H. Coal Resources of District VII: Illinois Mining Investigations Bull. 11, pp. 80-81, 1915.

DEWITT COUNTY

Introduction

DeWitt County lies across the trough of the Illinois coal basin. It is the only county in District IV in which coal has never been mined, nor is coal of workable thickness definitely known to underlie it.

Surficial Deposits

Special attention should be directed to the excessive thickness of the glacial drift which so effectively covers the hard rocks in DeWitt County that "Coal Measures" outcrops are unknown. The few deep drillings that have been made, records of which are reproduced above, show thicknesses of glacial material of from 163 to 350 feet. Leverett[1] states that the average thickness of the drift is probably more than 200 feet. The following data, compiled from Leverett's report, will give some idea of the thickness of the drift at various places in the county.

Thickness of the drift in De Witt County

Town	*Depth of Well*	*Terminal strata*	*Depth of rock entered*
Farmer City (city well)	176	sand	...
Farmer City (coal prospect)	...	...	189
Parnell	200	...	...
Clinton (water wells)	80-100	sand and gravel	...
Clinton (coal boring)	...	...	352
Clinton (coal boring)	...	...	270
Clinton (Barnett's gas well, 8 miles west)	137	sand	...
Hallsville (several gas wells)	117-127	sand	...
Kenney	291	sand and gravel	...
Waynesville (city wells)	150?	...	...
Wapella (water wells	80-100	till or sand	...
Maroa (Macon County)	...	...	270

The lower part of the drift commonly contains considerable sand and gravel, and some loose sand or quicksand, which are water-bearing and therefore sources of difficulty to be guarded against in shaft sinking. Furthermore, buried muck and peat beds and associated sands contain inflammable gas derived probably from the muck, and such beds would also probably be a source of considerable inconvenience and risk in opening mines.

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[1]Leverett, Frank, Illinois Glacial Lobe: U. S. Geological Survey Mon. 38, p. 705, 1899.

Coal-bearing Rocks

As has been said, coal of workable thickness is not definitely known to underlie DeWitt County. An unsubstantiated record of an old boring at Farmer City reproduced herewith reports 4 feet 4 inches of coal at 564 feet and 4 feet 9 inches at 665 feet. It is possible that the upper of these coals is No. 7, and the lower, No. 5; No. 6 being represented by a 9-inch bed at 606 feet. If the suggested correlations of the coal are correct, it is possible that the limestone beds between 300 and 340 feet represent the Carlinville limestone.

Record of drilling at Farmer City, T. 21 N., R 5 E., DeWitt County

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Soil	2	....	2	....
Clay, yellow	9	....	11	....
Clay, blue	36	....	47	....
Quicksand	2	....	49	....
Clay, blue, and gravel	6	....	55	....
Clay, blue, and gravel	15	....	70	....
Sand and gravel	40	....	110	....
Clay, blue	6	....	116	....
Sand and gravel	8	....	124	....
Clay, blue, and sand	40	....	164	....
Sand and gravel	10	....	174	....
Quicksand	13	....	187	....
Clay, blue	2	....	189	....
Pennsylvanian system—				
McLeansboro—				
Sandstone	4	....	193	....
Sand shale	11	....	204	....
Shale, red	2	....	206	....
Shale, blue	....	4	206	4
Shale, calcareous	2	8	209	....
Shale, blue	1	....	210	....
Shale, red	8	....	218	....
Shale with limestone seams	2	....	220	....
Sand shale	17	....	237	....
Shale, black	3	....	240	....
Coal	1	2	241	2
Clay shale	39	6	280	8
Clay shale	8	....	288	8
Shale, blue	4	....	292	8
Limestone	8	....	300	8
Shale, black	2	....	302	8
Shale, red and gray	9	....	311	8

Record of drilling at Farmer City—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Limestone	2	....	313	8
Sand shale	5	....	318	8
Limestone	4	....	322	8
Shale, blue	18	....	340	8
Sand shale	10	....	350	8
Shale lime	10	....	360	8
Shale, red	5	....	365	8
Shale, red	6	....	371	8
Sandstone	16	....	388	8
Sandstone, soft	20	....	408	8
Shale, red and gray	7	....	415	8
Sand shale	22	....	437	8
Shale, blue	46	....	483	8
Shale, blue	17	6	501	2
Coal	1	....	502	2
Fire clay	6	6	508	8
Shale, gray	10	....	518	8
Sandstone	6	....	524	8
Sand shale	7	....	531	8
Sandstone	17	....	548	8
Shale, blue	7	....	555	8
Shale, blue	3	....	558	8
Shale, black	1	3	559	11
Shale, gray	2	....	561	11
Shale, black	1	7	563	6
Coal (No. 7?)	4	4	567	10
Fire clay	3	9	571	7
Sandstone	3	....	574	7
Sand shale	6	....	580	7
Shale, blue	15	....	595	7
Shale, gray	4	....	599	7
Shale, bituminous	6	....	605	7
Carbondale—				
Coal (No. 6?)	....	9	606	4
Clay shale	3	3	609	7
Lime shale	6	....	615	7
Shale, blue	10	....	625	7
Sand shale	10	....	635	7
Sand shale	7	....	642	7
Shale, blue	22	9	665	4
Coal (No. 5?)	4	9	669	1
Shale, blue	....	9	669	10

Two deep drillings for oil have been put down in T. 20 N., R. 2. E. (Clinton Township), one in section 10 and the other in section 32. Both records are reproduced herewith, the record of the well in section

10 being copied from the Geological Survey of Illinois. Vol. 8, pages 34 and 35.

Record of drilling in sec. 10, T. 20 N, R. 2 E. (Clinton Township) DeWitt County

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Surface soil	5	....	5	....
Quicksand	15	....	20	....
Sand with gravel and boulders	17	....	37	....
Sand and clay mixed	53	....	90	....
Hardpan	12	....	102	....
Gravel	1	....	103	....
Hardpan	4	....	107	....
Clay and sand	4	....	111	....
Gravel and clay	7	....	118	....
Hardpan	3	....	121	....
Clay and sand	7	....	128	....
Clay and gravel	14	....	142	....
Clay	4	....	146	....
Hardpan	6	....	152	....
Clay and gravel	8	....	160	....
Quicksand	5	....	165	....
Sand and gravel	2	....	167	....
Coarse gravel	2	....	169	....
Clay	6	....	175	....
Gravelly hardpan	25	....	200	....
Quicksand	6	....	206	....
Sand and clay	7	....	213	....
Gravel	9	....	222	....
Sand	11	....	233	....
Gravel	9	....	242	....
Sand	9	....	251	....
Quicksand and gravel	101	....	352	....
Pennsylvanian system—				
McLeansboro and Carbondale—				
Slate, black	1	....	353	....
Fire clay	3	....	356	....
Limestone (Lonsdale?)	19	....	375	....
Fire clay	1	....	376	....
Shale, gray	1	....	377	....
Shale, red and gray	10	....	387	....
Shale, gray	2	....	389	....
Sandstone	36	....	425	....
Shale, gray	32	....	457	....
Shale, dark	6	....	463	....

Record of drilling in sec. 10, T. 20 N, R. 2 E.—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Shale, gray	5	....	468	....
Coal (No. 7?)	2	9	470	9
Coal and "slate"	....	9	471	6
Fire clay	7	3	478	9
Limestone	22	....	500	9
Sandstone	6	....	506	9
Clay shale, gray	11	....	517	9
Sandstone	11	....	528	9
Shale, gray	8	....	536	9
Slate, black, and coal	3	....	539	9
Limestone	7	....	546	9
Sandstone	19	....	565	9
Shale, gray	10	....	575	9
"Slate," black	3	....	578	9
"Slate," black and coal	4	....	582	9
Shale, gray	21	....	603	9
"Slate," black	3	....	606	9
Coal (Worthen's No. 3)	1	....	607	9
"Slate," black and trace of coal	2	....	609	9
Clay shale, gray	3	....	612	9
Coal (No. 2?)	1	....	613	9
Pottsville—				
"Slate," black and trace of coal	3	....	616	9
Shale, gray	16	....	632	9
Limestone, hard impure	1	....	633	9
Sandstone, hard	3	....	636	9
Shale, gray	5	....	641	9
"Slate," black	8	....	649	9
Sandstone	10	....	659	9
Shale, gray	3	....	662	9
"Slate," black	2	....	664	9
Shale, gray	8	....	672	9
Shale, sandy	11	....	683	9
Shale, gray	9	....	692	9
Limestone, hard	1	....	693	9
Sandstone, hard	2	....	695	9
Shale, dark	3	....	698	9
Shale, gray	3	....	701	9
Shale, sandy	3	....	704	9
Sandstone	6	....	710	9
"Slate," black, with trace of coal	2	....	712	9
Shale, gray	82	....	792	9
Coal (No. 1?)	1	....	793	9
Shale, gray	10	....	803	9
Sandstone and shale	25	....	828	9

Record of C. C. Morris' well near center sec 32, T. 20 N., R. 2 E., DeWitt County

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Soil	5	....	5	....
Gravel	12	....	17	....
Quicksand	2	....	19	....
Clay and gravel, mixed	13	....	32	....
Clay and gravel, mixed	78	....	110	....
Clay and gravel, mixed	40	....	150	....
Quicksand	20	....	170	....
Hardpan	50	....	220	....
Quicksand	45	....	265	....
Pennsylvanian system—				
Limestone and "slate"	3	....	268	....
"Slate" rock, different color	8	....	276	....
Coal	5	....	281	....
"Slate," changing color	24	....	305	....
Sand	7	....	312	....
"Slate," first red found	12	....	324	....
Shell and "slate"	17	....	341	....
Limestone	7	....	348	....
"Casey oil-bearing strata"	10	....	358	....
"Slate"	19	....	377	....
Limestone, hard	2	....	379	....
"Slate" and coal	4	....	383	....
"Slate"	25	....	408	....
Coal (No. 7?)	6	....	414	....
"Slate" of different color	49	....	463	....
Limestone	3	....	466	....
Sand	4	....	470	....
"Slate"	57	....	527	....
Coal (No. 5?)	2	....	529	....
"Slate," change color	33	....	562	....
Sand "slate"	15	....	577	....
"Slate"	90	....	667	....
Limestone	7	....	674	....
"Slate"	80	....	754	....
"Slate," sandy	12	....	766	....
"Slate," black, no coal	18	....	784	....
Sand, limy	4	....	788	....
"Slate"	16	....	804	....
Sand water	6	....	810	....
"Slate"	19	....	829	....
With oil scum	50	....	879	....
"Slate"	71	....	950	....
Mississippian system—				
"Marble, limy looking"	160	....	1110	....
"Some strange formation"	40	....	1150	....
"Slate"	40	....	1190	....
Shell	3	....	1193	....
"Slate"	7	8	1200	8

Worthen states that the drilling in section 10 was made with the diamond drill, and that it probably penetrated to the base of the "Coal Measures." He tentatively correlates the coal at 468 feet (2 feet 9 inches) with the upper vein (No. 7) in the Bloomington shaft, a record of which is given in the McLean County chapter; and regards the coals at 715 and 721 as possibly equivalent to No. 2 or No. 3, the latter coal not definitely recognized by the present Survey, and the coal at 903 as No. 1. These correlations seem to be consistent with the data assembled since the publication of Worthen's reports. Accordingly, a correlation of the upper coal at Clinton at 468 with the upper coal at Farmer City at 575 seems likely, especially as it is consistent with regional dip toward the trough at the foot of the west slope of the La Salle anticline. The actual difference in altitude may even be slightly more than is indicated by the difference in depth, as the surface altitude at Farmer City is less than at Clinton. It is possible that the limestone at a depth of 356 feet at Clinton is to be correlated with the Lonsdale. If so, the 114-foot interval between the limestone and No. 7 coal is only 25 to 30 feet greater than the usual interval to the north and west.

The log of the boring southwest of Clinton in section 32 is a churn-drill record, and the strata noted do not correspond closely with those reported to have been encountered in the drilling north of Clinton. However, the record is of interest in showing, probably accurately, the depth of the drift and the thickness of the Pennsylvanian; massive Mississippian limestone underlying the "Coal Measures" is entered at 950 feet, about 50 feet below the lower coal in the well north of Clinton. Accordingly it is probable that the well north of Clinton penetrated or nearly penetrated the Pennsylvanian strata at a depth of 942 feet, as suggested by Worthen. Correlations of the coal in the well in section 32 at 410 feet with No. 7 coal, and that at 527 feet with No. 5 is suggested.

Structure

DeWitt County lies near the center of the trough of the Illinois coal basin, the drilling at Farmer City possibly being approximately along the axis of the trough. It is believed that the strata dip gently eastward toward this trough, possibly at the rate of between 5 to 10 feet per mile. Data are insufficient to show whether or not there are important departures from the general dip. The eastward dip is also slightly modified by a still gentler southward dip of probably not over 5 feet per mile.

Coals

Three workable coals, No. 7, No. 5, and No. 2, possible underlie DeWitt County. The indications are that all the coals are thinner in the central part of the county in the vicinity of Clinton than to the east near Farmer City. The two upper coals are separated by 100 feet of strata and the two lower coals by about 150 to 175 feet of strata, consisting of sandstone and shale with some limestone. These intervals between coals No. 2, No. 5, and No. 7 persist directly northward into La Salle County and District I west of the La Salle anticline. To the northwest, west, and southward the intervals vary.

Further drilling is necessary in order to prove the presence or absence of considerable areas of workable coals in the county and the character of the roof and floor. No. 7 is reported to have a black shale cover at both Clinton and Farmer City, which is similar to conditions reported at Bloomington and farther north in the State. Blue shale is reported above No. 5 coal at Farmer City, and dark shale at Clinton. The coal is commonly capped by black shale elsewhere in the State.

It is possible that the coal resources of this county are large, but such data as are available do not encourage great expectation of large discoveries. Further careful prospecting is essential to a correct understanding of conditions.

FULTON COUNTY

Production and Mines

Production in tons, year ended June 30, 1920..... 2,331,975
Average annual production, 1916 to 1920..... 2,367,754
Total production, 1881 to 1920.....47,178,407

Fulton County ranked twelfth in 1920, among the coal-producing counties, the output in that fiscal year being between 3 and 4 per cent of the total output of the State.

Table 6 lists the 27 shipping mines operating in 1920.

Besides the shipping mines 131 local or wagon mines also operated in 1920 with a total production of 150,320 tons. All the shipping mines in Fulton County with one exception operate No. 5 coal; the Spoon River Colliery Company, located at Ellisville, operates No. 1 or Rock Island coal. The local banks operate No. 1, No. 2, No. 5, and No. 6 coals, and a coal possibly correctly called No. 3.

Surficial Deposits

The thickness of glacial drift is known to be as much as 155 feet in one place, but the average of 293 wells in the area of the Canton and Avon quadrangles is only 38 feet. The drift consists of glacial stony clay or till with which is commonly associated one or two beds of gravel. Above those a mantle of yellow loess or silt 5 to 20 feet thick covers much of the upland surface, and deposits of alluvium lie in the valleys.

It has been determined from data concerning water wells between Put and Lost Grove creeks, that the drift is thick, so that the outcrop of No. 5 coal lies farther east than is the case south of Put Creek, and north of Lost Grove Creek. The position of this outcrop is indicated on the map, Plate V. This is the only pre-glacial drainage line that has yet been discovered in the county and it is probably the only one within the area underlain by No. 5 coal.

Coal-bearing Rocks.

The general succession of coal-bearing rocks in Fulton County has been indicated to some extent in Part I. It was there stated that because of special field examination in the area of the Avon and Canton

quadrangles, which includes nearly all the north half of the county, and also because of the many exposures and coal prospects, knowledge of the coal-bearing rocks in this county is more definite than it is for the other counties in the district. However, as investigations and the commercial mining operations are restricted to the northern part of the county, conditions in the southern part can be less thoroughly described. It is believed that the southern part of the county, a large part of which is remote from a railroad, is probably not underlain by large bodies of the thicker and higher No. 5 and No. 6 coals, but that the lower coals may nevertheless be continuous. It is not improbable, however, that situated near the hill summits there are rather numerous small bodies of the thicker coal which may be suitable for stripping operations and local banks. The determinations of the actual amount of such coal require detailed field investigations which will probably be undertaken a little later. The present report concerns itself, therefore, chiefly with the area in the northeast part of the county underlain by No. 5 coal. The area to the west beyond the outcrop of this coal will receive more detailed description in the proposed report on District III in which coals No. 1 and No. 2 in the western part of the State from Rock Island to Alton will receive special attention. Drill records show that the base of the coal-bearing rocks declines eastward, so that these rocks are thickest in the eastern part of the county. In a deep well at Canton 465 feet of Pennsylvanian and overlying glacial material was penetrated; on the other hand, in the western part of the county near New Philadelphia, the base of the coal-bearing rocks is only 225 feet below the surface.

The youngest Pennsylvanian stratum exposed in the area is the Lonsdale limestone, which underlies the glacial drift in a small area in the northeast part of the county near Farmington. The special significance of this limestone in this study is the fact that its characteristic interval of about 60 feet above No. 7 coal furnishes a basis for the identification of this coal throughout Districts I and III. The limestone underlies a large area in Peoria County where it has been quarried to some extent. In this county No. 7 coal is too thin to be of commercial importance.

No. 6 coal is found outcropping in many places in the county between the outcrop of No. 5 coal and the area underlain by the Lonsdale limestone. It underlies an area of 35 to 40 square miles in the northeast part of the county, extending south from the north line to within two miles of Canton, and west as far as Fairview. It is also

present in small areas northeast of Cuba. The approximate outcrop of this coal on the Canton and Avon quadrangles, as determined by Savage, is indicated on the structure map, Plate V. Like all the "Coal Measures" strata, it dips eastward at a low angle. No. 6 (Herrin) coal has in this region, as elsewhere, a limestone cap-rock 3½ to 4 feet thick, separated from the coal by 6 to 14 inches of bluish to dark calcareous shale. The cap-rock contains the fossil found in Illinois only in this stratum, namely, *Girtyina ventricosa.* Savage has identified twenty-two other fossils from this same bed in this county, but none has the value of *Girtyina ventricosa* in identifying the limestone.

The strata between the cap-rock of No. 6 coal and the Lonsdale limestone consist largely of shale. Savage states that overlying the cap-rock of the Herrin coal there is usually 10 to 15 feet of shale, followed by a few feet of sandstone, and which in turn is overlain by about 14 feet of gray and 18 inches of blue shale. No. 7 coal lies 33 to 36 feet above No. 6 coal. Above No. 7 coal is about 40 feet of gray shale, followed by 10 to 12 feet of dark shale which underlies the Lonsdale limestone. It is of some interest that the variegated shales near the horizon of No. 7 coal are found in the Peoria-Springfield areas and are widespread in District VII. They are not known, however, in all districts.

The interval between No. 6 and No. 5 coals varies somewhat in the county. In the northeastern part where the main body of the upper coal lies, the interval is normally about 65 feet. In Putnam Township, however, in the vicinity of Cuba, the interval decreases to such an extent that locally the two coals are thought to be in contact. They have been seen in outcrop within 7½ feet of each other, and one drilling in the vicinity of Cuba found 10 feet of coal. It is thought that this unusual thickness is probably due to lack of intervening strata between the two coal beds, No. 6 lying directly upon No. 5.

The strata between No. 5 and No. 6 consist of a black "slate" above No. 5 coal, 2 to 6 inches, above which is 9 to 20 inches of limestone cap-rock, 12 to 20 inches of soft gray shale or "clod," 20 to 30 feet of gray shale, a variable thickness of sandy shale and sandstone, 6 to 8 feet of yellowish shale, and 1 to 3 feet of the underclay of No. 6 coal. Between the 20- to 30-foot shale member, known as the Canton shale, and the sandy stratum overlying it, is an uneven plane of contact, which results in considerable variation in the thickness of both of these strata. In places, especially in Putnam Township, the Canton shale member is entirely out, so that the sandstone rests on the

cap-rock of No. 5 coal or even locally upon the coal itself. Rarely all the strata normally occurring between the Springfield and Herrin coals are wanting, and more rarely a part or all of the No. 5 coal is absent.

The area in which No. 5 and No. 6 are actually in contact is small; and it is only in a small area lying mainly between the line of the Toledo, Peoria, and Western Railroad and Put Creek, in the north half of Putnam Township, that the nearness of No. 5 to No. 6 is especially noteworthy.

No. 5 coal is persistently present in that part of the county east of its line of outcrop. Numerous more or less detached areas of coal probably exist beneath the uplands along the main divides even south of Spoon River, since this coal has been mined at Astoria and in Schuyler County near Rushville. The outcrop of the coal within the Avon and Canton quadrangles is shown in Plate V.

Savage states that the No. 5 coal is uniform in thickness where it is found within the quadrangle, averaging 4 feet 8 inches in 141 well records and 43 measured sections, and generally departing less than 6 inches from the average. In the eastern and northern portions of the county, where the usual sequence of strata overlies this coal, the bed is commonly cut by numerous clay-filled fissures (clay seams or horsebacks), such as are characteristic of this coal in Sangamon County and in other parts of the State. Where sandstone overlies the coal in the vicinity of Cuba, no clay seams have developed. No. 5 coal is commonly correlated by its physical characteristics, especially the presence of horsebacks, and by the physical character of its roof. The black fissile shale containing ironstone or pyritic concretions, ranging from 3 to 4 inches to as many feet in diameter, is the very characteristic roof of the bed, a similar roof not being associated with the other coals. The clod and cap-rock are of local assistance in identifying the coal, but have not the State-wide distribution of the black "slate." The niggerheads, clod, and cap-rock are all fossiliferous, but as they lack definitely identifying forms, do not have the same value in correlation studies as the type fossil of the cap-rock of No. 6 coal. However, they are more or less characteristic.

Although coals below No. 5 are present in Fulton County within the area underlain by No. 5, they are worked only in areas west of the outcrop of this coal. There are two workable coals below No. 5, No. 1 (Rock Island) coal and No. 2 (Colchester or La Salle "Third Vein") coal. No. 2 coal has been worked at Avon; No. 1 is mined at Ellisville and has been worked recently at Seville; at local banks in the western and southern part of the county each of these coals is being worked.

Drilling in the northeastern part of the county, especially in Putnam and Buckheart townships, indicates the probable widespread presence of at least one of these lower coals.

No. 2 (Colchester) coal lies about 90 to 135 feet below No. 5, the lesser interval being found in the Cuba region, and the greater in the northeast part of the county. The strata between No. 5 and No. 2 consist mainly of shale and sandstone, a massive sandstone being rather widespread in the upper third of the section. The roof of No. 2 consists of gray shale or "soapstone" 9 to 14 feet in thickness in the northern and western parts of the county, but thicker toward the south. It is followed above by a black fissile shale 3 to 6 feet thick with which is commonly found a band of fossiliferous, septarian, nodular limestone one-half to one foot thick. Savage states that this is an easily recognized succession which is exposed in many places in the western part of the county. It is noteworthy also that essentially the same succession is found above No. 2 coal in the La Salle district west of the La Salle anticline and in much of District III to the west. The coal has a common thickness of about 2 feet 6 inches, but varies between 2 and 3 feet.

A coal believed to be the equivalent of the coal mined in Rock Island County and known as No. 1 or Rock Island coal, lies 60 to 90 feet below No. 2 coal, the interval being greatest to the east. The area in which this coal is best developed seems to lie west or south of the outcrop of No. 5 coal. The few drill holes to the base of the Pennsylvanian rocks east of the outcrop of No. 5 show coal thick enough to be of commercial value only at the horizon of the Rock Island coal in one or two cores, and these holes are located along the outcrop of the No. 5 coal in Putnam Township. The coal attains locally a thickness of about 4½ feet in the vicinity of Cuba, but there appears to be no large body of it and very commonly the seam is separated by shale partings. Where it is worked in the western part of the county at Ellisville, it is 3 to 5½ feet thick. This coal seems to have been laid down in a narrow trough or basin running north and south through the western part of the State, from Brown to Rock Island County, the eastern edge of which crossed the central part of Fulton County. Its area of main development is therefore west of this district in District III.

No. 1 coal where characteristically developed has a readily recognizable bluish, fossiliferous, limestone cap-rock 5 to 20 feet thick, which is separated from the coal by 6 inches to 3 feet of dark shale. In its typical development this cap-rock seems to be restricted to the same area as No. 1 coal, and to become thinner and possibly disap-

pear entirely toward the east. The few drill holes in eastern Fulton County that penetrate No. 1 coal do not find a cap-rock above No. 1 coal.

No. 1 and No. 2 coals will be described in greater detail in a proposed later bulletin which will discuss the coal resources of District III.

Coals between No. 1 and No. 2 seem to be somewhat more numerous in the eastern part of the county than in the western. Between No. 1 and No. 2, lying 20 to 30 feet below No. 2, Savage reports a thin coal, 18 inches thick, which seems to be fairly persistent as it is found in outcrop in the western and central parts of the county and in drilling in the eastern part. Whereas this is the only persistent coal known in the section in the western part of the county where strata outcrop, drilling in the vicinity of Cuba, St. David, and Dunfermline reveals the presence of one or two other coals between No. 2 and No. 1. In the Cuba region the interval between No. 2 and No. 1 coals is about 80 feet. The following record of a hole drilled between Fiatt and Cuba is typical of the succession in that part of the county.

Record of drilling between Fiatt and Cuba See Plate II, No. 1

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Clay	18	....	18	....
Pennsylvanian system—				
Carbondale—				
Sandstone, yellow	10	4	28	4
Slate, dark	1	10	30	2
Coal (No. 5)	4	6	34	8
Shale, light	2	4	37	....
Sandstone, light	2	....	39	....
Shale, mixed	19	....	58	....
Sandstone, light	12	....	70	....
Shale, sandy	37	....	107	....
Shale, gray	20	....	127	....
"Slate," dark	1	....	128	....
Rock (limestone?), dark	1	....	129	....
Shale, light	14	....	143	....
Coal (No. 2)	2	4	145	2
Pottsville—				
Shale, sandy, light	18	8	164	....
Coal	1	....	165	....
Shale, light, sandy	12	....	177	....
Shale, dark	1	....	178	....
Coal	....	4	178	4

Record of drilling between Fiatt and Cuba—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Shale, light, sandy	18	....	196	4
Shale, dark	7	....	203	4
Coal	....	4	203	8
Sulphur (pyrite)	....	2	203	10
Coal	3	2	207	....
Sandy bottom	....	4	207	4
Rock, boulder (limestone?)	....	8	208	....
Limestone, dark	11	....	219	....
Shale, dark, hard	6	7	225	7
Coal (No. 1)	4	4	229	11
Shale, light, sandy	6	1	236	....

The lower coal with the dark limestone cap-rock is without question No. 1. In the Cuba region rather systematic testing of this coal in certain areas reveals large variations in thickness and character. Its commercial value, therefore, for the present, at least, is small. The limestone cap-rock is commonly about 10 feet in thickness but in places is absent and in other places as thick as 20 feet. The coal overlying the cap-rock or but a short distance above it, is lenticular. In a few holes it has a thickness of about 4 feet, but commonly is less than a foot thick, and so interbedded with shale that it has no value. It is not known just how persistent this bed is in the southern part of the county. It is possible that outcrops of this bed in the vicinity of Lewiston were confused with No. 2 coal by Worthen, resulting in the misinterpretation of the section that appears in his discussion of the geology of Fulton County in Volume IV of the Geological Survey of Illinois.

The two other coals that are fairly continuous in the section, one 12 to 20 or 25 feet below No. 2 coal, and the other about 30 feet lower, are generally thin. In some holes, however, the upper of the two is reported 2 feet or more thick, but it is more commonly found a foot or less in thickness. It is quite possible that this coal outcropping near Lewiston was the one which was confused with No. 2 coal instead of the lower coal as described in the preceding paragraph.

Aside from the limestone and coals noted above, the strata between No. 1 and No. 2 coals are mainly shale, with a sandstone 3 to 8 feet thick rather persistent 17 to 25 feet below No. 2.

Structure

Geologic structure of the whole of Fulton County has not been determined. A report on the structure based on the altitude of No. 2

coal in the Avon and Canton quadrangles appears in Bulletin 33,[1] and Plate V is a reduction of the maps in that report.

Concerning the structures of the Canton and Avon quadrangles, Savage[2] states:

"In the Colmar region farther west, the oil is found in the upper part of a dome, and in a terrace on its side. Even on this favorable structure, the sand is present only in limited areas. Consequently, any recommendations for test borings for oil in the Avon and Canton area, based on the usual structure features, must be recognized as carrying an unusual amount of uncertainty. However, since it is not possible to tell before borings are made whether the Hoing sand is present or to what extent it is saturated with water in any particular locality, if test borings are to be made, it would seem wise to proceed first on the usual assumption that the rocks will be thoroughly saturated with water, and to test first the places where the structure is favorable, as the highest parts of the anticlines and domes.

"From the structure maps [Plate V] it will be seen that a broad dome is present northwest of Fairview, the highest point of which is in the NE. ¼ sec. 29, and the SE. ¼ sec. 20, T. 8 N., R. 3 E. Southwest of Farmington in secs. 10 and 11, T. 8 N., R. 4 E., there is a low arch in which the beds are somewhat higher than to the north or south.

"From Fiatt a low arch extends toward the southeast corner of the Canton quadrangle. The axis passes about one-half mile north of Jones School, SW. cor. sec. 27, T. 7 N., R. 3 E., and has been traced southeast to the center of sec. 10, T. 6 N., R. 4 E.

"In the northwest quarter of the Avon quadrangle [Plate V], a low anticline is present in the SE. ¼ sec. 14, T. 8 N., R. 1 W. The beds here are somewhat higher than to the west, south, and east; but no outcrops are available toward the north, and the dip in that direction is uncertain. One mile north of Babylon in secs. 11 and the western part of 12, T. 7 N., R. 1 E., the beds are higher than in any other direction except northwest."

The foregoing interpretation of the structure in the Canton and Avon quadrangles was designed to meet inquiries concerning the possible existence of structure favoring oil and gas accumulation in the area. In general such gentle structure does not affect the value of the coal, although knowledge of the structure is of some importance in laying out mines in order to take advantage of the natural slopes for drainage or haulage. However, where regional structure is as gentle as it is here, local variation in the level of the coal may largely offset

1Savage, T. E., Geologic structure of Canton and Avon quadrangles: Illinois State Geological Survey Bull. 33, p. 91, 1917.

2Op. cit., p. 99.

regional dip, and hence it becomes a distinctly local engineering problem to determine the structure or dip of the coal within each property to be developed. The present maps are of value in determining the general lay or dip of the bed and approximate depth, but should be used guardedly as a basis for laying out mining operations.

On Plate V is included a structure map, which constitutes an appendix to Savage's maps and shows the "lay" of the No. 5 seam in a strip south of the Canton quadrangle, based on detailed drilling and elevation of the surface, as determined by the company. In publishing the map the Survey does not assume the responsibility for the accuracy of these determinations which in all cases do not seem to check closely with the topography on the Canton sheet. However, the map is valuable, especially as it illustrates the slight irregularities that affect the coal and shows how the eastward dip is in places eliminated or even reversed, and hence illustrates the importance of detailed drilling in the accurate determination of the structure prior to laying out properties for mining.

Minor irregularities in the coal beds encountered in mines will be discussed in later paragraphs.

Minable Coals of Eastern Fulton County

The coals of Fulton County known to have present economic value —that is, those that can be profitably worked at this time—are Nos. 6, 5, 2, and 1. Possibly a coal lying between Nos. 1 and 2 may also be workable locally. These coals will be described in the order given.

No. 6 coal

Distribution and occurrence

No. 6 (Herrin or "blue band") coal is present over about 35 to 40 square miles in the northeast part of the county, north of Canton, over a much smaller area north of Cuba. Other small areas not improbably exist, though they are not definitely known to be present. The outcrop of the coal on the Canton quadrangle is shown in the map, Plate V. The area underlain by coal has not been entirely delineated near Cuba. Savage states that the coal lies so near the surface, usually from a few to 50 feet, that its quality has been injured by the action of ground water so that even where it is present the shafts of the commercial mines are put down through this coal to the No. 5 (Springfield) bed which is normally about 65 feet lower.

Character of No. 6 coal

No. 6 coal in Fulton County is not regarded with as much favor as is No. 5 coal. It is not always possible to tell from a physical

examination of a coal bed why the coal is regarded as better or less satisfactory than the coal of an adjacent bed, as the differences are not entirely physical. The relative acceptability of different coals rests largely on the following factors: (1) The amount of ash; (2) the amount of volatile hydrocarbons; (3) the clinkering character of the ash, which is probably the same as the fusibility of the ash; (4) the hardness of the coal, or its ability to withstand handling; and (5) the heat value. For a certain class of users knowledge of the coking quality of the coal is also important. As the coal lies in the bed it is not possible to determine the relative value of the coal with respect to any of the above factors unless it be the amount of ash, and so it is only as a result of experience that judgment can be passed upon the acceptability of a coal.

In general judgment is made on the basis of results attained by the haphazard methods of firing in most steam plants and practically all domestic heaters. Since the fact that popular and careless methods may not be adapted to a coal in question commonly does not enter into the popular judgment, it is quite possible that with better practices in firing and improvements in heating systems coal at present less desirable would eventually come into more popular favor. It is also true that improvements in mining practice particularly in the method of handling the coal at the face, and at the tipple, may largely reduce the differences that exist among coals, especially as concerns the ash content.

The reasons for popular judgment against No. 6 coal and preference for No. 5 are not fully tangible. The general opinion is that this coal is dirtier; that it contains more shale bone, blackjack, and pyrite than No. 5; and that it is smokier, higher in volatile hydrocarbons, and probably somewhat softer, than the lower bed. Some of the prejudice against the upper coal arises from the fact that it lies relatively near the surface and is thought to have suffered somewhat from weathering. A considerable quantity is probably "outcrop" coal, which is usually soft and contains much infiltered clay. Outcrops of No. 6 west of Farmington are usually very poor, especially where the bed lies near the prairie surface, and the coal has a reputation of being generally unsuitable to mine. East of the line of the Chicago, Burlington and Quincy Railroad, between Farmington and Canton, however, along Copperas Creek, the cover is solid and the coal little affected by weathering, except for a few feet immediately along the outcrop. Failure to develop this coal in the shafts between Canton and Farmington is by some laid to the supposed ill effects of weathering, in spite of the fact that it is 50 to 60 feet down. It is possible,

however, that the coal was affected somewhat by pre-glacial weathering, as the pre-glacial surface was much nearer the coal than is the present surface.

Where the coal has been observed in adjacent parts of Peoria County the only physical characteristic of the bed which suggests that it might have a value somewhat inferior to that of No. 5 is the rather high ash content, which is indicated by the presence of numerous sulphur balls and by the existence of a continuous blue band. Otherwise the coal does not appear notably different from No. 5 coal. It might justly be argued that the horsebacks of No. 5 coal represent a much more important source of impurities in that coal than do the sulphur balls and blue band in No. 6, so that the prejudice against No. 6 coal is probably based upon qualities not physically displayed in outcrop and at the face in mines.

Analyses and tests show very little difference between No. 5 and No. 6 coals in western Illinois, but whatever difference exists is to the advantage of the lower coal. The No. 6 coal averages about 4 per cent higher in volatile matter on the moisture-free basis, and possibly 2 to 4 per cent higher in moisture. Both coals, however, are relatively high in moisture, varying between 13 and 18 per cent, so that probably the difference in moisture content is of little consequence, and the difference in volatile content likewise hardly warrants favoring one coal more than the other on this score. It is possible, however, the higher coal yields its volatile matter at a lower temperature and hence is less desirable for general use. There is, however, no scientific basis for believing that a difference in the character of the volatile matter exists. Similarly also, whereas the ash of No. 6 coal may be considerably less refractory and hence harder to handle than the ash of No. 5 coal, this has not been scientifically established, and may or may not be a sound basis of difference. So much of the success in handling depends upon the adaptability of the furnace to the coal being used, upon the skill and experience of the fireman, and upon the method of firing that it is always a question until the matter has been authoritatively established, how much basis there is for popular discriminations as between different coals.

Physically No. 6 coal has the usual characteristics of the Illinois coals; namely, it is banded or laminated with alternations of dull and bright coal and occasional mother coal streaks. As a special characteristic of No. 6 coal, there exists a clay or "blue band" about a foot to 15 inches above the base of the bed. This is about 1 to 1½ inches thick and very persistent. Generally the coal is subdivided into three benches, the topmost of which is 12 to 15 inches. Between the

top and middle bench is generally a mother coal parting. Commonly the coal has a dark shale roof that is hard to hold, for it generally falls up to the cap-rock, a distance of three feet or less, shortly after the coal is removed. The cap-rock is a 3- to 5-foot limestone, generally solid. The underclay is hard and 1 to 3 feet thick. The expense of moving the roof shale is a handicap against the profitable mining of this coal, although in general roof and floor conditions are not distinctly unfavorable.

NO. 5 COAL

The No. 5 or Springfield bed is the chief source of coal in the shipping mines in Fulton County. Except for a few local mines where No. 6 is worked, it is the only source of coal east of the No. 5 outcrop.

The general physical characteristics of No. 5 coal in Fulton County are similar to those elsewhere in the district, namely, regularity in

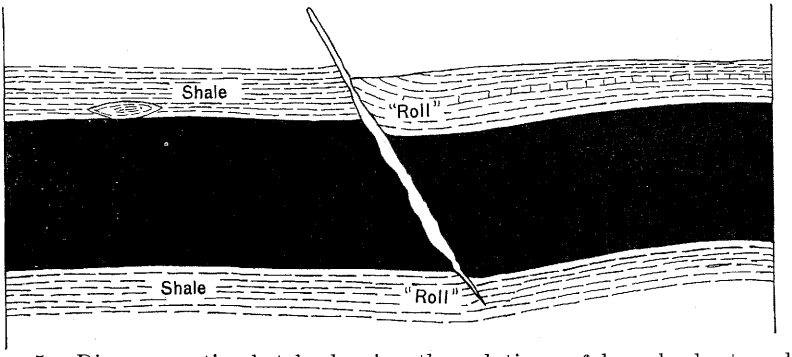

FIG. 5.—Diagrammatic sketch showing the relations of horsebacks to rolls in the roof and floor, and the accompanying faulting.

thickness, common occurrence of clay slips or horsebacks, and a persistent black "slate" roof. Like all Illinois coals, No. 5 is well laminated or banded in structure, and contains lenses, streaks, or partings of mother coal, and occasional masses of bone coal. Balls and lenses of brassy pyrite occur in greater or less fequency, and not uncommonly the coal is "frozen" to the roof by a lens or layer of pyrite. The amount of pyrite varies considerably from mine to mine.

No physical characteristics peculiar to No. 5 coal in Fulton County distinguish it from the same coal elsewhere in the State. As in other parts of the district there is considerable irregularity in the distribution of the horsebacks, sulphur balls, and other features that detract from the value of the coal in the bed. A few mines in the county are so fortunately located as to be working a block of coal relatively free from impurities. Indeed, one mine reported that any

payment to the miners for horsebacks, rolls, or boulders was the exception rather than the rule. In many other mines the extra pay for such irregularities is a serious item of expense. Necessarily this means a great difference in the profits for the various mines in the county. In 1917 the payment for horsebacks amounted to $2.84 for each horseback having an average thickness of 2 to 6 inches in the middle of the bed and 19 cents for each additional inch. In some mines the horsebacks are found as commonly as 12 to 15 feet; in other mines they are very unusual. No good reason has been arrived at for the erratic distribution of the horsebacks.

The horsebacks are usually accompanied by "rolls" in the roof and floor, which also must be paid for when removed. Those in the floor are usually removed, as they are thought to interfere with efficient shooting when left. Their removal is necessary to permit machine-mining. These rolls are apparently of two kinds: (1) In most in-

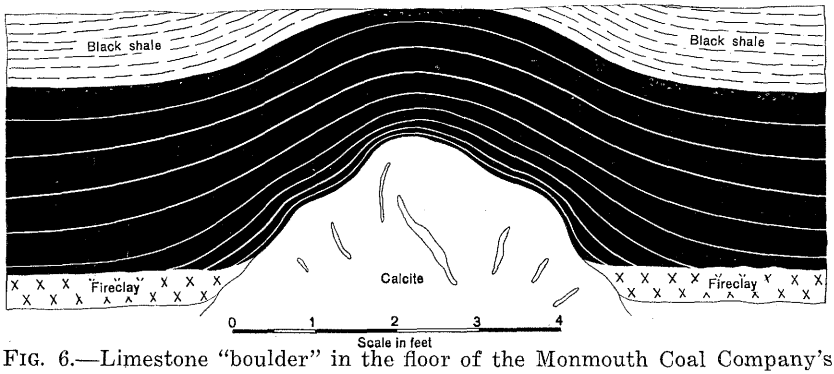

FIG. 6.—Limestone "boulder" in the floor of the Monmouth Coal Company's mine at Brereton.

stances, as in figure 5, faulting as well as fracturing has taken place at the horsebacks, and the coal, roof, and floor, has been offset from a few inches to as much as 18 to 24 inches in places. The upthrow side of the fault in the floor is called a roll in the floor, and the downthrow side of the fault in the roof is called a roll in the roof. In the case of low angle faulting the upthrow side of the floor is directly under the downthrow side of the roof, thereby reducing the apparent thickness of the coal in some places to 3 feet or less. In such instances the roof must be heightened to make head-room for the mules. (2) Rolls also may occur beneath horsebacks where the coal has not been faulted. They are commonly found under rather wide horsebacks and appear to be simply a bulge of the fire clay into the crack to a height of 6 to 12 inches. Rolls of the latter variety are usually small. Rolls are paid for by the inch per running yard.

An additional source of extra expense in some mines in the county consists of the floor "boulders" (fig. 6), which protrude from the fire clay into the bottom of the coal for a maximum distance of about 3 feet. They are commonly less than 2 feet in height in the coal, but may be nearly 3 feet thick, as has been stated, and extend laterally 4 to 5 feet. In 1917 the cost of their removal ran from $2.84 for those 18 to 24 inches high, down to $1.42 for those 6 to 12 inches high. No scale for large ones has been established, as they are uncommon. The boulders are masses of rather waxy-looking, silicified rock, part of a brownish color and part black. Both kinds seem to represent the silicification of woody material. These brownish parts show very distinct wood structure, and appear to be simply petrified. Material of the same character may be calcareous rather than siliceous. The black material, on the other hand, seems to represent silicified peat, or something of that nature, in which the unchanged carbon remains as a residue, making the rock black. The material has the appearance of a very carbonaceous quartzite. Such siliceous boulders are of course very hard and rather difficult to remove.

Some comment should be made upon the occurrence of the "spar" horsebacks that are found in this bed. These are as troublesome if not more troublesome than the clay slips, because they are harder along the immediate position of the fracture and the coal on each side of the fracture commonly contains a wider impregnation of pyrite. They consist merely of veins of pyrite in more or less vertical fractures, entirely resembling the horseback fractures except that they are not as wide and apparently do not extend to as great a distance vertically through the overlying rock. Rarely is the coal bed offset along such spar horsebacks.

The semi-monthly adjustment for horsebacks, rolls, and boulders is an ever-present source of bickerings and misunderstandings between miners and foremen, because of the difficulty in the interpretation of the rules of the agreement. It is exceedingly difficult to ascertain a fair average value for the thickness of a horseback or to accurately measure the size of a roll, especially as the adjustment is usually made after the roll and horseback has been removed from the room or entry and the measurement is made on the cross-section appearing on the rib. A more satisfactory adjustment of this labor problem will obviate much of the difficulty in mining the coal.

Where the coal is undisturbed by irregularities, conditions are relatively favorable for mining. The underclay is hard and generally thin and does not creep readily, so that it rarely causes trouble be-

cause of squeezes. The overlying black shale is usually hard and stands well without much timbering after the removal of the coal. Certain difficulties are encountered, however. The niggerheads in the shale, which are occasionally large enough to interfere with operation if left up in a roadway, are heavy and rather difficult to handle. Occasionally one of those left in the roof will loosen and fall. Therefore, to some extent they are a source of possible injury to miner or mule. In some of the mines near Farmington the lower 2 to 3 inches of the "slate" called "draw slate" separates from the main body of the "slate" at what is known as a "false parting" as the coal is removed. When this happens the coal is usually "frozen" to the "draw slate," so that in discarding the "slate" considerable coal, frequently as much as 6 to 8 inches, is thrown into the gob. The "freezing" of coal and "draw slate" is apparently due to a layer of pyrite or pyritized limestone in the top of the coal, the presence of which makes it very difficult to separate the coal from the shale. In one mine where this "draw slate" exists it is reported that its removal is not desired, as the overlying shale is rather difficult to hold. A more desirable condition is to have the coal break away from the roof just below the top of the seam, leaving the sulphur streak in the roof.

In the mines south of Canton and more or less throughout the county, the most serious difficulty arises from the tendency of the "draw slate" to come away with the coal. As long as this lower layer of the shale stays up and the air is kept away from the overlying shale, the roof will remain solid, but once it falls the conditions are almost immediately bad, the shale and overlying clod falling up to the cap-rock. In places even the cap-rock lacks coherence to withstand the strain put upon it when the "slate" falls and the resulting holes in the roof of the mine are expensive to handle.

In one or two mines west of Farmington, a fairly persistent thin "mud seam" occupies a position in the bed about 8 inches below the top. It was reported that in one mine there were several rooms in which the coal had been shot off below this mud seam. It was stated that unless the miner exercises care in placing his holes so that they end above this mud seam, the coal tends to break below it. A similar mud seam lies about 18 inches from the floor in this same mine, and similar care must be taken that the powder holes be driven below the band to insure complete removal of the bed. These bands are not persistent but are very common.

In some of the mines southwest of Canton lying in the bottom of the coal is a band of blackjack, 1 to 3 inches thick, which shoots up

with the coal and must all be handled and thrown into the gob. As separation from the coal is not clean, considerable coal is in this way wasted. The blackjack consists of soft carbonaceous shale and coal containing lenses of pyrite up to about 1 inch in thickness and making up about one-fourth of the mass.

MINE NOTES, NO. 5 COAL

ALDEN COAL COMPANY'S MINE NO. 5, AT FARMINGTON

Entrance: Shaft; depth to No. 5 coal, 185 feet.

Thickness of coal: Varies from 3 feet 9 inches to 4 feet 2 inches; averages 4 feet.

Section of the coal:

	Thickness					
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Roof: Black "slate"						
Coal	3	1½	4	3½	2	1
Sulphur	..	½	..	..	..	1
Coal	..	9¾	..	..	1	10
Floor: Fire Clay	..	..	..	..	..	..
	3	11¾	4	3½	4	0

Character of the coal: The coal is comparatively clean as compared with the same bed in Peoria County. The horsebacks are fairly numerous but rather narrow, commonly not over 4 inches through. About as common as the clay slips are the "spar" horsebacks which are hard and contain crystalline pyrite that fills the crack and ramifies into the coal for several inches on each side, producing a belt of hard coal often nearly 8 inches to a foot wide, through the center of which runs the vertical irregular fissure. "Facings" of pyrite in the joint cracks of the coal are not uncommon. Gypsum or pyrite facings are not common. Clay and mother-coal streaks are rarely more than half an inch thick and are neither continuous, nor especially numerous.

Pyrite in balls or niggerheads is not uncommon. This is pure shiny pyrite apparently of good quality, averaging probably at least 45 per cent sulphur for the hand-cleaned specimen. The masses of pyrite are said to attain a thickness of about 12 inches and to extend for a distance of 5 to 6 feet. None of this size were seen, the largest noted being about 6 inches thick with a lateral extension of possibly 3 to 4 feet. The rooms do not commonly have more than one sulphur ball in the face at one time, averaging possibly 1½ inches thick and 2 inches in diameter. The amount of pyrite actually seen in the face is probably less than 0.5 per cent by weight of the coal.

Character of the roof: The roof is very regular. It consists of the usual succession of black "slate" with niggerheads 8 to 14 inches thick, clod 6 to 8 inches thick, and cap-rock 4 to 8 inches thick. The niggerheads are commonly about 18 inches in diameter, though some are of still larger size. They parallel the bedding of the "slate" and are nearly as thick from top to bottom as is the "slate." These protrude down into the coal and are frequently slick on the surface and lie more or less loosely in the shale, so that they generally drop out. Many are considerably pyritized,

some of the smaller ones completely so, but the larger ones for a distance of only about half an inch from the surface. The change from the calcareous center to the pyritic outer layer seems to be direct and not gradual. Ordinarily, however, there is more or less pyrite all through the boulders with an increase in amount toward the pyritic shell.

The lower 2 to 6 inches of the black shale or "slate" is known as the "draw slate." Between it and the overlying shale is what is known as a false parting, along which the two beds separate in places in the mine. More often there is a good parting between the coal and the "draw slate," and the latter does not come away. Where the coal and "draw slate" stick together, a lens of fossiliferous limestone, for the most part highly pyritized, in most cases lies just at the top of the coal. The limits of pyritization are rather indefinite, extending outward into both the coal and "slate," so as to cause the adherence of the whole mass and the fall of the "draw slate" with the coal when the latter is shot.

Character of the floor: The floor clay in this mine, about which there is nothing unusual, is reported to be about 2 feet thick on the average. It apparently does not heave much. Along entries it is the practice to remove about 10 inches of the floor clay to make headway for the mules.

ALDEN COAL COMPANY'S MINE NO. 6, AT NORRIS

Entrance: Shaft, depth 190 feet to No. 5 coal.

Sections of the coal:

Sections of No 5 coal in the Alden Coal Company's No. 6 mine

	Face entry main west 1900 feet from shaft		2d north off east entry 1200 feet from shaft		Entry face main east 2000 feet from shaft	
	Ft.	*in.*	*Ft.*	*in.*	*Ft*	*in.*
Coal, dull	..	7	..	..	..	4
Coal bright	1	8	4	1	3	8
Coal, dull	..	¼	..	..	..	..
Coal, bright	1	10	..	..	..	..
	4	1¼	4	1	4	0

ASTORIA WOODLAND COAL COMPANY'S ABANDONED MINE

Entrance: Shaft; depth to coal, 58 feet.

Thickness of the coal: Varies from 5 feet to 6¼ feet; averages 5½ feet.

Section of the coal:

Section of No. 5 coal in the NE. entry about 1700 feet from shaft

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal	2	1
Black jack	..	1
Coal	1	..
Mother coal	..	¼
Coal	1	10
Sulphur	..	¼
Coal	..	11
Floor: Fire clay	..	..
	5	11½

The top coal is dark and often broken. At the top of the uppermost of the two 1-foot coals there is commonly a very dark-colored hard cannel-like coal 2 to 3 inches thick. The lowermost of these two coals is soft, and has irregular streaks of sulphur. The bottom bench is a very bright, hard coal. The roof is black shale, more than 3 feet thick, with large nigger-heads or balls of iron pyrite. The floor is fire clay, at least 3 feet thick. The irregularities include large clay veins, some displacing the coal 18 inches. These veins which are exceptionally large, commonly cut entirely through the coal and are as much as 12 feet long and 3 to 4 feet wide.

This property was abandoned in 1910.

BIG CREEK COAL COMPANY'S MINE NO 2, AT ST. DAVID

Entrance: Drift; No. 5 coal.

Thickness of coal: Varies from 4 feet 10 inches to 5 feet 2 inches; averages 5 feet.

Sections of the coal:

Sections 3 to 8 are taken from United States Bureau of Mines Bull. 22, p. 495.

Sections of No. 5 coal in the Big Creek Coal Company's No. 2 (St. David) mine

	(1) 2,200 feet N. W. of drift mouth		(2) 2,500 feet west of drift mouth	
	Thickness			
	Ft.	*in.*	*Ft*	*in.*
Coal	2	..	3	½
Sulphur	..	⅛	..	¼
Coal	..	6	1	7¾
Blackjack	..	⅛	..	..
Shale	..	..	..	2
Coal	1	10¼	..	..
Blackjack	..	1	..	..
Shale	..	2¼	..	..
	4	4½	4	8¼

	(3) Room 3 18th E. 6000 ft. from opening		(4) Entry face 7th W. 4500 ft. from opening		(5) Entry face 15th N. 6000 ft. from opening		(6) Entry face 11th N. 6000 ft. from opening		(7) Entry face 7th E. 5000 ft. from opening		(8) Entry face 14th E. 5500 ft. from opening	
	Thickness											
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Coal, dull	1	2	1	..	..	8	..	..	..	..	..	9
Sulphur	..	⅛	..	..	..	..	..	..	..	..	..	..
Coal, bright	3	7	4	3	4	..	2	1	4	4	..	..
Coal, dull	..	..	..	..	..	..	..	4	..	..	..	..
Mother coal	..	..	..	..	..	..	..	..	..	..	..	¼
Coal, bright	..	..	..	..	..	..	2	8	..	..	1	11
Sulphur	..	..	..	..	..	..	..	..	..	..	..	⅛
Coal, bright	..	..	..	..	..	..	..	..	..	..	1	10
Total	4	9⅛	5	3	4	8	5	1	4	4	4	6⅜

Character of the coal: The coal bed is uniform throughout, without persistent benches. Small pyrite bands and streaks of mother coal are present. Some gypsum is reported in the facings. At the time the mine was examined in the summer of 1912 the number of horsebacks in the working face was reported as relatively small. In 1908 an earlier observer reported a large number in the mine, which indicates that the coal probably varies considerably as regards frequency of the horsebacks.

Character of the roof: The roof consists of a "draw slate," composed of fine-banded, sandy shale, more or less impregnated with pyrite, 1 to 2 inches thick, black "slate" 2 to 4 feet thick, and a limestone cap-rock. The cap-rock, which is notably persistent, varies in thickness from 6 to 18 inches, but is commonly about 10 inches thick. Its distance above the coal varies from 1 to 4 feet, but is, for the most part, 2 to 2½ feet. The "draw slate" noted above is not a typical "draw slate" as it is usually left up. It probably has about the same characteristics as the "draw slate" observed in mine No. 4 of this company.

Character of the floor: The floor is a hard, bluish-gray clay, 2 feet 6 inches in average thickness. This clay is undercut by mining machines. It heaves somewhat after standing 18 months to two years.

BIG CREEK COAL COMPANY'S MINE NO. 4, AT DUNFERMLINE

Entrance: Shaft; depth to No. 5 coal about 82 feet.

Thickness of coal: Varies from 4½ feet to 5⅓ feet; averages 5 feet 8 inches.

Character of the coal: The coal is very similar to that southwest of Canton. The bed is fairly massive, but to some extent tends to shoot off in benches due to the presence of rather conspicuous but not entirely persistent "dirt" or charcoal bands. Commonly four thin dirt bands lie about 8, 14, 24, and 30 inches from the top, respectively. The coal has distinct horizontal partings and tends to shoot up rather fine. The considerable quantity of mother coal present makes the coal sooty and dirty to handle. A blackjack or clay band about 1½ inches thick is practically continuous. It does not contain the gray sulphur found in the Middleton and Eagle mines near Canton.

Horsebacks are present in about the usual number, but are apparently thinner than they are farther north, so that as a whole they constitute a somewhat less serious difficulty. Pyrite is present in the coal as balls of clean pyrite and to less extent as lenses of grayish laminated pyrite. The balls are most commonly 2½ to 3 inches thick and 8 to 14 inches in diameter, and weigh 20 to 30 pounds. The largest ones, however, may weigh as much as 200 pounds. It is estimated that about one ton of pyrite a day or about one-tenth of one per cent of the total coal mined is uncovered in the coal.

Character of the roof: Roof conditions are similar to those generally found in the mines south and southwest of Canton. The interval between the cap-rock and the coal increases to the south and the cap-rock is somewhat thicker than it is north of Canton. It is more difficult to distinguish the stratum called "draw slate" from the black shale above, as neither does it contain the whitish limy concretions found in the mines farther north,

nor are the limestone lenses present which in the mines north of Canton are so commonly found at the top of the coal and the base of the "slate." The parting between coal and "slate" is better than to the north so that the coal breaks away, leaving the "slate" undisturbed. Where the "draw slate" falls, conditions are almost immediately bad, for the black shale and clod (the upper part of the shale) have very little coherence. Over many of the entries the cap-rock is exposed the intervening shale having fallen in. It is higher above the coal than is commonly the case north of Canton, generally being 4 to 5 feet. In places the cap-rock is thin, especially where its lower surface is smooth instead of knobby, as is more frequently the case. The special problem in the mine seems to be that of holding the thin layer of "draw slate" in the rooms. The main haulageways are commonly brushed up to the cap-rock. The expense of this dead work of course is to be avoided if possible in the rooms.

Character of the floor: When machines are used the coal is cut just above the blackjack band in the base of the coal. In solid shooting the entire bed shoots out and the blackjack must then be cleaned off the coal. The underclay is about 2 feet thick. The floor rolls, as a rule, under the horsebacks.

CANTON COAL MINING COMPANY'S NO. 1 MINE (ABANDONED), SOUTH OF CANTON

Entrance: Shaft; depth to No. 5 coal about 55 feet.

Thickness of the coal: Reported to average 5 feet in thickness.

Section of the coal: In room No. 1 off the third southwest entry the coal was 53 inches thick, and had 2 inches of bone or blackjack at the base. The coal is probably similar to that elsewhere south and southwest of Canton.

EAGLE MINING COMPANY'S MINE AT CANTON

Entrance: Shaft; depth to No. 5 coal 103 feet.

Thickness of the coal: Varies from 4 to 5½ feet; averages 4 feet 11 inches.

Sections of the coal:

Section measured in the Eagle Mine near Canton 1000 feet north-northeast of shaft; face of 4th east entry off the main north entry

	Thickness	
	Ft.	*in.*
Slate	..	10
Coal	4	7½
Dirt band	..	1½
Fire clay	2+	..

Character of the coal: The coal in this mine is representative of the seam south of Canton. It differs from that to the north in being more slabby. Three fairly persistent soot or clay partings, which may vary in position as much as an inch or two each way, lie about 8, 14, and 22 inches from the top, respectively. Commonly a sulphur parting is found

22 to 24 inches from the bottom or about 35 inches from the top, which in places enlarges to become a bright sulphur ball 3 to 6 inches thick. Sulphur lenses and balls are also present here and there in the bed, but are found most frequently in the middle of the bed or up near the roof, and adjacent to horsebacks. In the bottom of the coal is a band of fire clay, coal, and sulphur, 1 to 3 inches thick, called blackjack, which shoots up with the coal and must be cleaned by the miner. The pyrite in the blackjack is of a gray banded variety similar to the brown sulphur found in some of the mines in the Peoria district.

Horsebacks are rather frequent, occurring probably about every twenty feet, but are generally less than 4 inches thick. As elsewhere they are separated from the coal that is loaded out, and a large per cent of the discarded mass is good coal. The waste represented by their removal makes up a considerable but not definitely known per cent of the bed.

Character of the roof: The roof of the seam is the usual black "slate" and clod. The black "slate" is about 10 inches and the clod 14 inches thick. The "draw slate," which is commonly 2 to 3 inches thick and contains numerous small scattered lenses of whitish limestone not larger than ¼ inch by 1 inch, usually stays up. In places an inch or so of the coal stays up in the roof with the "slate," but in other places the coal is separated from the "slate" by a smooth parting. The shale contains a good many niggerheads which tend to fall out, bringing more or less of the shale with them and thereby weakening the roof. When the "draw slate" comes down and the air gets to the black "slate" and clod, they also generally fall. The cap-rock may or may not be strong enough to hold after the shale has fallen. Roof conditions in this mine are not especially satisfactory; room occasionally have to be abandoned on account of the poor roof conditions.

Character of the floor: The floor consists of the ordinary fire clay and ordinary floor conditions prevail.

EAST CUBA COAL MINING COMPANY'S LOCAL MINE NO. 1 (ABANDONED), AT CUBA

Entrance: Shaft; about 71 feet to No. 5 coal.

Thickness of the coal: Varies from 4 feet 8 inches to 5 feet 4 inches; averages 5 feet.

Sections of the coal:

Section in the mine of the East Cuba Coal Mining Company
Room 1, off 2d east off 1st south off west

	Thickness	
	Ft.	*in.*
Coal	1	11½
Sulphur	..	¼
Coal	..	8¾
Sulphur	..	⅛
Coal	2	..
Sulphur	..	½
Coal	..	1½
Fire clay	4	10½

Character of the coal: Except for the lower 1½ to 2 inches of the coal, which is blackjack, the coal is bright, black, and hard.

Character of the roof: The roof is a black shale 2½ feet thick overlain by six inches of clod or soft gray shale, followed by the cap-rock, which is about 2½ feet thick.

Character of the floor: The floor is gray clay.

Irregularities: The continuity of the bed is broken by what is described as an old stream channel, probably a buried pre-glacial or glacial line of drainage along which the coal has been removed.

MAPLEWOOD COAL COMPANY'S MINE NO. 1, AT FARMINGTON

Entrance: Shaft; about 122 feet to No. 5 coal.

Thickness of coal: Varies from 3 feet 10 inches to 5 feet; averages 4 feet 2 inches.

Character of the coal: The coal is noted as black, shiny, long grain, and uniform from top to bottom. The horsebacks or clay veins are commonly 3 to 6 inches thick, but exceptionally 3 to 4 feet. The smaller veins are the harder.

Character of the roof: The roof consists of 4 inches of black "draw slate," about 24 inches of black shale, and about 10 inches of limestone cap-rock. Above the cap-rock is 15 feet more or less of light sandy shale.

Character of the floor: The floor consists of fire clay 20 inches thick, resting upon a 1-foot limestone layer.

MAPLEWOOD COLLIERY COMPANY'S MINE NO. 2, AT FARMINGTON

Entrance: Shaft; about 146 feet to the top of No. 5 coal.

Thickness of coal: Varies from 3½ to 4 feet; averages 3 feet 9 inches.

Sections of the coal:

Sections in mine No. 2, Maplewood Colliery Company
Section 1—Third south off third west entry

	Thickness	
	Ft.	*in.*
Roof; shale, black, sheety, with niggerheads	..	..
Shale, black, draw	..	4
Coal	4	..
	4	4

Section 2—Face of room 1 off 5th west off north entry, 4,000 feet from shaft

	Thickness	
	Ft.	*in.*
Coal, dull	..	9
Coal, bright	2	11
	3	8

Section 3—Entry rib in the 2d west off main north entry, 3,500 feet from shaft

	Thickness	
	Ft.	*in.*
Coal, dull	1	..
Blackjack	..	¼
Coal, dull	..	9
Blackjack	..	¼
Coal, bright	..	10
Pyrite	..	⅛
Coal, bright	..	4½
Coal, bony	..	½
Coal, bright	..	2
Coal, bony	..	¾
Coal, bright	..	10
	4	1⅜

Character of the coal: The coal has no special peculiarities. It is without benches and conspicuous bedded irregularities. The most persistent banded irregularity is a thin layer of blackjack and pyrite 6 to 8 inches above the base of the coal. The coal is commonly "frozen" to the roof shale, so that it does not come away very evenly.

Character of the roof: The roof consists of 4 to 6 inches of carbonaceous shale or "draw slate," 18 to 30 inches of black shale, and 12 to 18 inches of limestone cap-rock.

Section of the roof of mine No. 2, Maplewood Colliery Company, 700 feet east of the shaft on the main east entry

	Thickness	
	Ft.	*in.*
Shale, carbonaceous, rather soft, with ironstone concretions, about	6	..
Cap-rock; a dark gray limestone with irregular fracture. Bottom of limestone very uneven	1	3
Clod; a black sheety shale with fossil shells	1	2
"Slate;" black, hard, sheety shale with bands of ironstone nodules. Lower 4 inches filled with bands of ironstone, limestone, and pyrite nodules	1	3
Coal	..	..

MONMOUTH COAL COMPANY'S MINE NO. 1, AT NORRIS

Entrance: Shaft; about 142 feet to No. 5 coal.

Thickness of coal: Varies from 4 feet to 4 feet 8 inches; averages 4 feet 4 inches.

Sections of the coal:

Sections of coal in No. 1 mine of Monmouth Coal Company

	(1) Entry face 1st E. off S. (16th N.) 4200 ft. from shaft.		(2) 23d W. off main south 4500 ft. from shaft.		(3) Entry face 15th S. off 1st west north side 4500 feet from shaft	
	Thicknesses					
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Coal	4	2	..	..	..	..
Coal, dull	..	..	..	..	..	7
Coal, bright	..	..	2	9	3	9
Sulphur	..	..	..	⅛	..	..
Coal, bright	..	..	1	8	..	..
	4	2	4	5⅛	4	4

Character of the coal: The coal is uniform throughout in general appearance, and does not lie in benches. Streaks of pyrite and mother coal are not uncommon, but for the most part the coal is laminated, bright, and blocky, and is typical for Illinois. The greatest difficulty consists of the horsebacks which average 1 to 2 inches in width and which often contain considerable pyrite.

Character of the roof: The immediate roof is 18 inches to 2 feet of black shale called "slate," with a gritty limestone cap-rock about 6 inches thick.

Character of the floor: The floor is fire clay 1 to 1½ feet thick, containing boulders and nodules of pyrite. The boulders in the clay are reported by one observer to be septarian in character, that is, crossed by cracks and containing cavities lined with calcite. The coal is reported to ride over the boulders as shown in the accompanying reproduction of a sketch (fig. 6) made in the northeast part of the mine. The boulders are especially numerous on the north side of the shaft and are also found in the mines at Norris.

STAR COAL COMPANY'S MINE NO. 1, AT FIATT

Entrance: Shaft; depth of No. 5 coal about 56 feet.

Thickness of coal: Varies from 4½ to 5 feet; averages 4 feet 8 inches.

Sections of the coal:

Sections of the coal in mine No. 1 of the Star Coal Company

Section 1—Room face, room 39 off 15th south, off main east

	Thickness *Ft.*	*in.*
Roof: Black sheety shale containing niggerheads	..	..
Coal: Rather dull and hard with irregular rather than banded appearance. A few vertical irregular veinlets of pyrite, and a little calcite in facings is present and mother coal in slight amount in thickness up to about ¼ inch	4	7
Floor: Fire clay, soft, dark gray; heaves badly in air as well as in water; considerable pyrite in upper two inches	..	..

Sections 2 to 4

	(2) Entry face 20th south 4500 ft. from opening		(3) Entry face 15th south 3500 ft. from opening		(4) Entry face 16th 4000 ft. from opening	
	Thicknesses					
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Coal, dull	..	10	..	..	..	..
Coal, bright	..	..	4	4	4	3
Mother coal	..	¼	..	..	..	..
Coal, bright	..	6	..	..	..	..
Mother coal	..	½	..	..	..	..
Coal bright	2	..	..	..	..	..
Mother coal	..	½	..	..	..	..
Coal, bright	1	2	..	..	..	..
	4	9	4	4	4	3

Character of the coal: The coal is not subdivided into benches. It is fairly hard, dull in appearance and has hackly fracture and laminated structure. A little pyrite is ordinarily interbedded about 18 inches from the top. There are no clay slips.

Character of the roof: The immediate roof is black "slate" 6 to 20 inches thick, above which is a micaceous sandstone 2 feet or less in thickness. The lower 2 inches of the "slate," called the sulphur band, is crowded with fossils largely pyritized.

Section of roof of No. 5 coal, mine No. 1, of the Star Coal Company, at Fiatt

Section 1—1800 feet from opening on the main east entry

Sandstone.
Soapstone, unconformable in relation to strata below; in places cuts out cap-rock.
Cap-rock; a fine-grained, calcareous and micaceous sandstone, carrying carbonaceous material; thickness up to 6 inches.
Clod; a dark brownish-gray shale with many shells—3 inches.
"Slate;" a black sheety shale, 1 foot 6 inches.
Coal.

Section 2—2500 feet from portal on main east entry

	Thickness	
	Ft.	*in.*
Soapstone; dark gray sandy shale, irregularly bedded, about	4	..
Cap-rock and clod	few inches	
"Slate;" hard black sheety shale	1	3
Shale; sheety, hard, with pyrite	..	4
Coal	..	..

STAR COAL COMPANY'S MINE NO. 3, AT CUBA

Entrance: Shaft; 26 feet to No. 5 coal.
Thickness of coal: Averages 4 feet 8 inches.
Section of the coal:

Section of the coal in mine No. 3 of the Star Coal Company
(Measured in temporary north entry)

	Thickness	
	Ft.	*in.*
Coal	1	9
Parting	..	..
Coal	..	8
"Soot" seam	..	..
Coal	1	8
	4	1

Character of the coal: At the section given above, the coal was uniform in appearance, hard, and rather tough. A narrow vertical sulphur streak lay in the upper part of the bed. Horsebacks are not numerous.

Character of the roof: The roof consists of 2½ feet of black "slate" above which is the cap-rock, about 12 to 18 inches thick.

Character of the floor: The floor consists of fire clay.

MIDDLETON COAL COMPANY'S MIDDLETON MINE, AT CANTON

Entrance: Shaft; 60 feet to the top of No. 5 coal.

Thickness of coal: Varies from 4½ to 5 feet; averages 4 feet 9 inches.

Character of the coal: The coal is separated into poorly distinguished benches by thin clay and mother coal partings, one about 8 inches from the top and another about 1 foot lower. The partings are fairly persistent and the tendency of the coal to break along them must be considered in placing the shots, in order that all the seam may be loosened. A blackjack seam 1 to 3 inches thick at the bottom of the bed is an important impurity. It is composed largely of soft carbonaceous shale and coal with lenses of pyrite up to about 1 inch in thickness making up about one-fourth of the mass. It commonly shoots up with the coal and must be separated by the miner. Considerable coal is wasted in this way. This material makes up the greater part of the gob.

Pyrite is present in the coal as balls of hard, bright "sulphur" and in the blackjack band in a grayer, more earthy form. Sulphur balls were observed at the face of about two-thirds of the rooms and entries visited. They are commonly 2½ by 10 or 12 inches, but in rare cases are 6 inches thick and 3 feet across. A few horsebacks cut the coal, occurring possibly every 50 to 75 feet, but they are not especially troublesome.

Character of the roof: Roof conditions in this mine are somewhat different from those in the mines north of Canton. The "draw slate" is not well differentiated. The coal more commonly breaks smoothly away from the "slate" so that over much of the mine a smooth clean roof is present. In places, however, the coal is "frozen" to the "slate," and coal and slate come away together. This weakens the roof so that eventually it falls even through the cap-rock. Above the cap-rock is a layer of weak clay shale which is called clod, but which is not to be confused with the clod between the black "slate" and cap-rock. Above the upper clod is a gray soapstone. As the shales above the cap-rock carry considerable water, water enters where falls occur.

Character of the floor: The floor is fire clay.

SILVER CREEK COLLIERY COMPANY'S NO. 1 MINE, AT FARMINGTON

Entrance: Shaft; 41 feet to the top of No. 5 coal.

Thickness of coal: Varies from 3 feet to 4 feet 2 inches; averages 4 feet.

Character of the coal: The coal does not lie in benches but contains a few discontinuous thin partings ⅛ to ¼ inch thick, and an occasional nodule of clean, brassy pyrite. Clay and "spar" horsebacks are rather numerous; the removal of this material necessitates extra expense and results in considerable waste. That the amount of bright brassy-looking pyrite is small is indicated by the fact that out of 17 rooms visited, two had one nodule each in the face. One of these was 4 to 6 inches thick and 12 to 15 inches in length, and the other 3 to 4 inches thick and 18 inches across. The amount of pyrite present is rather below the average for the mines of the county.

The peculiar hard masses, called boulders, at the base of the coal, consist of masses of hard brownish rock with a porous texture. Certain of these boulders have the appearance of coke. The material seems to be silicified or calcified wood or peat, as certain fragments show very clearly the wood structure. The character of the replacing mineral varies, some boulders being part silica and part calcite. Further investigation is necessary in order to determine the exact nature of this impurity. One of these boulders measured 14 inches high by about 2 feet across but they vary greatly in size.

Character of the roof: The roof succession, which is similar to that in the other mines of the Farmington region, consists of the "draw slate," "slate," and cap-rock. The behavior of the "draw slate" is uncertain. In places the coal parts freely from the "slate" and the latter stays up, so that slightly less head room is left than is necessary for the mules, and along considerable stretches of the entries about 10 inches of fire clay must be dug up. Commonly, however, the coal sticks to the "draw slate" because a band of pyrite or limestone at the junction of the two strata "freezes" the coal to the "slate." Under these circumstances the "draw slate" comes down with the coal, a condition which is desired even though the coal must then be cleaned off by the miner.

Character of the floor: The floor is fire clay. The layer is about 6 inches in thickness and squeezes up into the entries somewhat where they are wet.

NATIONAL COAL MINING COMPANY'S MINE, WEST OF FARMINGTON

Entrance: Shaft; 105 feet to the top of No. 5 coal.

Thickness of coal: Varies from 3 to 4 feet; averages 3 feet 10 inches.

Character of the coal: The rooms and entries of only the north and west sides were visited. The property adjoins that operated by the Silver Creek Colliery Company on the east and it is probable that conditions in the adjacent parts of the two mines are similar.

At the face the coal displays a slight tendency toward benching. Two "mud" bands a quarter of an inch or less in thickness are commonly present, one about 8 inches from the top and another about 18 inches from the bottom. These are not persistent in the Farmington district, and even

in the National mine, are not continuous; but they are reported in at least one other mine. Their presence makes it necessary for the miner to drill his holes so that they end above the upper seam and below the lower; otherwise the middle bench will break away from the upper and lower portions of the bed.

Impurities other than the clay bands noted in the preceding paragraph are not common. Horsebacks of either the clay or "spar" variety seem to be somewhat less common than in most of the mines in the county. The amount of pyrite present in balls and lenses is small. Although no boulders in the bottom of the coal were observed, their occurrence in the adjoining Silver Creek mine would indicate that they may be found or at least expected occasionally in the National mine.

Character of the roof: Roof conditions in general are excellent. The succession is similar to that in other mines in the vicinity, namely, "draw slate," about 3 inches; "slate," 8 to 14 inches, averaging about 10 inches; "clod," about 10 inches; and cap-rock, about 18 inches. In some places pre-glacial erosion channels have cut down nearly to the coal, so that the rock above the seam is only 15 to 20 feet thick. Under such places the roof tends to be weak, so that the rooms cave and let in water. Such falls are the principal difficulty encountered in the mine.

Character of the floor: The floor is fire clay 12 to 18 inches thick and has hard rock below it. The clay heaves but little if any.

GENUINE NORRIS COAL MINING COMPANY'S MINE NO. 1, AT NORRIS

Entrance: Shaft; 180 feet to the top of No. 5 coal.

Thickness of the coal: Varies from 3 feet 9 inches to 4 feet 2 inches; averages 4 feet.

Character of the coal: The coal is without benches, and contains a few streaks of clay and mother coal one-eighth inch or less in thickness, none of them regular, and here and there a pyrite nodule 2 to 3 inches by 6 to 8 inches. These latter are not common. The horsebacks occur in about the usual frequency and size. The impurity most difficult to handle consists of the floor boulders. These are masses of very hard brownish to black rock occupying the lower part of the bed. Some are nearly 3 feet thick and extend laterally 4 to 5 feet. They are similar to the boulders noticed in the mine of the Silver Creek Colliery Company and apparently consist of areas of silicification. Pyrite is present in only relatively small amount as spar sulphur and balls. It is an impurity of little consequence in this mine.

Character of the roof: The usual roof conditions for this area exist. The "draw slate" is persistent. Best mining practice in this mine requires that the "draw slate" remain up, for considerable difficulty is experienced in holding the black "slate" and clod after the "draw slate" falls. The cap-rock seems to be fairly good, but is crossed here and there by incipient cracks which widen on exposure to the air, thereby loosening the rock.

At one locality in the mine along the main south entry, above the black "slate," a massive sandy rock is present which appears to be a very sandy phase of the cap-rock. The sandstone "rolls" down through the clod so that it rests upon the black "slate" within 14 inches of the coal. At this place the coal also dips rather sharply beneath the roll. This is the

only structural irregularity, other than the clay or spar slips, that has been noted in the county.

The "draw slate" is a limy black "slate" containing small lenticular bodies of calcareous sandstone or sandy limestone about ⅛ inch thick and 1 inch in diameter. In places it becomes very calcareous and contains lenses of limestone composed of shells which are commonly pyritiferous. The niggerheads seem to be of different origin. They are apparently concretionary and generally not fossiliferous. They seem to be embedded mainly in the black shale or "slate" and to extend down into the "draw slate" or even into the coal.

Character of the floor: The floor is described as fire clay and is said to be about 2 feet thick.

SIMMONS COAL COMPANY'S MINE, AT CANTON

Entrance: Shaft; 121 feet to the top of No. 5 coal.

Thickness of the coal: Varies from 4 to 4½ feet; averages 4 feet 4 inches.

Character of the coal: The coal face was not observed in this mine. The coal is reported to be cut by fewer horsebacks than usual for this area, and the quantity of pyrite is also small. Some bright pyrite in balls is present, however. No boulders in the floor are reported.

The coal bed is interrupted both to the north and south by "faults." They appear to be deposits of sand and gravel made in pre-glacial channels, the floors of which were below the level of the coal.

Character of the roof: The roof is of the usual character. There is generally about 3 inches of "draw slate" present, black "slate" with clod above, about 18 inches thick in all, and the ordinary limestone cap-rock 4 to 10 inches thick.

CRIPPLE CREEK COAL COMPANY'S MINES AT BRYANT

Entrance: Drift; No. 5 coal.

Thickness of the coal: Varies from 4 feet 6 inches to 5 feet 2 inches; averages 4 feet 8 inches.

Character of the coal: The coal lies in benches due to three thin "soot" or mother-coal bands, 8, 22, and 31 inches from the top of the bed respectively. Horsebacks are present but are thin, rarely being more than 2 to 3 inches across. Rolls in the floor are usually less than 6 inches in height. In most of the rooms the coal breaks smoothly ½ to 1 inch below the "slate," leaving a fairly even top, a condition which is rather uncommon for this area. Niggerheads generally work loose and fall out and then the rest of the roof up to the cap-rock falls down. Pyrite is not common.

Character of the roof: The general succession above the coal is the same as in other mines in the area. The black shale and clod above the coal varies in thickness from 3 to 5 feet and the limestone cap-rock is 4 inches or more thick.

COAL BEDS BELOW NO. 5 COAL

In Fulton County the two coals which represent the largest resource are beds No. 2 and No. 1. The former seems to be widespread east of its outcrop. It is thin, but in many records of drilling it varies between 2 feet 6 inches and 3 feet, so that very probably there are large areas that could be profitably mined later if not now. Fortunately the need for the exploitation of such bodies of coal does not exist. No. 2 coal has the usual soapstone or gray shale roof commonly found over this coal in northern Illinois, with a 3-foot bed of black sheety shale at various intervals above the coal, up to possibly about 20 feet. The roof is such as to favor the longwall system of extraction, which is practically always employed where the coal is mined. The bed is usually fairly free from impurities and the coal of somewhat better quality than the coal in the higher beds in the same region.

The lower coal, No. 1 (Rock Island) bed has a much more erratic distribution than have the upper beds. It seems to be fairly persistent, but varies greatly in thickness and is commonly interrupted by lenses of shale which would render it unminable. It is not impossible, although the possibility is gradually being lessened by drilling, that there are areas of sufficient size to be of importance in which No. 1 coal attains a continuous thickness of more than 4 feet. Its normal development, however, is in lenticular bodies, the exploration and outlining of which is expensive, so that it will not be generally undertaken for many years. Furthermore, the roof conditions of this coal are irregular and result in high mining costs. Where it is present close to the coal the limestone cap-rock makes an excellent roof; but too commonly there is a mass of rather loose shale between the coal and the limestone which under present practice must usually be moved. The irregular character of this coal makes possible the discovery of small areas from which large returns can be expected, but for the most part No. 1 probably is not as important a resource as No. 2 coal.

Intermediate thin coals between No. 2 and No. 1, each generally less than a foot thick, locally thicken so as to be workable. Sometime there will no doubt be an eager search for workable areas of these coals, but at present they seem to have no commercial importance.

KNOX COUNTY

Production and Mines

Production in tons year ending June 30, 1920	34,753
Average annual production, 1916-1920	29,387
Total production, 1881-1920	1,866,061

The production of coal from Knox County in 1920 was entirely from wagon or local mines, about three-fourths from No. 6 coal, about one-fourth from No. 5, and a small amount from another bed possibly No. 1. The statistics of labor tabulate 27 mines, of which more than half are drift and slope mines. The county ranked thirty-ninth among the fifty-three producers.

Members of the present Survey have visited only four operations in the county and none of these is now in operation. The outcrop and structure of the various coals have never been determined, and for general geological conditions reliance is placed chiefly upon the report by Worthen in the Geological Survey of Illinois, Vol. IV, pp. 313 to 324. His account of the coals underlying the county is unfortunately confusing because of the wrong identification of at least one and possibly other coals, and because of general uncertainty as to correlation.

Knox and Fulton counties occupy a corresponding position across the outcropping edges of the commercial beds of the State. All the beds of commercial importance except No. 7 and possibly No. 1 outcrop within the county in more or less parallel belts extending north and south. No. 6 lies near the east line and what is possibly No. 1 near the west line. The coal of greatest importance in quantity is probably No. 5. No. 2 probably underlies the largest area, whereas No. 6 is limited to a small area in the eastern part of the county, bounded by its line of outcrop on the west, and No. 1 is limited as a commercial coal in its distribution by its decrease in thickness to the east.

Surficial Deposits

A factor which greatly hinders the development of the considerable amount of outcrop coal in the county is the covering of glacial drift.

The glacial drift is generally but 20 to 30 feet in depth, but in places where valleys have been filled, the depth may reach 100 feet or more.[1]

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[1]Leverett, Frank, Illinois Glacial Lobe: U. S. Geological Survey Mon. 38, p. 676, 1898.

The upper part of the drift is composed of fine yellowish silt or loess, which is somewhat more widespread than the glacial clay or till and is especially effective in concealing outcrops.

The position of the pre-glacial channels which cross the county has not been determined.

Coal-bearing Rocks

It is believed that in general the succession of coal-bearing rocks in Knox County is the same as in Fulton County eastward, and the coals outcrop in more or less parallel belts extending north and south. No. 6 coal underlies the higher parts of the county south and east of Spoon River, with No. 5 coal outcropping at lower levels. North of Spoon River, No. 6 coal is present on the uplands in the north half of the county as far west as Wataga, Oneida, and possibly Knoxville, but it is probably not generally present south of the Santa Fe Railroad. The area wherein No. 5 coal lies nearest the surface has not been well defined, due to some extent to the confusion in the correlation of this coal. Coal which is described by Worthen[1] as No. 4 is probably No. 5, just as is the case in Fulton County. Other coals, such as that mined at Soperville, which have been called No. 5, are still lacking definite correlation but appear to lie below No. 5 coal. No. 2 coal seems to be the coal nearest the surface in the western part of the county along the Chicago, Burlington and Quincy Railroad, running south from Galesburg through Abingdon and St. Augustine. There are many outcrops of this coal along Spoon River and its tributaries at relatively low altitudes in the county. It is also exposed at a few places near the western edge of the county north of Galesburg. No. 1 coal is possibly of workable thickness along Spoon River valley near the south line of the county, since it is being worked but a short distance south in Fulton County at Ellisville. However, as elsewhere in the State the distribution of this coal is irregular; whether it is generally present in workable thickness is doubtful.

For the general succession in the county we are dependent upon a few records of scattered drilling, the most of which are located in Henderson Township. Other holes have been drilled in Lynn, Galesburg, Copley, Persifer, and Knox townships.

The succession in Henderson Township is illustrated by the following drill records:

1Geological Survey of Illinois, Vol. IV, pp. 313-324.

Record of drilling on the farm of J. Snodgrass in the SW. ¼ NE. ¼ sec. 10, T. 12 N., R. 1 E., Knox County, Illinois.

Estimated elevation about 800 feet above sea level.

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Clay, sandy	20	....	20	....
Pennsylvanian system—				
Shale, gray	33	....	53	....
"Slate", dark	2	1	55	1
Coal	1	2	56	3
Shale, gray	2	7	58	10
Sandstone, light	3	2	62	....
Shale, light	2	2	64	2
Sandstone, light	1	4	65	6
Shale, light	15	3	80	9
"Boulder" (limestone?), light	2	2	82	11
Shale, gray	8	1	91	....
Shale, sandy brown	30	....	120	....
Sandstone, gray	15	4	135	4
Shale, dark	7	11	143	3
Limestone, blue, very hard	2	....	145	3
Shale, dark	7	9	153	....
"Slate," dark	1	11	154	11
Coal	1	7	156	6
Coal, impure (No. 1?)	....	2	156	8
Coal	....	4	157	....
Fire clay	2	....	159	....
Sandstone, white	8	10	167	10
Shale, sandy, light	4	10	172	8
Shale, sandy, gray	7	8	180	4
Shale, sandy, light	5	8	186	....
Coal, soft	1	....	187	....
Shale, sandy, light	2	2	189	2
Shale, lime	4	4	193	6
Sandstone, light	3	10	197	4
Shale, sandy, light	1	4	198	8
Sandstone, light, very hard	4	2	202	10
Shale, sandy, light	7	6	210	4
Shale, gray	2	7	212	11
Coal	1	2	214	1
Shale, gray, sandy	5	11	220	....
Sandstone, gray	....	6	220	5
Shale, dark	1	8	222	2
"Cap rock" (limestone?), very hard	1	1	223	3
Coal, impure	2	4	225	7
Sandstone, gray, hard	....	10	226	5

Record of drilling on the farm of J. Snodgrass—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Sandstone, light, hard	3	3	229	8
Shale, sandy, light	7	4	237	....
Shale, sandy, gray	10	3	247	3
Coal	....	11	248	2
Shale, gray	3	6	251	8
Shale, light gray	4	....	255	8
Shale, sandy, gray	8	1	263	9
Coal	....	3	264	....
Fire clay	1	4	265	4
Shale, sandy, gray	4	1	269	5
Coal	....	2	269	7
Shale, sandy, light	....	10	270	5
Sandstone, light, hard	2	8	273	1
"Slate," dark	10	6	283	7
Sandstone, light, very hard	1	6	285	1
Shale, dark	36	....	321	1
"Slate," dark, hard	15	10	336	11
Sandstone, light, hard	2	6	339	5

Record of a drilling on the H. Smith farm in the SE. ¼ SW. ¼ sec. 16, T. 12 N., R. 1 E., Knox County, Illinois.

Estimated elevation about 750 feet above sea level.

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Clay	26	....	26	....
Sand, gray	35	4	61	4
Sand and gravel	5	....	66	4
Pennsylvanian system—				
Shale, dark	....	6	66	10
Coal	3	1	69	11
Shale, light	6	9	76	8
Coal	....	2	76	10
Shale, sandy, brown	6	2	83	....
Sandstone, dark	7	....	90	....
Sandstone, light	25	....	115	....
Shale, gray, light	3	2	118	2
Shale, dark	8	6	126	8
"Cap-rock" (limestone?)	2	....	128	8
Shale, dark	7	2	135	10
Shale, bituminous	2	3	138	1
Shale, light gray	1	6	139	7
Coal, (No. 1?)	2	3	141	10
"False bottom"	....	4	142	2
Fire clay	1	10	144	....

The identification of the coals in the foregoing records is not definite. The nine holes drilled in the vicinity of Henderson are alike in showing a coal at a depth of 125 to 150 feet which is apparently the coal found at 154 feet 11 inches in the drilling on the Snodgrass farm and at 139 feet 9 inches in the drilling on the Smith farm. The presence of a hard blue limestone cap-rock a few feet above this coal suggests its correlation with No. 1 coal of Mercer and Rock Island counties. It is thought that this same bed is worked at Soperville by T. H. Milan and Company, where the coal is 100 feet below the surface. In this shaft the cap-rock (or "bed-rock," as it is called) is about 8 feet above the coal. The seam is from 2 to 4½ feet thick, with an average thickness of about 4 feet. If this is No. 1 coal, then the stratigraphic succession in northwestern Knox County varies from that farther south in that the Pottsville formation is thicker and the Carbondale formation probably thinner to the south and southeast.

It is believed that the coal underlying Henderson Township is certainly below the horizon of No. 5, and accordingly that this part of the county, as well as Rio, Galesburg, Cedar, Indian Point, Orange, and Chestnut townships forms part of District III, in which coals No. 1 and No. 2 are the principal coals mined. They will accordingly be included in the District III report. It is believed that with a small amount of additional field work the correlation of the coals in this part of the county can be satisfactorily settled.

The coals lying below No. 1 or the Soperville coal as shown in the record of the drilling on the Snodgrass farm are not commonly present in Illinois, except possibly in adjacent parts of Henry, Mercer, and Rock Island counties. Except in these counties 200 feet or more of Pottsville is unusual in the northern part of the State. It is possible that locally some of these lower coals may be of workable thickness, but they are not known to be worked in Knox County.

The succession in Galesburg Township is known only from the logs of churn-drill holes for water made by the city. Although these records are of little service in determining the character of the strata, they indicate, however, that the base of the Pennsylvanian strata is at a depth of about 330 feet below the surface at well No. 3. Of this thickness about 80 feet is drift and the remainder probably Pottsville. At Knoxville, in Knox Township, the base of the Pennsylvanian is possibly at a depth of 480 feet, as indicated by the deep water well record.

The following record is that of a diamond-drill hole near Etherly in Copley Township, the exact location of which is not known:

Record of drilling for the Etherly Coal Company, near Etherly, T. 12 N., R. 3 E, Knox County, Illinois.

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Clay, yellow	33	....	33	....
Pennsylvanian system—				
McLeansboro—				
Sandstone	9	....	42	....
Shale, light	3	....	45	....
"Soapstone"	16	....	61	....
Limestone, blue	1	3	62	3
Clay	....	6	62	9
Carbondale—				
Coal (No. 6)	4	2	66	11
Clay	....	6	67	5
"Slate"	7	7	78	....
Limestone	5	....	83	....
"Soapstone"	14	....	97	....
Shale, dark	30	....	127	....
Shale, black	18	....	145	....
"Slate"	6	4	151	4
Coal	....	11	152	3
"Slate" (No. 5 coal?)	2	....	154	3
Coal	....	8	154	11
Shale, light	12	1	167	....
Clay	5	....	172	....
Shale, light	34	....	206	....
Limestone	2	....	208	....
Shale, dark	14	....	222	....
Clay, fine	8	....	230	....
"Soapstone," black	17	....	247	....
Limestone	1	....	248	....
"Soapstone," black	2	....	250	....
Limestone	....	4	250	4
"Slate"	5	8	256	....
Clay	....	9	256	9
Coal (No. 2)	3	6	260	3
Pottsville—				
Clay	1	8	261	11
Limestone	....	3	262	2

Of the coals listed above, it is probable that the one at 62 feet 9 inches is No. 6 coal and the one at 256 feet 9 inches, No. 2. No. 5 coal does not seem to be present, though it may be represented by the thin coals at 151 feet 4 inches, and 154 feet 3 inches. The interval

between No. 2 and No. 6 in this drilling, namely, 190 feet, is about the same as it is in Fulton County.

A boring near Dahinda in Persifer Township penetrated strata to a depth of 220 feet, beginning apparently about 30 feet above the level of No. 2 coal. No coal was encountered below No. 2. The record is reproduced below.

Record of a boring near Dahinda, Knox County, on the Sargent farm
Drilled 1914

Description of Strata	Thickness		Depth	
Quaternary system—	*Ft.*	*in.*	*Ft.*	*in.*
Pleistocene and Recent—				
Clay, sandy	6	....	6	....
Sand and gravel	3	6	9	6
Sand, gray	13	....	22	6
Sand	1	6	24	....
Pennsylvanian system—				
Carbondale?—				
Coal, soft drift	2	8	26	8
Shale, light	3	5	30	1
Coal (No. 2?)	2	9	32	10
Pottsville?—				
Fire clay	2	....	34	10
Sandstone, light	11	7	46	5
Shale, sandy, light gray	14	....	60	5
Shale, light	4	10	65	3
Sandstone, gray	57	8	122	11
Sandstone, light	10	6	133	5
Sandstone, gray	11	....	144	5
Shale, sandy, gray	1	4	145	9
Shale, dark	1	2	147	11
Fire clay	....	9	148	8
Shale, dark	2	1	149	9
Fire clay	4	10	154	7
Shale, sandy, gray	11	2	165	9
Shale, dark	2	....	167	9
Limestone, dark	13	....	180	9
"Slate," dark	1	4	182	1
Shale, light sandy	3	6	185	7
Sandstone, light	4	....	189	7
Sandstone, hard, white	7	2	196	9
Shale, gray	11	2	207	11
Shale, light, sandy	8	....	215	11
Sandstone, light	3	6	219	5
Shale, light, sandy	1	4	220	9

A boring in the extreme northeast corner of the county shows a total thickness of about 420 feet of drift and Pennsylvanian strata. If

the record can be relied on, the stratigraphic succession in the locality seems to differ considerably from that in the southern part of the county. Although there is little basis for the correlation of any of the coals, a tentative correlation is suggested in the record which follows:

Record of coal prospect in sec. 1, T. 13 N., R. 4 E, Knox County

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Clay, gravel and sand	36	....	36	....
Pennsylvanian system—				
McLeansboro—				
Sandstone, gray	9	....	45	....
"Slate," gray	9	....	54	....
"Slate," dark	42	....	96	....
"Slate," dark, gritty	4	....	100	....
Carbondale—				
Coal (No. 6)	....	4	100	4
Fire clay, blue	2	9	103	1
"Slate," light	2	....	105	1
Sand rock, gray	5	....	110	1
"Slate," light	4	....	114	1
Sand and rock, gray	5	....	119	1
"Slate," light	3	....	122	1
"Slate," gritty, gray	43	....	165	1
"Slate," dark	20	....	185	1
"Slate," mild black	22	8	207	9
"Slate," gritty, blue	4	....	211	9
"Slate," gray	3	9	215	6
Coal (No. 5)	2	6	218	....
Fire clay, light	2	11	220	11
"Slate," gray	5	....	225	11
"Slate," dark	2	....	227	11
Shale, light	11	....	238	11
Sand rock, gray	3	....	241	11
"Slate," light	8	....	249	11
Sand rock, gray	12	....	261	11
"Slate," dark	1	8	263	7
Coal (No. 4)	1	10	265	5
Sand rock, gray	2	6	267	11
"Slate," dark	6	5	274	4
Coal (No. 3)	....	7	274	11
Fire clay, light	3	....	277	11
"Slate," dark	10	....	287	11
"Slate," black	2	....	289	11
"Slate," light	11	....	300	11
"Slate," dark	16	6	317	5
Coal (No. 2)	1	1	318	6

Record of coal prospect in sec. 1, T. 13 N., R. 4 E., Knox County—Concluded

Description of Strata	Thickness		Depth	
Pottsville—	*Ft.*	*in.*	*Ft.*	*in.*
Fire clay, light	1	5	319	11
"Slate," light	3	....	322	11
Sand rock, light	10	....	332	11
"Slate," dark	12	....	344	11
Coal (No. 1)	....	11	345	10
Fire clay, dark blue	4	1	349	11
Shale, light	3	....	352	11
Rock, hard, gritty, white	4	4	357	3
Lime shale, blue	12	8	369	11

The foregoing represents the information available concerning coal in Knox County, aside from that found in Volume IV of the Geological Survey of Illinois, which may be briefly summerized as follows:

"No. 6 coal is found principally in the eastern half of the county. It varies in thickness from 4 to 6 feet and has a blue band 1½ to 2 feet from the floor. The coal has been worked probably entirely by wagon mines, in T. 13 N., R. 2 E., sec. 36; in T. 12 N., R. 4. E., secs. 4, 5, 17, 18, 19, 29, 30, 31 and 32; in T. 12 N., R. 3 E., secs. 1, 10, 11, 18, 19 and 20; in T. 12 N., R. 2 E., secs. 12, 13, 15, 22, 23 and 24; in T. 11 N., R. 3 E., secs. 3, 4 and 5; in T. 10 N., R. 4 E., sec. 15; in T. 9 N., R. 4 E., secs. 23, 24, 31, and probably 32 and 33; and in T. 9 N., R. 3 E., in sec. 35. The coal has a limestone cap-rock which in places is 4 feet thick.

"The coal is only found in the higher portions of the county, which are principally in the eastern half, and north of Spoon River in the western half of Victoria Township, T. 12 N., R. 4 E., and northwest part of T. 12 N., R. 3 E., Copley Township, and east part of Sparta, T. 12 N., R. 2 E."

No. 5 coal (Worthen No. 4?) lies 40 to 60 feet below No. 6 and commonly varies between 3 and 4 feet in thickness. Mines have been operated in this coal in sec. 25, T. 12 N., R. 4 E., and in secs. 2 and 3, T. 13 N., R. 1 E., possibly along Sugar Creek in T. 12 N., R. 3 E., secs. 9, 16, 32, and along Middle Creek in T. 11 N., R. 2 E., and sec. 25, T. 11 N., R. 1 E., sec. 3, T. 9 N., R. 4 E., and secs. 26 and 27, T. 10 N., R. 4 E.

This coal underlies more of the county than does No. 6; it is probably present in T. 13 N., Rs. 2, 3, and 4 E., and the eastern part of R. 1 E.

No. 2 coal is generally from 1½ to 3 feet thick and of good quality in comparison with other coals in the county. It has been worked in secs. 20, 21, 29, 30, 32, and 33, in T. 12 N., R. 1 E.; in secs. 16 and 23, T. 11 N., R. 2 E.; in secs. 13, 19, 22, 23, and 35, T. 11 N.,

R. 3 E.; at various places in Truro Township, T. 11 N., R. 4 E., along Spoon River; in secs. 8, 16, 19, 29, T. 10 N., R. 3 E.; in secs. 14, 22, 23, 25, 26, 27, 29, 33, 34, T. 10 N., R. 2 E. These operations are by drifting or stripping. There were no shafts to No. 2 when Worthen's report was written in 1870.

No. 1 coal (Worthen correlation) was worked in one place in sec. 21, T. 12 N., R. 1 E., where it is 6 feet thick. It was worked by a shaft 30 feet deep. This is probably the same bed now worked at Soperville.

Mine Notes

Detailed information about the mines in Knox County is very meager. Four mines have been visited by members of the Survey, none of which is now in operation.

The following data are available concerning these operations:

MINE OF ALBERT WALBURG, KNOXVILLE

Wagon mine.

Entrance: Shaft, 45 feet in depth. Coal mined is probably No. 5. The coal is cut by numerous vertical clay "veins" which pass into the coal, some from the floor and others from the roof. A section of the bed is measured about 300 feet southwest of shaft, as follows:

Section of coal at Walburg mine

	Thickness		Thickness of coal	
	Ft.	*in.*	*Ft.*	*in.*
Roof: Shale, black	2	..		
Sulphur	..	2		
Coal	1	10		
Sulphur	..	½	2	5
Coal	..	6½		
Floor: Fire clay	..	1		

JOHN D. YOUNG MINE, NEAR ABINGDON

Drift mine, operating No. 2 coal, with an average thickness of 2 feet, but varies from 20 to 26 inches. The coal is bright, hard, with brownish streaks. It breaks into cubical pieces, with a conchoidal fracture. Sulphur occurs in irregular lenses at various places in the bed. The following section was measured about 100 feet southeast of entrance:

Section of coal at Young mine

	Thickness		Thickness of coal	
	Ft.	*in.*	*Ft.*	*in.*
Roof: Shale gray	6	..	..	..
Coal	1	3		
Sulphur	..	¾	1	11¾
Coal	..	8		
Floor: Fire clay	3	..	..	..

The roof is fine gray shale, falling in layers 2 to 4 inches thick. It has a thickness of 6 feet or more. The floor is a shale or fire clay at least 3 feet thick.

MINE OF PENDERGAST BROS., AT SOPERVILLE

Entrance: Shaft 120 feet deep, to No. 1 coal. The record of the shaft is as follows:

Record of Pendergast shaft

	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Drift	10	..	10	..
"Soapstone," gray	85	..	95	..
"Slate"	2	6	97	6
Coal	1	10	99	4
Shale, blue	7	..	106	4
Limestone, white, flinty	1	2	107	6
Limestone, bluish	7	..	114	6
Coal (No. 1)	5	..	119	6

This is apparently No. 1 coal of Mercer and Rock Island counties. Another coal, about 40 feet lower, outcrops in places along the creek. The coal was measured in 2d room north, on the east side of shaft about 75 feet east and 100 feet north of opening.

Section of coal in Pendergast mine

	Thickness		Thickness of coal	
	Ft.	*in.*	*Ft.*	*in.*
Roof: Limestone	7	..		
Coal	..	7		
Black jack	..	2		
Coal	2	..	3	5⅞
Sulphur	..	⅜		
Coal	..	8½		
Floor: Fire clay	4	..		

MINE OF GALVA MINING CO., NEAR WATAGA

Shaft mine, 68 feet 6 inches to the floor. Coal averages 4 feet in thickness, varying from 3 feet 4 inches to 4 feet 2 inches. The cap-rock is black to gray shale, 1½ to 4 feet, with a limestone cap-rock 3 feet or more thick. The coal was measured at the 2d north entry about 450 feet from the shaft.

Section of coal in Galva mine

	Thickness		Thickness of coal	
	Ft.	*in.*	*Ft.*	*in.*
Roof: Gray to black shale	1	6+		
Coal	1	2		
Sulphur and soft shale	..	½		
Coal	..	10	2	10½
Shale, soft (blue band?)	22	2		
Coal	..	8		

LOGAN COUNTY

Production and Mines

Production in tons year ending June 3, 1920..... 2,263,222
Average annual production 1916-1920..... 452,644
Total production, 1881-1920.....10,130,415

Logan County produced a little more than ½ of 1 per cent of the total output for Illinois during the year ending June 30, 1920, and ranked twenty-third in the State. Two mines, both at Lincoln, are now being operated in this county, one by the Latham Lincoln Coal and Mining Company, and the other by the Citizens Coal Mining Company. Table 6 is a list of the shipping mines and data concerning them.

Surficial Deposits

The rock succession in Logan County is known only as it is shown by the records of three drill holes and of three shafts. The drill holes are located at Atlanta and near Lincoln and the shafts at Lincoln and at Mt. Pulaski. One of the drill holes at Atlanta does not enter rock, although it is 151 feet deep.

According to Worthen[1] the outcrops in this county are limited to certain exposures of limestone along Salt Creek in T. 19 N., Rs. 3 and 4 W. Most of the county is thickly covered by drift. In the vicinity of Atlanta the drift has a known thickness of over 200 feet.[2] The character of the material in the drift sheet is shown by the following record of a drilling at Atlanta.

Log of the well at the waterworks at Atlanta, Illinois

Description of strata	Thickness	Depth
Quaternary system—		
Pleistocene and Recent—	*Feet*	*Feet*
Soil, black	3	3
Clay, yellow	15	18
Clay, blue	10	28
Sand and gravel	10	38
Clay, blue	2	40
Sand and gravel	9	49
Clay, white, and sand	7	56
Clay, blue, with gas	3	59
Sand, white, and gravel	10	69
Sand	6	75

1Geology of Illinois, Vol. 4, p. 184, 1870.

2Leverett, Frank, Illinois Glacial Lobe: U. S. Geological Survey Mon. 38, pp. 205 and 206, 1899.

Log of the Atlanta well—Concluded Description of strata	Thickness *Feet*	Depth *Feet*
Sand, dry, and gravel with gas	13	88
Clay, blue	4	92
Clay, sand, gravel, and gas	16	108
Hardpan	9	117
Drift, black	6	123
Clay, white	2	125
Clay, green	4	129
Hardpan	10	139
Gravel and water	12	141

A less detailed record of another boring at Atlanta shows that the drift has a thickness of at least 217 feet in this vicinity.

Record of a coal prospect near Atlanta, Illinois

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Soil	3	3
Clay, yellow	17	20
Clay, blue	50	70
Hardpan	55	125
Drift, black	8	133
Clay, green	7	140
Hardpan	30	170
Gravel with water	2	172
Gravel and sand, cemented	18	190
Sand and gravel with water	3	193
Clay and gravel and sand	14	207
Loam, yellow	4	211
Sandstone, yellow	1	212
Clay, soft, pink	5	217
Pennsylvanian system—		
"Soapstone"	3	220
Limestone	1	221
Fire clay	3	224
Limestone (?)	53	277
Shale with clay	40	317
"Slate"	7	324
Coal (No. 5?)	4	328
Fire clay	1	329
Limestone	1	330

As the northern part of the county is crossed by a glacial moraine, the drift is thicker there than it is in the southern part. At Lincoln and Mt. Pulaski records show that the glacial covering is generally

between 75 and 100 feet deep. Because of the difficulties attendant upon sinking shafts through unconsolidated material the desirability of given areas for mining operations becomes less as the thickness of the drift increases. Accordingly the exploitation of the coal resources of the northern part of Logan County will probably be greatly delayed with respect to the development of the southern part, especially as the character and thickness of the coal is apparently as good in the southern portion as it is in the northern.

Coal-bearing Rocks

The character of the coal-bearing strata of the county is known from the record of the Atlanta coal prospect given above, and the few outcrops noted above, and from the following records of three other holes:

Record of the shaft of the Citizens Coal Mining Company, Lincoln, Illinois

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Soil and clay	18	....	18	....
Drift	3	....	21	....
Clay, blue	8	....	29	....
Hardpan	16	....	45	....
Sand and water	16	....	61	....
Sand and hardpan (water)	24	....	85	....
Gravel, coarse	3	....	88	....
Hardpan	1	5	89	5
Pennsylvanian system—				
McLeansboro—				
Fire clay	3	5	92	10
Limestone, impure	20	....	112	10
Shale, black	1	5	114	3
Fire clay	2	....	116	3
Clay, red and white	12	....	128	3
Fire clay	2	....	130	3
"Conglomerate"	12	....	142	3
"Slate," brown	30	....	172	3
"Slate," black	4	....	176	3
Coal (No. 7)	1	5	177	8
Fire clay	10	....	187	8
Sandstone, blue	22	....	209	8
"Slate," black	1	....	210	8

Record of the shaft of the Citizens Coal Mining Company—Concluded.

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Carbondale—				
Coal (No. 6?)	1	....	211	8
Fire clay	3	5	215	1
Sandstone, blue	18	....	233	1
"Soapstone"	3	....	236	1
Rock, fine blue	7	....	243	1
Shale, blue	18	....	261	1
Limestone	1	6	262	7
"Slate," black	3	4	265	11
Coal (No. 5)	5	2	271	1

Record of a boring for oil in the NE. ¼ sec. 3, T. 19 N., R 2 W., Logan County

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Soil	19	....	19	....
Gravel	20	....	39	....
Quicksand	14	....	53	....
Clay and sand in streaks	18	....	71	....
Pennsylvanian system—				
Limestone, shell	2	....	73	....
Shale, sandy	20	....	93	....
Shale, blue, mucky	8	....	101	....
Quicksand and water	25	....	126	....
Shale (mud), blue	7	....	133	....
Limestone, hard, flinty (Lonsdale?)	12	....	145	....
Shale, red, sandy	15	....	160	....
Shale ("marrow"?), blue	5	....	165	....
Limestone, shell	2	....	167	....
Shale, red	10	....	177	....
Shale ("marrow"?), blue	30	....	207	....
Limestone, shell	2	....	209	....
Shale, white	16	....	225	....
"Slate," blue	4	6	229	6
Limestone, shell	1	....	230	6
Coal, (No. 5)	4	....	234	6
Shale, white	20	....	254	6
Shale, blue	3	6	258	....
Shale, white	20	....	278	....
Limestone, shell	1	....	279	....
Shale, black	7	....	286	....
"Slate," blue	3	....	289	....
"Slate," white	20	....	309	....
Limestone, white; water	10	....	319	....

Record of a boring for oil in the NE. ¼ sec. 3, T. 19 N., R. 2 W., Logan County—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
"Slate," white	101	....	420	....
"Slate," sandy, black	5	....	425	....
Shale, white	98	....	523	....
Shale, blue	2	....	525	....
Shale, white	5	....	530	....
"Slate," black	30	....	560	....
"Slate," white	5	....	565	....
Shale, dark	12	....	577	....
"Slate," white	33	....	610	....
Shale, black	15	....	625	....
Sand, black; gas and water	10	....	635	....
"Slate," white	4	....	639	....
Coal	....	6	639	6
Shale, blue	20	6	660	....
"Slate," white	12	....	672	....
Shale, black, sandy	14	....	686	....
Shale, white	10	....	696	....
Mississippian system—				
Limestone	25	....	721	....
Sandstone	3	....	724	....
"Slate," white; streaks of limestone	18	....	742	....
Limestone	20	....	762	....
Sandstone; salt water	8	....	770	....
Limestone	4	....	774	....
Shale, sandy	5	....	779	....
"Cap rock"	1	6	780	6
Sand, gas	1	6	782	....
"Cap rock"	7	....	789	....
Limestone, hard and soft layers	81	....	870	....
Shale, sandy, dark	3	....	873	....
"Cap rock"	3	....	876	....
Sandstone; salt water	14	....	890	....
"Soapstone"	1	....	891	....
Shale, dark	3	....	894	....
"Cap rock," hard	1	....	895	....
"Cap rock"	2	....	897	....
Sandstone, dark	....	4	897	4
Sandy shale, dark	1	....	898	4
"Cap rock"	1	....	899	4
Sandstone; gas	.....	4	899	8
Rock, very hard	8	4	907	....

Record of a coal mine shaft, Mount Pulaski, Illinois[1]

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent				
Drift clay and gravel	92	....	92	....
Pennsylvanian system—				
Shale, sandy	20	....	112	....
Limestone	1	....	113	....
Fire clay	1	6	114	6
"Slate," gray	20	....	134	6
Shale, sandy	40	....	174	6
Limestone	2	....	176	6
Shale, black	1	....	177	6
Coal (No. 8?)	1	6	179	....
Fire clay	2	....	181	....
Shale, clay	4	....	185	....
Shale, gray, sandy	60	....	245	....
Limestone, conglomeratic	15	....	260	....
Shale, clay	2	....	262	....
"Slate," black	1	....	263	....
Coal	....	6	263	6
Fire clay	....	6	264	....
"Slate," black	....	10	264	10
Coal	....	4	265	2
Fire clay	....	8	265	10
Shale, reddish	10	....	275	10
Sandstone	30	....	305	10
Shale, sandy, clay	30	....	335	10
Limestone, black	8	....	343	10
Coal (No. 5)	4	....	347	10
Fire clay	4	....	351	10

The foregoing records differ so much from one another that it is impossible to make a generalization that is of much value in regard to rock succession in the county. The only workable coal in the section, however, seems to be No. 5, at least under present conditions. The only drill hole penetrating the horizon of No. 2 coal is the oil prospect, and as this was drilled by a churn drill, the details are not to be relied upon for accuracy. The absence of a coal which can be correlated with No. 2 in this record is of no great significance.

[1]Geological Survey of Illinois, Vol. 8, p. 51, 1890.

Mine Notes

MINE OF THE CITIZENS COAL MINING COMPANY, AT LINCOLN

Entrance: Shaft; 266 feet to the top of No. 5 coal.

Thickness of coal: Averages 5 feet 2 inches; maximum observed, 6 feet.

Character of the coal: The bed lies in a single bench with no persistent partings. It contains a few thin streaks of mother coal or "blackjack" (pyritized mother coal), commonly less than $\frac{1}{16}$ of an inch in thickness. Pyrite lenses and balls are uncommon in the coal. Horsebacks are numerous and vary in width from mere cracks with pyrite filling to openings 3 to 4 inches in width, filled with clay. Rarely the horsebacks or clay slips are as much as 2 feet across. As a general thing the clay veins do not seem to be quite so hard and difficult to handle as are those in some of the mines in the Peoria region. However, the expense of the dead work produced because of the presence of the clay vein is a considerable handicap against the profitable operation of this mine.

Character of the roof: The immediate roof is a black shale which in places is hard and sheety, carrying niggerheads. Over much of the mine, however, the black shale is more massive, softer and thicker, and tends to break out in chunks rather than in sheets. This sort of roof is difficult to hold, especially as the limestone cap-rock is also thin or absent at these places. The cap-rock is a thin gray to whitish limestone, discontinuous in distribution and varying considerably in thickness, but generally present. Where the black "slate" is hard, sheety, and about 3 feet thick, the cap-rock is generally believed to be present, and to be thicker and harder than elsewhere, possibly 12 to 15 inches thick. That this is actually the case must be inferred from the few places where the "slate" has been taken down, as under ordinary conditions it does not fall so that the roof can be seen. Elsewhere the limestone is more clayey, softer, thinner, and in places entirely absent.

Between the coal and the better "slate" roof there is generally a ¾-inch sheet of pyrite, which sticks to the roof rock and remains up. Where the pyrite is present in this manner, the roof is easier to hold; and the absence of the pyrite band generally indicates that roof conditions will be bad.

Character of the floor: Underclay lies beneath the coal. It has not been penetrated but is known to be 5 to 6 feet thick in places. The clay heaves some when it is wet.

The mine encounters some difficulty in handling the water that enters the shaft from a gravel bed 45 to 61 feet from the surface, as shown in the record given above. It is evident that this water was not properly sealed off at the time the shaft was sunk.

MINE OF THE LATHAM LINCOLN COAL COMPANY, AT LINCOLN

Entrance: Shaft; 280 feet to No. 5 coal.

Thickness of coal: Varies from 4 feet 8 inches to 5 feet 3 inches; averages 5 feet.

Sections of the coal:

SECTIONS OF NO. 5 COAL IN MINE OF LATHAM LINCOLN COAL COMPANY, LINCOLN, ILLINOIS

Section 1—Room 3, off first stub off straight south entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, clean, hard	..	5
Mother coal, soft	..	½
Coal, dirty	2	4
Pyrite	..	⅛
Coal, clean and bright	..	3
Pyrite lens	..	⅞
Coal, dirty, bright	1	10½
	5	0

Section 2—Room 1, off second right off straight east entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, clean, bright, hard	..	3
Mother coal	..	¼
Coal, fairly clean	2	4½
Mother coal	..	¼
Coal, dirty	..	5¼
Pyrite	..	¼
Coal, very dirty	1	9
	3	10½

Section 3—Room 2, off second stub off third right off north entry [1]

	Thickness	
	Ft.	*in.*
Roof: Black slate	..	..
Pyrite	..	¼
Coal, fairly clean and hard	2	½
Mother coal	..	¼
Coal, dirty	..	2
Pyrite	..	1
Coal, dirty	1	3½
Coal, bony (pyrite and black jack)	..	2½
Coal, very dirty	1	2½
Floor: Underclay	..	..
	5	½

[1] U. S. Bureau of Mines Bull. 22, p. 497.

Section 4—1,600 feet N. E. of shaft, room 1, third entry off main cross entry on the northwest side [1]

	Thickness	
	Ft.	*in.*
Roof: Shale	..	..
Coal	..	10
Sulphur	..	½
Coal	3	6
Sulphur	..	⅛
Coal	..	6
Floor: Shale	..	..
	4	10⅝

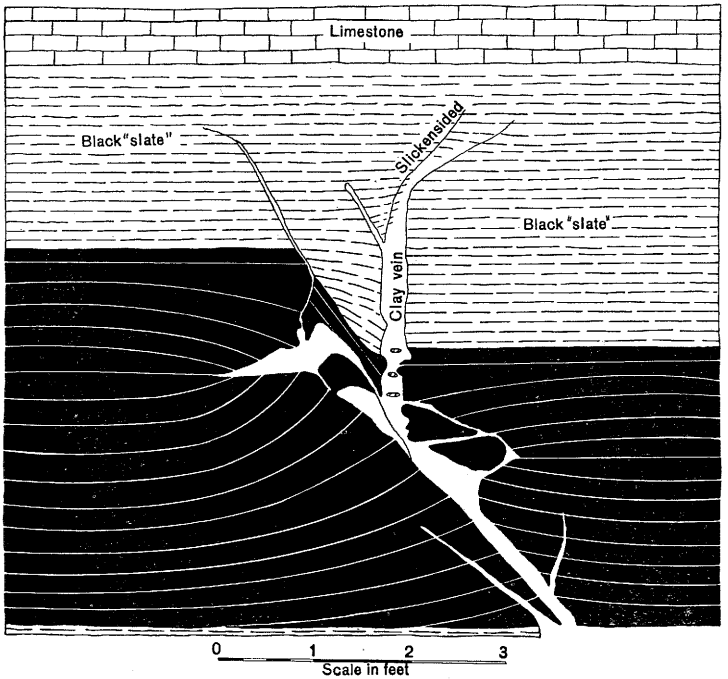

FIG. 7.—Sketch of a clay vein ("horseback") in the Latham-Lincoln Coal Company's mine at Lincoln.

Section 5—1,500 feet southeast of shaft in room 11 off the third south stub

	Thickness	
	Ft.	*in.*
Roof: Shale	..	..
Coal	..	4½
Shale	..	¾
Coal	..	9
Sulphur	..	⅛
Coal	3	8
Floor: Shale	..	..
	4	10⅜

[1] Op. cit.

Character of the coal: The coal lies in a single bench with no persistent impurities. There are thin mother-coal partings and the lower 2 inches of the bed in places contains bony coal. There is very little pyrite present. Usually also the top 2 inches of the coal is bony. Clay veins or "horsebacks" are rather numerous. The accompanying reproduction of a sketch of one of the clay veins (fig. 7) shows the way in which it plays out in the roof shale.

Character of the roof: The roof is a carbonaceous and sheety black "slate," commonly about 3 feet thick. Above the "slate" is a few inches of dark shale or clod upon which lies the cap-rock. This is a dark-gray fossiliferous limestone, the bottom of which is nodular and uneven. The thickness of the cap-rock averages 8 to 10 inches, but varies from 1 to 18 inches. Overlying the cap-rock there is usually soapstone or gray shale. At the base of the black "slate" and in contact with the coal there is usually a shell of pyrite 2 to 3 inches thick. This generally stays up, forming a good roof. Niggerheads are common along the contact of the coal and "slate."

Character of the floor: The fire clay is said to be 12 feet thick. It slakes in the air and heaves when wet.

MINE OF MT. PULASKI COLLIERY COMPANY (ABANDONED), AT MT. PULASKI, ILLINOIS

Entrance: Shaft 365 feet deep. Figure possibly refers to depth to the top of No. 5 coal.

Thickness of coal: Varies from 3 feet 6 inches to 4 feet 4 inches, averaging 4 feet.

Section of the coal:

Section of No. 5 coal in mine of the Mt. Pulaski Colliery Company, Mt. Pulaski, Illinois

Room 9 off back east entry off main south; 200 feet from shaft

	Thickness	
	Ft.	*in.*
Coal	1	9
Pyrite	..	1½
Coal	1	..
	2	10½

Character of the coal: The coal is all fairly hard and blocky. Pyrite is present in regular streaks but is fairly common. Clay veins or "horsebacks" are numerous, varying in thickness from 2 inches to 2 feet.

Character of the roof: The roof is black "slate" up to 4 feet in thickness.

Character of the floor: The underclay beneath the seam is said to be 10 feet thick. It tends to heave somewhat.

McLEAN COUNTY

Production and Mines

Production in tons, year ending June 30, 1920	43,357
Average production, 1916-1920	71,308
Total production, 1881-1920	5,478,350

McLean County ranked 37th in 1920, having a total production of about 0.05 per cent of the entire output. The output was from one mine, that at Bloomington. The Colfax mine reported no production. Table 6 gives data concerning both mines.

Surficial Deposits

Like most of the counties in central Illinois, McLean County is covered by glacial drift, and in this county its thickness averages probably over 200 feet. Leverett[1] makes the following statement concerning the thickness of the drift:

"The drift is of great depth, averaging probably over 200 feet. Records of ten deep borings were obtained which reach rock at an average of 155 feet, but twenty-one others have an average depth of 174 feet without entering rock. The drift is apparently thinnest in the northern part of the county, where rock is struck at about 100 feet. The drift in the central and southern portions has a depth of 200 to 250 feet. Buried soils are found at two or more horizons at depths usually of 100 feet or more, but on the plain outside the morainic system a soil occurs at 40 feet or less. The drift above the first buried soil is usually a soft blue till. At greater depths the till is frequently found to be very hard, as in the neighboring counties to the north and northeast, already discussed. In some of the deep borings a large amount of sand and gravel is found in the lower part of the drift. Many wells have been sunk to a depth of 150 to 200 feet in order to reach the water-bearing beds beneath the blue till, there being only a small amount of water-bearing gravel interbedded with the blue till."

Coal-bearing Rocks

Because of the thick covering of glacial material and the consequent lack of outcrops, the geology of the coal-bearing rocks can be determined only by borings or shafts. The only available information of the sort is the record of two drill holes at Saybrook, and three drill or shaft records at Bloomington. The record of a deep boring for oil at Heyworth is too generalized to be of service in these studies.

Such of these records as are not confidential are reproduced herewith.

[1]Leverett, Frank, Illinois Glacial Lobe: U. S. Geological Survey Mon. 38, p. 693, 1899.

Record of the shaft of the Bloomington Coal Company[1]

Description of Strata	Thickness *Ft.*	Depth *Ft.*
Quaternary system—		
Pleistocene and Recent—		
Surface soil and brown clay	10	10
Clay, blue	40	50
"Hardpan," gravelly	60	110
Mold, black; pieces of wood, etc.	13	123
"Hardpan" and clay	89	212
Mold, black, etc.	6	218
Clay, blue	34	252
Quicksand, buff and drab; fossils	2	254
Pennsylvanian system—		
McLeansboro—		
Shale, clay	16	270
Sandstone	32	302
Shale, clay	1	303
Coal (No. 6 or 7)	4	307

Record of the shaft of the McLean County Coal Company, Bloomington, Illinois.

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Surface soil and gravel	19	7	19	7
Clay, blue	61	2	80	9
Sand (water)	4	....	84	9
Clay, blue	76	4	161	1
Pennsylvanian system—				
McLeansboro and Carbondale—				
"Soapstone"	39	....	200	1
Limestone	1	....	201	1
Clay, blue	35	5	236	6
Clay, yellow	15	10	252	4
Shale	4	....	256	4
Sandstone, soft, gray	11	....	267	4
Limestone, hard, conglomerate	12	6	279	10
"Soapstone"	5	....	284	10
Coal (No. 7?)	3	6	288	4
Fire clay	9	3	297	7
Sandstone, gray	4	....	301	7
"Soapstone"	22	6	324	1
Shale, dark	8	6	332	7
"Soapstone"	9	6	342	1
Fire clay	10	....	352	1

[1]Geol. Survey of Illinois, Vol. IV, pp. 178 and 186.

Record of the shaft of the McLean County Coal Company—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Shale, gray	22	....	374	1
Shale, black ("slate")	5	....	379	1
Coal (No. 5)	4	4	383	5
Fire clay	10	....	393	5
"Slate"	3	....	396	5
Fire clay	4	6	400	11
Sandstone	20	6	421	5
"Soapstone"	62	5	484	10
Shale, black ("slate")	2	7	486	5
Fire clay	1	7	488	....
"Sulphur" rock	1	2	489	2
Shale, gray	11	1	500	3
Shale	1	2	501	5
Limestone, hard	2	1	503	6
Shale, gray	2	8	506	2
"Soapstone"	6	8	512	10
Coal (No. 2)	3	8	516	6
Pottsville—				
"Soapstone," coal, and "slate"	25	....	541	6

Record of a drilling near Saybrook, in the SE. ¼ NW. ¼, sec. 28, T 23 N., R. 6 E.

Description of Strata	Thickness		Depth	
Quaternary system—	*Ft.*	*in.*	*Ft.*	*in.*
Pleistocene and Recent—				
Soil, dark	4	....	4	....
Clay, blue	2	....	6	....
Gravel	2	6	8	6
Clay, blue	20	....	28	6
Clay, blue, with some sand and pebbles	10	....	38	6
Sand, coarse, with some clay	12	....	50	6
Gravel, coarse, mixed with sand	45	....	95	6
Clay, hard, and gravel	55	....	150	6
Quicksand	3	....	153	6
Clay, blue	4	....	157	6
Clay, hard, and gravel	36	6	194	....
Sand and gravel; water	3	....	197	....
Sand, coarse, gray	11	....	208	....
Clay, soft, blue	1	....	209	....
Sand and fine gravel	2	....	211	....
Sand and gravel, cemented	12	....	223	....
Sand, fine, with small boulders	11	....	234	....
Sand, soft	1	6	235	6
Sand, coarse, red	2	6	238	....

Record of drilling near Saybrook—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Pennsylvanian system—				
Sandstone, soft, red	1	....	239	....
Limestone	....	8	239	8
"Soapstone" and shale	10	9	250	5
Shale, black, and coal	....	6	250	11
Shale	16	....	266	11
Limestone	....	7	267	6
Shale, blue	6	6	274	....
Shale, with streaks of limestone	14	....	288	....
Shale, dark	1	....	289	....
"Soapstone"	3	6	292	6
Shale	4	....	296	6
Shale, with spots of limestone	14	....	310	6
Limestone, hard	15	6	326	....
Limestone and shale	8	....	334	....
Shale	19	6	353	6
Shale and sandy shale	51	....	404	6
Shale, blue, tough	8	7	413	1
Shale, soft, in loose layers	7	....	420	1
Shale, black, and coal	....	4	420	5
Coal (No. 7?)	2	6	422	11
Clay, soft	....	8	423	7
Shale, with some sandy shale	94	....	517	7
Sandstone	6	....	523	7
Shale, sandy, gray	2	....	525	7
Shale, black	1	....	526	7
Shale, dark, with limestone bands	5	6	532	1
Limestone, hard, fine	....	6	532	7
Coal (No. 6?)	1	....	533	7
Shale, clay	5	....	538	7
"Soapstone"	3	....	541	7
Shale, clay, bluish	14	....	555	7
Shale, bluish, soft	16	....	571	7
Shale, gray, hard	2	9	574	4
Coal, cannel } (No. 5?)	5	4	579	8
Coal }	3	....	582	8
Fire clay and shale	6	8	589	4

The interpretation of the records is practicable to a certain extent. The lowest coal at Bloomington, at 512 feet 10 inches, is No. 2 coal, or the same bed that is mined in the Longwall field. The middle bed at 379 feet is No. 5 or Springfield coal. Both of these beds are worked in the McLean County Coal Company's mine at Bloomington. The upper coal at 285 feet is either No. 6 or No. 7 coal, but the probabilities

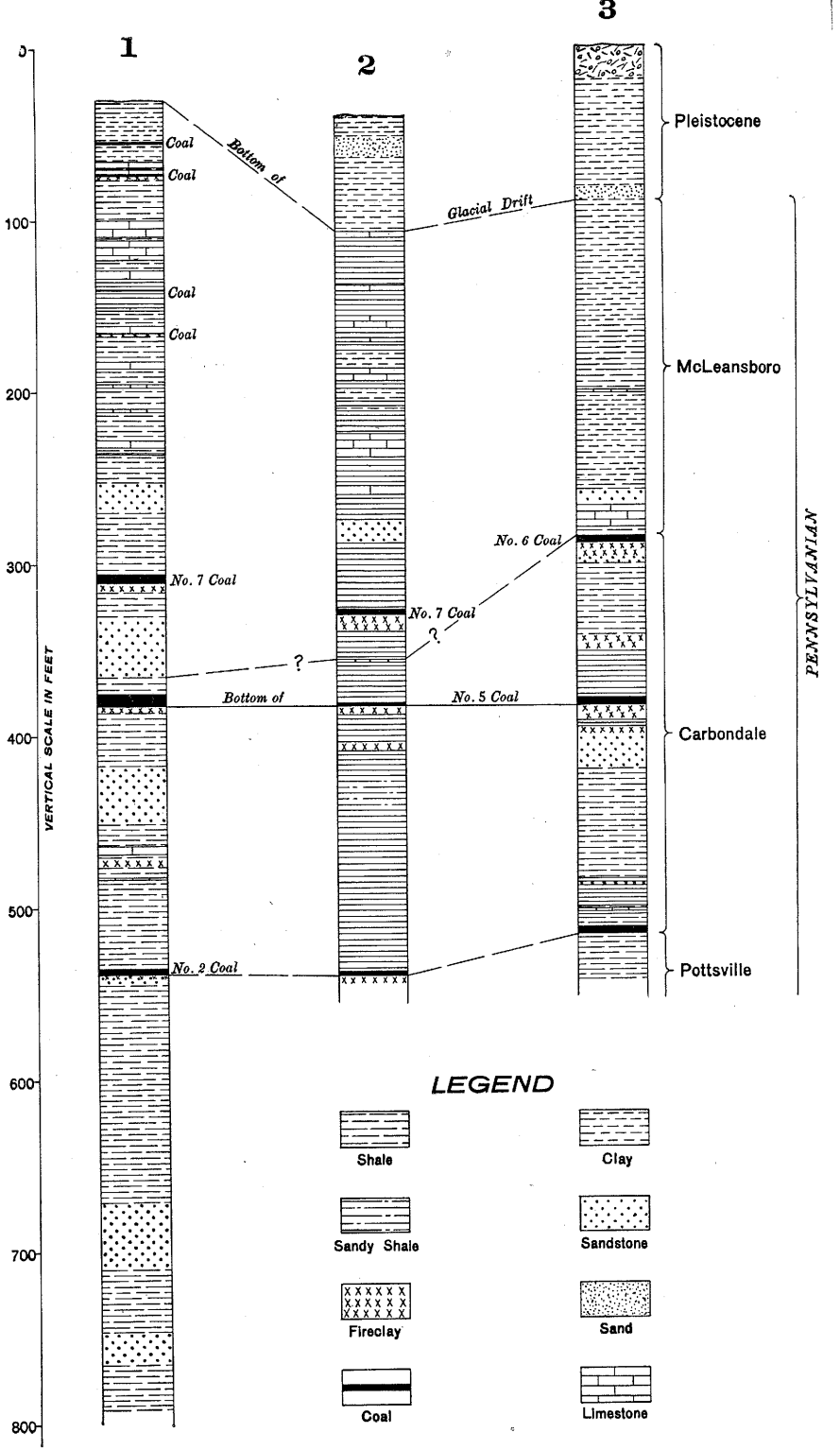

FIG. 8.—Graphic sections showing the Pennsylvanian succession at La Salle, Bloomington, and an intermediate point.

1. La Salle 2. Toluca. 3. Bloomington.

seem to be that it is No. 7, although Worthen regarded it as No. 6. It seems probable that this upper bed is the same as the upper bed at La Salle, which is considered to be No. 7. North from Bloomington the Pennsylvanian section resembles closely the section in the La Salle field west of the La Salle anticline as may be noted from a comparison of the accompanying graphic sections (fig. 8) showing the succession at La Salle, Bloomington, and an intermediate point, Toluca.

The coals encountered in the drilling at Saybrook can not be definitely identified, as neither the thickness nor the intervals between the coals, or the associated strata are characteristic. The writer is inclined to regard the lowermost coal and overlying cannel coal as No. 5 coal, and possibly the other two coals are No. 6 and No. 7, respectively, in their order of occurrence above No. 5. It is unfortunate that the drill did not penetrate to a greater depth, as there is a possibility that there are coals below 590 feet, which can not be proved without exploring the entire thickness of Pennsylvanian strata.

It seems quite probable that McLean County is very largely if not entirely underlain by three workable beds of coal. The upper bed may be eroded in places and is probably not as desirable as are the other two beds. This coal is probably No. 7 of the Illinois section, which is the same as the Streator coal and the upper or First Vein at La Salle. The second bed is the No. 5 or Springfield coal, which is the same as the Second Vein coal at La Salle, formerly mined at Cherry and now mined by the Matthiessen and Hegeler Zinc Company at La Salle. The lowest bed is No. 2 (La Salle) or Third Vein coal.

The coal mined at Colfax is apparently the upper bed, either No. 6 or No. 7.

Field notes are available for two mines in McLean County.

Mine Notes

Mine of the Colfax Coal Company, at Colfax

Entrance: Shaft; 406 feet deep; No. 6? coal.

Thickness of coal: Varies from 4 to 6 feet; averages 5 feet 6 inches.

Section of the coal:

Section of the coal in the mine of the Colfax Coal Company

	Thickness	
	Ft.	*in.*
Roof: Gray shale	..	..
Coal	3	11½
Pyrite and clay	..	¾
Coal	..	11¾
Pyrite	..	1½
Coal	..	4
Floor: Underclay	..	..
	5	5½

Character of the coal: The coal lies in three benches. The bottom coal is bony and dull, with small bands of shale. The middle 11¾ inches has a dull luster with no shale bands; the upper 3 feet 11½ inches is a very bright, glossy hard coal. The seam has no regular bands of sulphur but this impurity is present in irregular lenses.

Although this coal has been designated as No. 6 by the State inspector, it does not possess the identifying characteristics such as the "blue band" and the limestone cap-rock carrying the characteristic fossil *Girtyina ventricosa*. The coal also lacks the characteristics that might correlate it with No. 5, namely, the black shale roof and "horsebacks" or clay slips. The conditions at Colfax possibly resemble those found in the mines at Fairbury and Pontiac, the coal in each of these places being worked under a gray shale roof. However, facts do not warrant a definite correlation of the Colfax coal with that at Fairbury and Pontiac. Furthermore, whether the Pontiac coal should be correlated with No. 5, No. 6, or No. 7, or with any of these coals is a question. The permanent closing of the mine at Colfax will probably make definite correlation of this coal impossible without considerable drilling.

MINE OF THE McLEAN COUNTY COAL COMPANY, AT BLOOMINGTON

Two seams, No. 5 and No. 2, are operated from this shaft.

NO. 2 COAL

Entrance: Shaft; depth to the coal 513 feet.

Thickness of coal: Averages 3 feet 8 inches; the coal maintains a very uniform thickness.

Sections of the coal:

Sections of No. 2 coal in the mine of McLean County Coal Company, at Bloomington

Section 1—Room 21, 5th south off straight west entry

	Thickness	
	Ft.	*in.*
Roof: Gray shale or "soapstone"	..	..
Pyrite	..	½
Coal, clean, hard, and bright	..	9½
Mother coal	..	½
Coal, clean and bright	..	6½
Mother coal	..	¼
Coal, fairly clean	1	3
Bone	..	¼
Coal, dirty	..	5
Floor: Dark underclay	..	..
	3	1½

Section 2—Face of straight west entry, 7,000 feet from shaft

	Thickness	
	Ft.	*in.*
Roof: Gray shale	..	..
Coal, clean, bright, hard	1	4
Bone and pyrite	..	¾
Coal, clean, dull, and hard	1	..
Bone	..	¼
Coal, dull, bony	..	6
Floor: Fire clay	..	..
	2	11

Section 5—Room No. 3 off 5th north off main west entry, 7,300 feet from the shaft

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, hard, clean, and bright	..	10½
Mother coal and bone	..	½
Coal, clean and hard	..	5
Mother coal	..	¼
Coal, clean and bright	1	1
Bone	..	¾
Coal, soft, dirty	..	6½
Floor: Underclay	..	..
	3	6½

Character of the coal: The coal lies in a single bench. It is hard and tough, but seems to be lighter and cleaner than the upper bed (No. 5). Pyrite balls are rather common, but are easily separated from the coal. There are also lenses of "black jack," which apparently consists of mother coal impregnated with pyrite. These lenses are about as hard as pure pyrite nodules. There is a fairly continuous band of pyrite 4 to 8 inches above the bottom of the bed. This is lenticular in character, the lenses thickening up to about 1 inch. About 1 foot from the top there is a streak of dirty coal 4 to 5 inches thick in part of the mine. The pyrite balls attain a thickness of 6 to 8 inches by 24 inches across, but more commonly they are 1 to 1½ inches thick and 6 to 8 inches across. This coal is said to be dry because it does not "sweat" like the upper coal.

Character of the roof: The typical roof is gray shale, called "soapstone," which is generally about 10 feet thick. In places, however, it has a thickness of 20 feet, and in other places is absent, the black "slate" which elsewhere overlies it resting here upon the coal. The "soapstone" resembles in all respects the shale roof of No. 2 coal noted at La Salle and in the Pottstown mine in Peoria County. It is a fine-grained gray shale, containing small nodules, which weather to a brownish color. The black sheety shale, or "slate," also resembles its counterpart in the La Salle and Peoria regions. It is about 3 feet thick and in places contains large niggerheads or limestone concretions. The coal is reported to be somewhat thinner under the black "slate" than under the gray shale. Where the shale overlies the coal and contains large niggerheads, they

may extend well down into the coal, cutting it out in a small area. The coal under the "slate" is spoken of by the miners as being "depressed," as though it had been crushed. There is said to be more pyrite in the coal in this situation; this opinion could not be verified, however, although it may be the case.

The miners speak of the gray shale, overlying the black shale, as the cap-rock. There is no true limestone or sandstone within a short distance above the coal.

Character of the floor: The underclay below the coal is said to have a thickness of about 3 feet. This clay heaves somewhat. The gob from the mine including the floor clay has been used in brick manufacture by a neighboring plant within recent years.

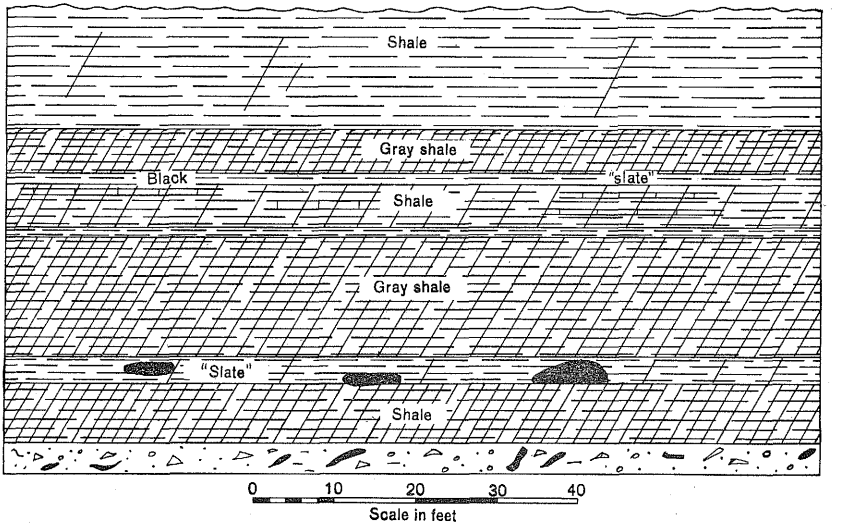

FIG. 9.—Section of the slope between No. 2 and No. 5 coals in the McLean County Company's mine at Bloomington, showing diagrammatically the character of the intervening strata and the cracking resulting from subsidence.

NO. 5 COAL

Entrance: A slope extends from the upper seam to No. 2 coal down which the coal is run to the shaft, where it is hoisted to the top. The bottom of No. 5 coal lies at a depth of 380 feet, according to Worthen,[1] there being an interval of about 130 feet between the two coals. The slope between the beds shows the character of the intervening strata and the effect of subsidence is clearly shown in the walls. The section as measured roughly and the amount of cracking in evidence is given herewith and is shown diagrammatically in Fig. 9.

1Geological Survey of Illinois, Vol. 4, p. 185, 1870.

Section of strata measured in slope between No. 5 and No. 2 coals in mine of the McLean County Coal Company

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Coal (No. 5)	4	....	4	....
Fire clay	2	....	6	....
Shale and sandy shale	12	....	18	....
Shale, black	....	11	18	11
Coal	....	1	19	....
Fire clay	5	....	24	....
Shale, sandy and clay shale	15	....	39	....
Shale, lime; few cracks near bottom	60	....	99	....
Shale, gray, cracked	5	....	104	....
"Slate," black; not cracked	1	....	105	....
Shale, limy; cracked slightly	5	....	110	....
"Slate," black; few cracks	1	....	111	....
Shale, gray (cap-rock); cracked	15	....	126	....
"Slate," black; few cracks	3	....	129	....
Shale; "Soapstone"; cracked	11	....	140	....

The preceding section may be compared with the following log of the shaft between the two coals as given by Worthen.[1]

Section of strata between No. 5 and No. 2 coal encountered in the shaft of the McLean County Coal Company

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Coal (No. 5)	....	....	....	....
Fire clay	10	....	10	....
"Slate"	3	....	13	....
Fire clay	4	6	17	6
Sandstone	20	6	38	....
"Soapstone"	62	5	100	5
Slate, black	2	7	103	....
Fire clay	1	7	104	7
Sulphur rock	1	2	104	9
Slate, gray	11	1	116	10
Shale	1	2	118	....
Limestone, hard	2	1	120	1
Slate, gray	2	8	122	9
"Soapstone"	6	8	129	5
Coal (No. 2)	3	8	133	1

Thickness of coal: Averages about 4 feet, varying from about 3 feet 8 inches to 4 feet 6 inches. The bed maintains a nearly uniform thickness.

[1] Op. cit.

Sections of the coal:

Sections of No 5 coal in the mine of the McLean County Coal Company, Bloomington, Illinois

Section 1—Face of straight west entry	Thickness *Ft.*	*in.*
Roof: Black shale	..	..
Coal, clean, hard, bright	1	6½
Pyrite	..	⅛
Coal, clean, bright, hard	..	10½
Pyrite	..	⅛
Coal, clean, bright, hard	..	9
Pyrite	..	⅛
Coal, fairly clean, hard	..	11
	4	1⅜

Section 2—Straight east entry, 600 feet from shaft

	Thickness *Ft.*	*in.*
Roof: Black "slate"	..	..
Coal, bright	1	8
Sulphur	..	1
Coal, bright	..	5
Sulphur	..	½
Coal, bright	1	4
Sulphur	..	¼
Coal, dull	..	3
Floor: Fire clay	..	..
	3	9¾

Section 3—North side of pillar, 150 feet from shaft

	Thickness *Ft.*	*in.*
Roof: Black "slate"	..	..
Coal, bright	1	7½
Sulphur	..	¾
Coal, bright	..	4
Sulphur	..	¾
Coal, bright	..	7
Sulphur	..	⅛
Coal	..	2
"Blackjack"	..	½
Coal, bright	..	5
"Blackjack"	..	9
Coal, bright	..	9
Floor: Underclay	..	..
	4	10⅛

Character of the coal: The coal is rather impure because of numerous pyrite streaks and plates, and numerous horsebacks. The pyrite plates are commonly less than a quarter of an inch in thickness and not readily removed from the coal, though an attempt to reject all pyrite is made. None of the pyrite lies persistently at one horizon. The horsebacks are of the usual sort; they are somewhat harder than those found in the Peoria region, however, due to the unusually high pyrite content. Pyrite veins or "spar" veins are also rather common. The coal is also commonly impregnated with pyrite for several inches either side of a clay or "spar" vein, so that the percentage of coal discarded on account of the horsebacks is high. In general, the coal presents no unusual characteristics.

Character of the roof: The immediate roof is a very fine black shale, 1 to 7 inches in thickness, which is almost a cannel coal. The contact between the coal and "slate" is very close, the upper part of the coal and the slate commonly being "frozen" by an intervening layer of pyrite, so that usually the upper 2 to 5 inches of the coal is left in the roof. A persistent layer of nodular limestone about 1½ inches thick lies above the lower black "slate"; overlying this another black "slate" about 11 inches thick, containing streaks of limestone. This is overlain by dark gray shale, which is black when wet and which is called "soapstone." It is between 1 and 2 feet thick and is overlain by a hard gray shale known as the "cap-rock." There is no very good contact between the last-mentioned strata and it is probable that they grade into each other.

Character of the floor: The underclay of No. 5 coal is 2 to 3 feet thick. It has no unusual characteristics.

MACON COUNTY

Production and Mines

Production in tons year ending June 30, 1920	218,820
Average annual production, 1916-1920	252,426
Total production, 1881-1920	10,783,991

In 1920 Macon County ranked twenty-sixth among the counties of the State, having a coal production of about .3 per cent of the entire Illinois output. There were three shipping mines in operation, all working No. 5 coal, two at Decatur, operated by the Macon County Coal Company and the Decatur Coal Company, and one at Niantic, operated by the Niantic Carbon Coal Company. Table 6 lists the shipping mines and gives data concerning them.

Coal-bearing Rocks

Lying below a cover of drift, which has an average thickness of 100 feet, are the coal-bearing rocks of Macon County varying in thickness from 800 feet or less to 1,100 feet. They tend to be somewhat thicker to the south than to the north and considerably thicker to the west than to the east. Rock does not outcrop in the county, so that the geology of the coal-bearing strata is known only from drill and shaft records, seventeen in number, most of which are in the vicinity of Decatur.

From the information furnished by these records and the records of holes in adjacent counties, it appears that Macon County lies but a short distance west of the axis of the Illinois coal basin. The strata dip eastward toward the axis, so that No. 6 coal has a depth at Niantic of 310 feet, at Decatur, about 560 feet, and at Lovington in Moultrie County, 900 feet. There is also a slight increase in depth southward through the county, but it is less than the increase to the east. The eastward dip of the rock effects a thickening of the Pennsylvanian system in that direction, as noted above, and younger and younger rock underlies the drift toward the east. It is probable that the New Haven limestone, commonly found about 600 feet above No. 6 coal, outcrops below the drift in a belt running approximately north and south in eastern Macon County or western Moultrie County.

The Carlinville and Shoal Creek limestones possibly outcrop below the drift in parallel belts in western Macon County west of Niantic. One of these limestones, probably the Shoal Creek, underlies the drift in the shaft at Niantic. It seems probable, therefore, that the Pennsyl-

vanian rock below the drift includes strata lying between the horizon of the Carlinville limestone and strata adjacent to the New Haven limestone; that is, between about 300 and about 600 feet above No. 6 coal.

In Macon County the occurrence and distribution of the coals are somewhat similar to the occurrence and distribution in Sangamon County, which lies adjacent in District VII. In the extreme southern part of the county No. 6 is probably present in commercial thickness, but as far south as Moweaqua, Shelby County, No. 5 coal is possibly of as great or greater importance. In the northern part of the county No. 6 coal plays out, so that only No. 5 coal can be mined. Thus a thinning of No. 6 comparable to the thinning of that coal in Sangamon County exists in Macon County.

No. 2 coal in a thickness not known to exceed 2½ feet, is probably present 150 to 175 feet below No. 5. No. 1 coal, mined at Assumption in Christian County, is also present, possibly generally, about 100 feet below No. 2, with a maximum known thickness in the county of about 3 feet. It is doubtful whether either of the lower coals is at present of workable thickness in competition with the thicker overlying beds.

The following records, together with the Blue Mound record given in Part I, will aid the driller and prospector in identifying beds in Macon County.

Log of air shaft at Decatur, about one-half mile southwest of the coal shaft near bluffs of the Sangamon river[1], *sec. 14?, T. 16 N., R. 2 E.*

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Soil and loamy clay	25	....	25	....
Sand and water (flow of 400 gallons per minute)	30	....	55	....
Clay, blue	4	....	59	....
Soil and drift wood	2	....	61	....
Sand, green	4	....	65	....
Sand, gray	6	....	71	....
Clay, hard blue	9	....	80	....
Sand and gravel (five strata)	37	....	117	....
Hardpan	23	....	140	....

[1]Geological Survey of Illinois, Vol. VIII, pp. 48-49.

Log of air shaft at Decatur—Continued

Description of Strata	Thickness		Depth	
Pennsylvanian system—	*Ft.*	*in.*	*Ft.*	*in.*
McLeansboro—				
Sandstone	1	6	141	6
Shale, soft	6	....	147	6
Shale, gray and blue, sandy	28	....	175	6
Clay shale	15	....	190	6
"Slate," blue	17	....	207	6
Fire clay, ferruginous	6	....	213	6
Limestone, conglomerate	7	....	220	6
"Slate," brown	10	....	230	6
Flint stone	2	6	233	....
"Slate," black	1	....	234	....
Flint rock	2	6	236	6
Coal (No. 11)	....	10	237	4
Fire clay	8	....	245	4
Shale, blue sandy	10	....	255	4
Flint stone	3	....	258	4
Clay shale	5	....	263	4
Shale, sandy	21	....	284	4
"Slate," black	2	6	286	10
Coal (No. 10)	1	....	287	10
Fire clay	6	....	293	10
Shale, black, and 1 inch of coal	8	1	301	11
Fire clay	6	....	307	11
Shale, black	3	....	310	11
Limestone, impure	1	....	311	11
Shale, brown	8	....	319	11
Sandstone	1	....	320	11
"Slate," black	4	....	324	11
Flint stone	11	....	335	11
"Slate," black	12	....	347	11
Fire clay	4	....	351	11
Limestone (Shoal Creek)	10	....	361	11
"Slate," black (No. 9 coal)	2	....	363	11
Fire clay	8	....	371	11
Clay shale	13	....	384	11
Sandstone	5	....	389	11
Flint stone	2	....	391	11
"Slate," blue	8	....	399	11
Clay shale	39	....	438	11
Sandstone, blue	1	....	439	11
"Slate," black	3	....	442	11
Coal (No. 8)	1	4	444	3
Fire clay	6	....	450	3
Shale, sandy	10	....	460	3
Shale, black	33	....	493	3
"Slate," hard black	5	....	498	3

Log of air shaft at Decatur—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Coal (local)	....	3	498	6
Fire clay	4	....	502	6
Limestone	11	....	513	6
Shale, black	4	....	517	6
Clay shale	2	....	519	6
Coal (No. 7)	....	4	519	10
Fire clay	2	....	521	10
Stone, conglomerate	3	....	524	10
Clay shale, gray and blue	14	....	538	10
"Slate," black and ½ inch of coal	4	....	542	10
Fire clay	4	....	546	10
Sandstone	7	....	553	10
Shale, gray	6	....	559	10
"Slate," black	2	....	561	10
Carbondale—				
Coal	1	4	563	2
Clay shale (No. 6)	....	6	563	8
Coal	2	10	566	6
Shale, hard gray	8	....	574	6
Limestone	2	6	577	....
Shale bituminous and coal	....	6	577	6
Fire clay	4	....	581	6
Sandstone	17	....	598	6
Clay shale	3	....	601	6
Sandstone	13	....	614	6
Clay shale, dark	8	....	622	6
"Slate," black	1	6	624	....
Coal (No. 5)	4	6	628	6

Log of well on farm of T. C. Grady, T. 18 N., R. 2 E., Maroa, Illinois.
Elevation—720 feet

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Clay	62	....	62	....
Gravel, hardpan	6	....	68	....
Clay	16	....	84	....
Hardpan	129	....	213	....
Hardpan, sandy	6	....	219	....
Clay, hardpan	54	....	273	....

Log of well on farm of T. C. Grady—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Pennsylvanian system—				
McLeansboro—				
Limestone	15	....	288	....
Shale, light	1	....	289	....
Shale, black	2	....	291	....
Shale, gray	5	....	296	....
Limestone	4	....	300	....
Shale, light	12	....	312	....
Sand shale	30	....	342	....
Shale, gray	28	....	370	....
Limestone	10	....	380	....
Shale, gray	19	....	399	....
Shale, sandy	90	....	489	....
"Slate," dark	10	....	499	....
Carbondale—				
Coal (No. 6)	....	6	499	6
Fire clay	1	6	501	....
Sandstone, gray	3	....	504	....
Shale, light	8	....	512	....
Limestone	9	....	521	....
Shale, blue	4	....	525	....
Limestone	7	....	532	....
Sand shale	34	....	566	....
"Slate," black	3	6	569	6
Coal (No. 5)	1	6	571	....
"Slate," dark	4	....	575	....
Limestone	17	....	592	....
Sand shale	20	....	612	....
Slate, black	4	....	616	....
Shale, light	6	....	622	....
Limestone	4	....	626	....

Log of Niantic Carbon Coal Company's shaft, sec. 12, T. 16 N., R. 1 W.[1]

Elevation—585 feet

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Soil and clay, brown	11	....	11	....
Sand and gravel	4	....	15	....
Hardpan, gravelly	25	....	40	....
Hardpan, blue	10	....	50	....
Clay, soft	15	....	65	....
Hardpan, gray	10	....	75	....
Clay, soft brown	7	....	82	....

1Geological Survey of Illinois, Vol. VII, p. 19.

Log of Niantic Carbon Coal Company's shaft—Concluded

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Pennsylvanian system—				
McLeansboro—				
Limestone	10	....	92	....
Rock, blue flinty	2	....	94	....
"Slate," black	3	....	97	....
Fire-clay	6	....	103	....
Limestone	10	....	113	....
Shale, blue and gray	7	....	120	....
Shale, black	1	....	121	....
Coal (No. 9)	....	2	121	2
Fire-clay	1	....	122	2
Limestone, nodular	5	....	127	2
Clay shale	5	....	132	2
Sandstone, soft blue	16	....	148	2
Shale, gray	42	....	190	2
Coal (No. 8)	1	3	191	5
Fire-clay	2	6	193	11
Sandstone	10	....	203	11
Shale, gray	45	....	248	11
Rock, hard flinty	10	....	258	11
Shale, black	3	....	261	11
Fire-clay	9	....	270	11
Shale, blue and red	15	....	285	11
"Slate," black	5	....	290	11
Coal (No. 7)	1	3	292	2
Fire-clay	4	6	296	8
Shale, black	11	....	307	8
Carbondale—				
Coal (No. 6)	2	6	310	2
Clay shale	15	....	325	2
Shale, black	3	....	328	2
Coal (local)	....	10	329	....
Fire-clay	2	....	331	....
Shale, gray	14	....	345	....
Rock, hard, black (limestone)	1	....	346	....
"Slate," black	3	....	349	....
Coal (No. 5)	5	6	354	6

Known Minable Coals in Macon County

No. 5 coal

So far as is known, No. 5 coal is present in workable thickness below the entire area of Macon County. There has been no prospecting so far as known in the eastern part of the county and future drilling may call for a reversal of the opinion expressed about the continuity of the coal.

MINE NOTES

The best information concerning No. 5 coal is that found in mine notes taken in the various mines of the county as summarized below.

MINE OF THE NIANTIC CARBON COAL COMPANY, AT NIANTIC

Entrance by shaft; 360 feet to No. 5 coal. Working No. 5 coal, which has an average thickness of 5½ feet, varying between 5 and 6 feet. The coal contains small sulphur streaks in the upper part of the bed, but these are not persistent. The clay veins or "horsebacks," characteristic of the

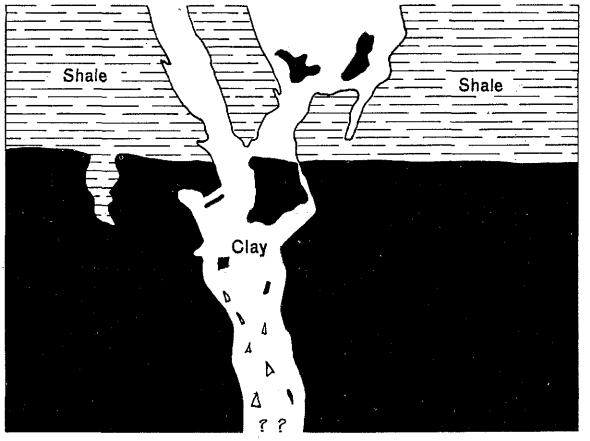

FIG. 10. Sketch of a clay vein ("horseback") in the Niantic Carbon Coal Company's mine at Niantic.

bed, are present. A sketch of one made near the face of the main west entry in 1912 is shown in figure 10. In this instance the filling is described as being of two kinds of rock, hard and soft. The former seems calcareous and contains pyrite. The soft part is clay. The clay veins are numerous and greatly increase mining costs.

The roof of the coal is commonly black shale or "slate," but varies locally from blue to gray and has a thickness of about 3 feet. Nigger-heads are common in this roof. A cap-rock 4 to 12 inches thick is present above the shale.

Sections of the coal in this mine are given herewith.

Sections of No. 5 coal in Niantic mine

Section 1—3d west entry off south entry on the east side	Thickness Ft.	in.
Roof: Shale, black	..	..
Coal, fairly clean and bright	3	..
Sulphur parting	..	..
Coal, clean and bright	..	2½
Sulphur parting	..	..
Coal, fairly clean	..	8½
Mother coal	..	¼
Coal, dirty	..	2¾
Mother coal	..	¼
Coal, dirty	..	2½
Mother coal	..	¼
Coal, fairly clean	..	7
Floor: Fire clay, dark	..	..
	5	2

Section 2—8th east off north on east side	Thickness Ft.	in.
Roof: Shale, black	..	..
Coal, fairly clean, bright	2	6
Sulphur	..	⅛
Coal, streaked with mother coal	2	8
Floor: Fire clay, dark	..	..
	2	2⅛

Section 3—1st west off northwest entry, room 35	Thickness Ft.	in.
Roof: Shale, black	..	..
Coal, top, local only	..	3¾
Coal, clean, bright, slightly streaked	1	8½
Sulphur parting	..	⅛
Coal, streaked with bone	..	4¼
Sulphur parting	..	..
Coal, fairly clean but with some bone	2	8¾
	5	1⅜

MINE OF THE MACON COUNTY COAL COMPANY, AT DECATUR[1]

Entrance by shaft, 560 feet to the floor of mine. No. 5 coal here has a thickness of 4½ feet and 5 feet 1 inch, respectively, where measured in two places. The coal contains some sulphur in bands or lenses, but this impurity is not in large amount. There are some horsebacks. The roof is black, fine-grained shale or "slate" containing niggerheads, which in places in the mine are numerous and of a large size. One was noted which cut out the coal to within one foot of the floor. Above the "slate" is the cap-rock, a hard limestone 10 to 24 inches thick. This is followed by gray shale, 4 to 5 inches thick, overlying which is sandstone.

[1]Formerly Manufacturers and Consumers Coal Company.

The following sections of coal in this mine are available.

Sections of No. 5 coal in the mine of the Macon County Coal Company

Section 1—At face, 3d left entry off the 1st east off 1st south

	Thickness Ft.	in.
Roof: Black shale	..	..
Coal, clean, hard, bright, blocky	3	7
Coal, bony, with little sulphur	..	1
Coal, clean, bright	..	4½
Mother coal	..	½
Coal, fairly clean	..	7
Floor: Fire clay	..	..
	4	8

Section 2—Face of the 9th west off 1st south

	Thickness Ft.	in.
Roof: Black shale	..	..
Coal, clean, bright, hard	2	4
Bone and coal	..	1½
Coal, fairly clean and hard	..	8¼
Pyrite	..	¼
Coal, fairly clean	..	7
Mother coal, soft	..	½
Coal, dirty	..	10½
	4	8

NO. 6 COAL

MINE NOTES

No. 6 coal has been mined at only one mine in this county. Conditions in the mine are shown in the following notes.

ABANDONED MINE OF THE BLUE MOUND COAL COMPANY, AT BLUE MOUND

Entrance by shaft, 472 feet to floor. The coal averages 5 feet, varying between 3½ feet and 6½ feet.

A section measured in the mine is as follows:

Section of No. 6 coal at Blue Mound, face of 1st entry off main west

	Thickness Ft.	in.
Coal	2	6
Sulphur	..	½
Coal	..	5
Sulphur	..	½
Coal	1	6
Sulphur	..	½
Coal	..	7½
Blue band	..	1
Coal	..	9
Floor: Fire clay	..	..
	6	0

The roof in this mine is shale or limestone. The shale varies up to 3½ feet and the limestone is known to be as thick as 17 feet.

MASON COUNTY

Introduction

Coal has never been mined in Mason County and so far as is known, only one drill hole, the one located at Mason City, has penetrated the Pennsylvanian rocks.

Surficial Deposits

The coal-bearing rocks are deeply covered by glacial drift which in the hole at Mason City has a thickness of 204 feet. Its thickness in other places in the county is not known. Leverett says: "The county occupies a low basin-like expansion of the Illinois valley, heavily covered with sand, except where the old river channels have left a surface deposit of muck."[1]

Coal-bearing Rocks

Except for information afforded by the drilling at Mason City, and for a general knowledge of conditions in surrounding counties, nothing is known concerning the coal which possibly underlies Mason County. In the drill hole a coal 34 inches thick was struck at a depth of 290 to 293 feet. This thickness of the coal suggests correlation with No. 2 rather than with one of the higher coals. Further evidence in support of this correlation is that No. 5 coal at Lincoln lies at about the same depth and latitude as the coal at Mason City, whereas by reason of the regional eastward dip, No. 5 coal should be considerably higher at Mason City than at Lincoln; in fact, high enough to bring it above erosion level beneath the drift.

It is probable, therefore, though by no means established, that if Mason City is underlain by coal, it is No. 2 rather than one of the higher beds, except in the eastern part of the county, where locally the drift may be thin and one of the higher coals, possibly No. 5, may be present in small areas.

[1]Leverett, Frank, The Illinois Glacial Lobe: U. S. Geological Survey, Mon 38, p. 688, 1899.

MENARD COUNTY

Production and Mines

Production in tons, year ending June 30, 1920..... 145,868
Average annual production, 1916-1920..... 179,861
Total production, 1881-1920.....10,639,327

One shipping mine and eight wagon mines reported production in Menard County during the fiscal year 1920. The total production was a little less than .2 per cent of the State's entire output, and the county ranked thirty-first in order of production. Table 6 gives data concerning the shipping mine.

Coal-bearing Rocks

The southern part of Menard County, including the town of Tallula and others, is included in the area of the Tallula-Springfield quadrangles.[1] The north line of these quadrangles passes within less than one mile of Petersburg. The mining operations of the county accordingly lie mostly within the boundaries of these quadrangles, and the description of the coal-bearing strata on those areas given in the U. S. Geological Survey report, is adequate for the county.

The strata underlying Menard County are a continuation northward of those underlying the west half of Sangamon County. The description of these strata presented in the discussion of the coal-bearing rocks of that county will apply approximately to the strata underlying Menard County.

The rocks immediately underlying the drift are included between No. 5 coal which is thought to outcrop near the west line of the county, and the Lonsdale limestone. Accordingly No. 5 coal probably underlies the entire county, and so far as is known is everywhere of workable thickness. No. 6 and No. 7 coals are present east of their lines of outcrop, which run parallel to that of No. 5, between Tallula and the county line to the west. These coals are thin and of no commercial value. No. 2 coal is probably present but it may be too thin to be profitably worked in competition with No. 5. The interval between these coals and the character of the intervening strata have been discussed in the description of the coal-bearing rocks of Sangamon County. The reader is also referred for further detail concerning the geology of the region to the Tallula-Springfield Folio, cited above.

Only six records of drilling or shafts are available in the county, and none exceeds a depth of 165 feet. The only one of these that has sufficient detail to make it of value to this report is reproduced herewith.

[1]Shaw, E. W., and Savage, T. E., Tallula-Springfield Folio: U. S. Geological Survey Geologic Folio 188, 1913.

Record of shaft of the Loyd coal mine in the NW. ¼ sec. 23, T. 17 N., R. 7 W.

Record given from memory by H. C. Bradt

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary stystem—				
Pleistocene and Recent—				
Clay, surface	20	....	20	....
Pennsylvanian system—				
McLeansboro—				
Limestone	7	....	27	....
Shale, blue	15	....	42	....
Rock, blue	5	....	47	....
Shale, blue	5	....	52	....
Rock, blue	5	....	57	....
Carbondale—				
Coal (No. 6?)	1	2	58	2
Fire clay	4	....	62	2
Flint rock (limestone)	4	....	66	2
Sandstone	11	....	77	2
Shale, blue and red	15	....	92	2
Cap rock (limestone?)	....	6	92	8
Slate	1	2	93	10
Coal (No. 5)	5	10	99	8

Mine Notes

Observation has been made in four mines in Menard County.

ABANDONED MINE OF THE MIDDLETOWN COAL CO., AT MIDDLETOWN

Entrance: Shaft; 210 feet to No. 5 coal.

Thickness of the coal: Varies from 5 feet 8 inches to 6 feet 2 inches. The average thickness is 6 feet.

Section of the coal:

Section of No. 5 coal in the mine of the Middletown Coal Company, at Middletown

2d west entry off 3d south main entry, about 1,375 feet from shaft

	Thickness	
	Ft.	*in.*
Roof: Black fissile shale	..	..
Coal	2	1
Pyrite	..	⅛
Coal	1	9½
Pyrite	..	⅛
Coal	1	8
Floor: Fire clay	..	..
	5	6¾

Character of the coal: The top coal in the foregoing section is very black and brittle, and has a bright lustre. The rest is not so bright and is softer. Most of the pyrite is found in the middle portion in irregular lenses. Mother coal is less common in the upper coal than in the lower part of the bed. The bed is cut by the usual horsebacks.

Character of the roof and floor: The roof is black fissile shale 1½ to 6 feet thick, with a limestone cap-rock 4 inches to 3 feet thick. The floor is clay above limestone.

ABANDONED MINE OF THE SOUTH MOUNTAIN COAL CO., AT PETERSBURG

Entrance: Slope, 80 feet to the top of No. 5 coal.

Thickness of the coal: Varies from 5½ to 7 feet, averaging 6 feet.

Section of the coal:

Section of No. 5 coal in the South Mountain Coal Company's mine, at Petersburg

1st entry off the 7th east entry about 2,600 feet from slope

	Thickness	
	Ft.	*in.*
Roof: Shale	..	..
Coal	1	4
Pyrite	..	⅛
Coal	..	11
Mother coal		1
Coal	..	7
Pyrite	..	⅛
Coal	1	6
Pyrite	..	⅛
Coal	1	6½
	5	11⅞

Character of the coal and roof: The coal is reported to be cut by clay veins. The roof is shale, probably black, 1½ to 6 feet thick, with a cap rock of limestone 2½ feet or less in thickness usually present.

UNION FUEL COMPANY'S NO. 4 MINE, AT ATHENS

Entrance: Shaft; 203 feet to the top of No. 5 coal.

Thickness of coal: Varies from 5 to 6 feet; averages 5 feet 8 inches.

Sections of the coal:

Sections of No. 5 coal in the No. 4 mine of the Union Fuel Company, at Athens

Section 1—Room 1 off 11th north off main west entry, 6,500 feet from shaft

	Thickness	
	Ft.	*in.*
Roof: Black "slate"	..	..
Coal, bright	2	7
Pyrite	..	¼
Coal, bright	3	3
Floor: Fire clay	..	..
	5	10

Section 2—19th south off main west; entry face, 5,800 feet from shaft

	Thickness	
	Ft.	*in.*
Roof: Black "slate"	..	..
Coal, bright	..	4
Mother coal	..	½
Coal, bright	..	6
Mother coal	..	¼
Coal, bright	4	11
Floor: Fire clay	..	..
	5	9¾

Section 3—Entry face on the main east stub; 1,500 feet from shaft

	Thickness	
	Ft.	*in.*
Coal, bright	3	8
Pyrite streak	..	¼
Coal, bright	1	5
	5	1¼

Character of the coal: The coal lies in a single bed without partings. The middle of the bed contains a few pyrite lenses running parallel to the bedding, and the bottom 4 inches of the coal is bony in many places. There are no persistent impurities, however. "Horsebacks" occur with the usual frequency. The accompanying figures 11 and 12 are reproduced from sketches made of two kinds of clay veins, in one of which the fracture is about vertical and there has been no offset of the bed, and in the other an inclined fracture is accompanied by offset. Figure 11 shows also how the clay in the floor bulges up toward the "horseback" but does not enter it, the vein material being apparently entirely different from the underclay. In figure 12 it will be noted that the fracture does not extend up into the cap rock.

The coal is broken also by what seems to be true faults which cross all the strata associated with the coal. In this case the limestone rests upon the coal; the difference in the character of the fractures may be due to this fact.

The clay veins vary in width, but their maximum is about 2 feet. The filling consists of clay with small fragments of coal scattered through it. These fragments are sharp, unshattered, and have the same appearance as the coal in the bed. In one case where the floor has apparently been pushed up about 18 inches, no displacement was noted in the roof of the coal, although the fracture extended into the cap-rock, with a width of 1 to 1½ feet across, slightly less than its width in the coal.

Character of the roof: The immediate roof is usually black "slate," which varies from 6 inches to 6 feet in thickness, but averages 2 feet. In places it is less hard and sheety and becomes less like a "slate." This more massive shale is most everywhere wet and eventually falls to the cap rock. The cap rock is usually strong enough to stand where these falls occur.

The cap rock is a very carbonaceous limestone about 5 feet in thickness. Ordinarily it forms a good roof. In a few places the limestone is in contact with the coal. This contact, however, is not sharp on account of the common occurrence of coal stringers in the lower 2 inches of the rock.

The cap rock locally also cuts down through the "slate" as a "roll" under which the coal is ordinarily somewhat crushed. Overlying the cap rock is a gray "soapstone" or shale. In places the cap rock is represented

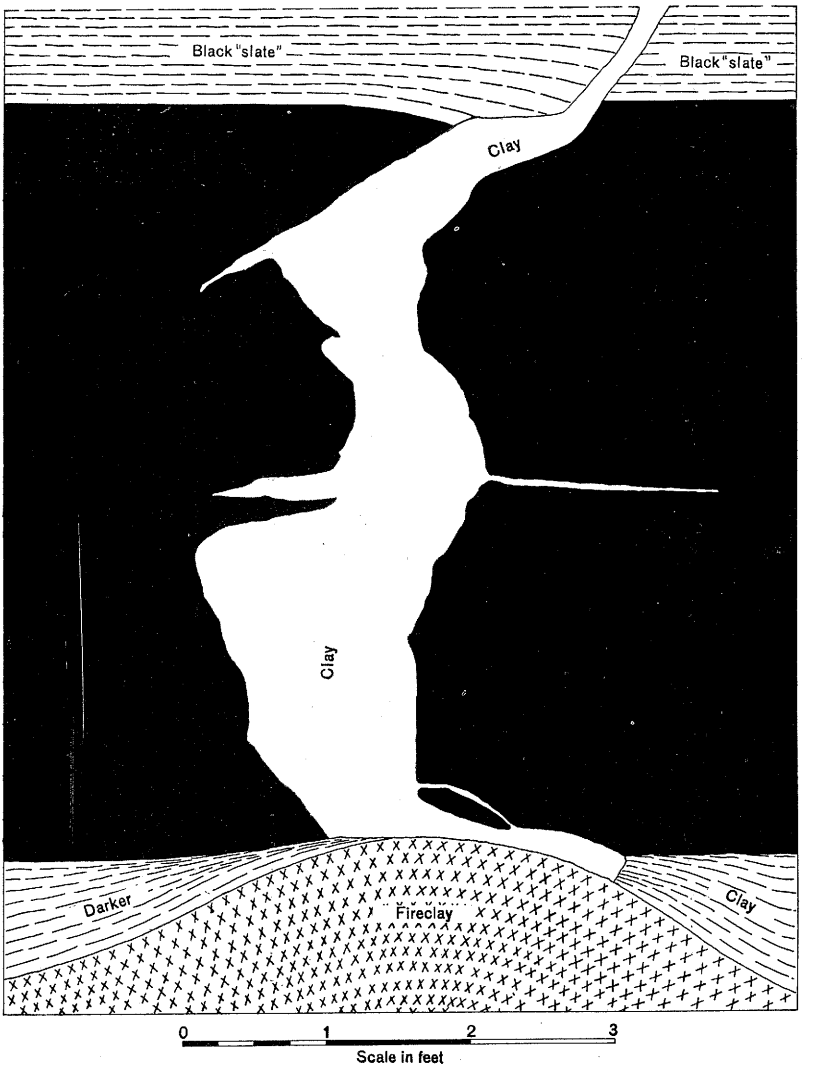

FIG. 11.—Sketch of a nearly vertical clay vein ("horseback") in the Union Fuel Company's No. 4 mine at Athens. The fracture is not accompanied by an offset.

only by a band of boulders, the gray shale resting directly upon the black "slate," except for these nodules.

Character of the floor: The underclay is reported to have a thickness of 14 feet. The upper 7 feet is said to be rather soft and to contain many nodules or "boulders." The upper 18 inches is said to heave somewhat.

ABANDONED MINE OF THE TALLULA COAL COMPANY, AT TALLULA

Entrance: Shaft; 179 feet to No. 5 coal.

Thickness of coal: Varies from 5 feet 8 inches to 7 feet 6 inches; averages 6 feet.

Section of the coal:

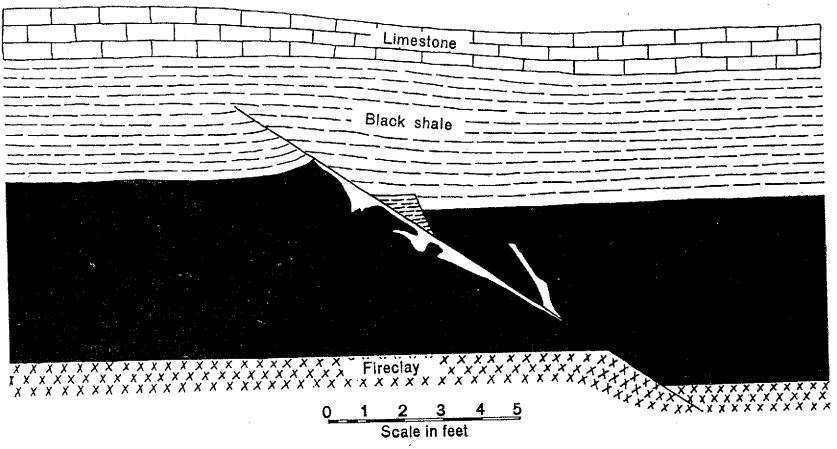

FIG. 12.—Sketch of an inclined clay vein ("horseback") in the Union Fuel Company's No. 4 mine at Athens. The bed is offset.

Section of No. 5 coal, Tallula Coal Company, at Tallula.

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal	1	3
Pyrite	..	⅛
Coal	2	6
Pyrite	..	1
Coal	..	6
Pyrite	..	⅛
Coal	1	8
Floor: Fire clay	..	..
	6	¼

Character of the coal, roof, and floor: The coal bed is crossed by numerous clay veins. It has the usual black "slate" roof 14 inches to 6 feet thick, with a limestone cap rock 3 inches to 3 feet thick.

PEORIA COUNTY

Production in tons, year ending June 30, 1920..... 1,244,013
Average annual production 1916 to 1920..... 1,327,926
Total production 1881 to 1920.....31,867,000

Peoria County ranked 14 in production in 1920; the output in that fiscal year (1919-1920) was 1.7 per cent of the total output of the State. During 1920 there were 2 shipping mines operating in this county and 51 local or wagon mines. The local mines produced 183,689 tons of coal. Most of the mines operated in No. 5 coal, but there was some coal mined from No. 6 coal, and plans have been made to resume operations in No. 2 coal in the Wantling (Blue Fly) mine at Pottstown.

Coal-bearing Rocks

The geology of the portion of this county in which mining operations are most active has been described in detail after careful field examination by Dr. J. A. Udden.[1] Much of the geological information included in the following paragraph is drawn from his publication.

The thickness of the coal-bearing strata is about 520 feet, of which the lower 300 feet is known only from drilling or mine shafts. The exposed 220 feet extends downward 20 feet below the chief productive coal bed. The most reliable and detailed information concerning the lower unexposed portion of the section is based upon the records of two shafts. One of these, located at Pottstown, passes through No. 2 coal at a depth of 106 feet, has a depth of 240 feet, and reaches a bed believed to be equivalent to the Ellisville or Rock Island coal. The workings in No. 2 coal in this mine have been reopened. The other shaft, at Orchard about 4 miles south of Bartonville, extended down to a coal bed believed to be No. 2, and equivalent to the upper bed in the Pottstown shaft. The section of strata in these two shafts follows:

[1]Udden, J. A., Geology and mineral resources of the Peoria quadrangle, Illinois: U.S. Geological Survey Bull, 506, 1912.

Section of rocks penetrated by the shaft of the Blue Fly mine at Pottstown, west side of the SW. ¼ sec. 36, Kickapoo Township, Peoria County[1]

Description of Strata	Thickness		Depth	
Quaternary system—	*Ft.*	*in.*	*Ft.*	*in.*
Pleistocene and Recent—				
Alluvium	10	....	10	....
Sand, dry	6	....	16	....
Gravel	3	....	19	....
Hardpan	2	....	21	....
Pennsylvanian system—				
Carbondale formation—				
Soapstone, white	10	....	31	....
Iron band	....	2	31	2
Soapstone	8	....	39	2
Iron band	....	3	39	5
Shale, black	20	....	59	5
Iron band	....	3	59	8
Soapstone, white	20	....	79	8
Iron band	....	2	79	10
Shale, white	4	....	83	10
Iron band	....	4	84	2
Shale, white	3	....	87	2
Iron band	....	2	87	4
Shale, dark	6	....	93	4
Cap rock	2	....	95	4
Slate, black	2	8	98	....
Shale, white	9	....	107	....
Coal (No. 2)	2	8	109	8
Pottsville formation—				
Fire clay	4	....	113	8
Sandstone	17	....	130	8
Soapstone	6	....	136	8
Sandstone, white	56	6	193	2
Clod, black	3	6	196	8
Fire clay	1	6	198	2
Coal	2	4	200	6
Sandstone, dark	4	6	205	....
Rock, hard	3	6	208	6
Clod, dark	8	....	216	6
Sandstone, hard	7	6	224	....
Slate, black	3	....	227	....
Shale	2	....	229	....
Rock, white	3	....	232	....
Coal	1	4	233	4
Clod, black } No. 1	3	6	236	10
Coal	3	....	239	10
Fire clay	1	....	240	10

[1]Op. cit., p. 23.

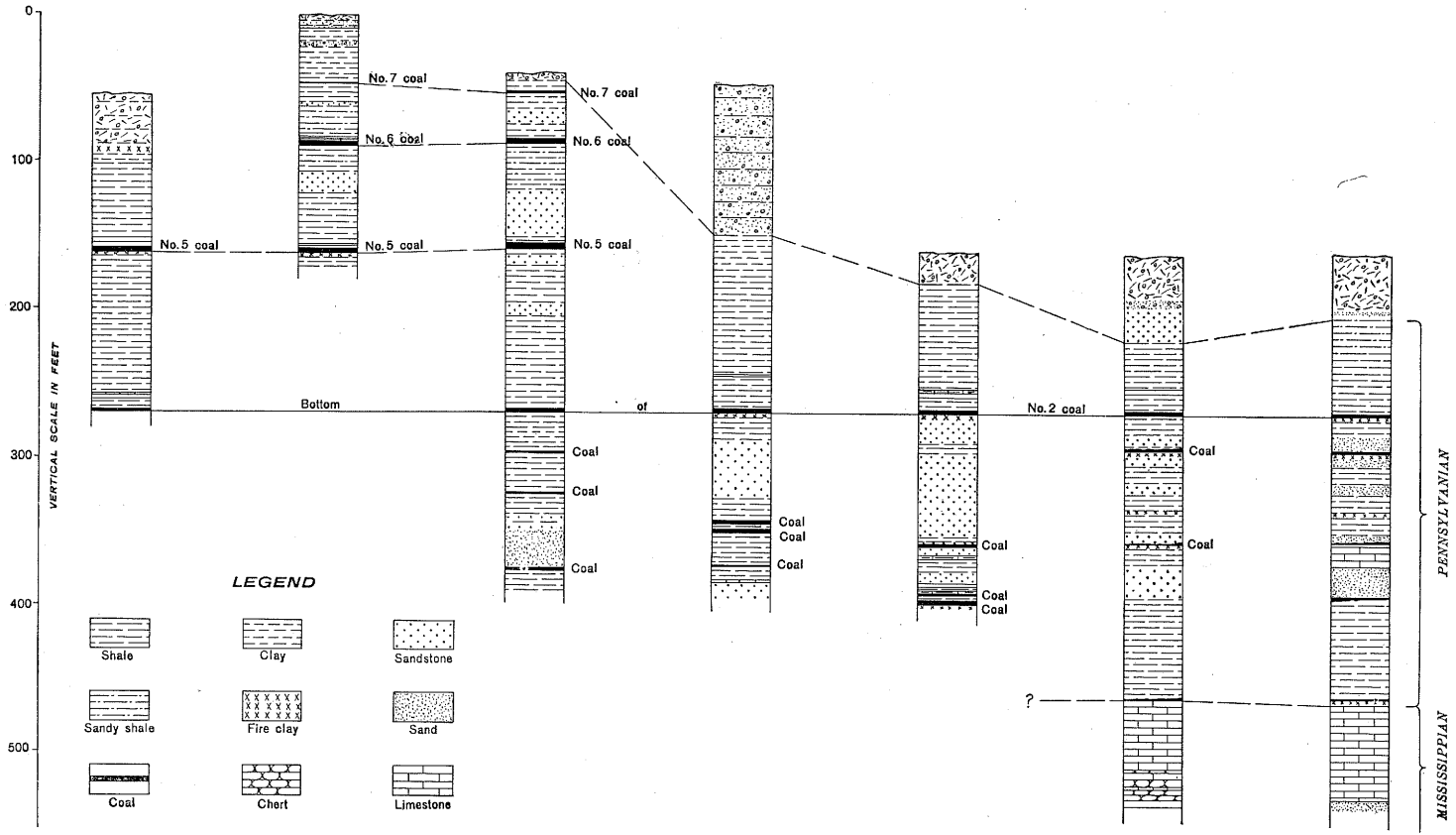

FIG. 13.—Graphic sections showing the character of the Pottsville formation in Peoria County.

Section of the Orchard shaft[1], *about 4 miles south of Bartonville*

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Quaternary system—				
Pleistocene and Recent—				
Surface	3	....	3	....
"Fire clay"	2	....	5	....
Hardpan	1	8	6	8
Loam, black	3	6	10	2
Pennsylvanian system—				
Carbondale—				
Shale, black	....	9	10	11
Soapstone, soft	2	....	12	11
Shale, sandy	7	6	20	5
Limestone	2	....	22	5
Sandstone	17	....	39	5
Soapstone	4	....	43	5
Iron band	....	8	44	1
Soapstone	18	....	62	1
Sandstone, blue	4	....	66	1
Soapstone	36	....	102	1
Slate, gray, and iron band mixed	16	....	118	1
Slate, black	4	8	122	9
Hardpan	1	8	124	5
Slate, black	....	10	125	3
Soapstone	12	....	137	3
Coal (No. 2)	2	6	139	9
Pottsville—				
Fire clay	1	10	141	7

POTTSVILLE FORMATION

The succession of the Pottsville formation in Peoria County is not very definitely known. Several of the better records are reproduced graphically in the accompanying figure (Fig. 13).

Study of the available drill records, several of which are included in figure 13, indicates that the base of the Pennsylvanian system is commonly at an elevation of about 140 feet above sea level in the vicinity of Peoria. Although this figure is a generalization, it is thought to be accurate within about 25 feet. In the northwest part of the county near Princeville, the base of the "Coal Measures" is probably more than 300 feet above sea level, and along the Fulton County line near Farmington, between 270 and 300 feet. The pre-

1Op. cit., p. 24.

Pennsylvanian surface accordingly probably slopes about 10 feet to the mile. There is some evidence that the surface of the Mississippian strata upon which the "Coal Measures" rest is uneven, aside from the general slope just mentioned, and therefore the Mississippian may be reached at depths which vary somewhat from what would be expected. However, if the character of the drilling chips is carefully noted when wells or tests are being put down, there should ordinarily be no difficulty in determining the base of the "Coal Measures," as at that horizon the drill passes from a succession of shales, sandy shales, and sandstones into massive limestone.

The strata in the lower 100 feet of the Pottsville are apparently mostly shale, with interbedded sandstone reported in two wells. Drill cuttings from the Glen Oak Park well, taken about 20 feet above the base of the "Coal Measures," contained coal, according to Udden.[1] Coal was reported in the Carter well in East Peoria at about the same level but was either not recorded or not present in other wells in the region. In the interval from about 100 feet above the base of the formation (at an altitude of 220 to 240 feet) up to No. 2 coal (at various altitudes between 330 and 380 feet) there seem to be several coal beds. The meager information at hand is sufficient for correlation of the coals found in the different holes. It is not even safe to assume that the coal found in several holes at an altitude of 220 to 240 feet is a continuous bed, as Pottsville coals in Illinois are characteristically lenticular, having been deposited in what apparently were local basins that probably did not synchronize.

Coal at an altitude of 226 feet and at a depth of 236 feet has been mined at Pottstown. The coal in this mine lies in two benches, the lower one according to Udden,[2] varying from 2 feet 2 inches to 3 feet, and the upper measuring 1 foot 3 inches. The two benches are separated by nearly 3 feet of shale, and the average thickness of the coal and included shale is 6 feet. Udden states that this coal bed has been recognized in no less than six of the artesian borings in the vicinity of Peoria and Pekin, but as was stated in the previous paragraph, the correlation of these lower coals upon the basis of water-well records, in several cases of doubtful accuracy, is not possible; especially is this evident when several diamond-drill holes the records of which have become available since the field work on the Peoria quadrangle was completed, show several thin coals in the section below No. 2 coal. Yet it is not at all improbable that this lower coal may be fairly con-

1U. S. Geological Survey Bull. 506, p. 35.
2Op. cit., p. 25.

tinuous, at least in the southern part of the county, for it is reported in a drilling at Elmwood at the west edge of the county.

The strata in the upper part of the Pottsville above the lower coal, which Udden[1] suggests is the No. 1 coal, are variable. In the Pottstown shaft they are largely sandstones with a 28-inch coal bed about 40 feet above the No. 1 coal. Two records in Limestone Township report several black shales and thin coals in the succession, as well as a large amount of sandstone and sandy shales. These records both report coal between 1 and 2 feet thick about 30 feet below the top of the formation, or No. 2 coal. The record of the drilling at Elmwood shows almost continuous shale. The interval between coals No. 2 and No. 1 seems to vary from about 100 to 140 feet. It is not probable that any of the intervening coals are of workable thickness.

FIG. 14.—Photograph of a block of the roof shale of No. 5 coal in Peoria County, showing laminated structure.

CARBONDALE FORMATION

The Carbondale formation includes all the coal beds worked in the county, and is economically the most important part of the "Coal Measures" section, not only in this county but in the State as a whole. With the exception of the small mine at Pottstown which has recently reopened an old development in No. 2 coal the commercial operations

[1] Op. cit., p. 81.

in the county are all in No. 5 coal. No. 6 coal has a little development by wagon mines at various places in the county.

NO. 2 COAL

No. 2 coal lying at the base of the formation has the usual characteristics of that bed in the northern part of the State. It is about 30 inches thick and is overlain by the gray "soapstone" and black fissile shale which is the very characteristic roof of this coal in the typical La Salle region. The coal contains the bright sulphur balls also common to this bed. Besides its similarity in appearance and occurrence as a basis of correlation with No. 2 coal, there is a similarity in the flora in the shale above this coal and in that above the coal at La Salle, which Dr. David White[1] regards as suggestive of correlation.

STRATA BETWEEN NO. 2 AND NO. 5 COALS

The interval between No. 2 and No. 5 coals varies from 110 to 140 feet, and except for the uppermost 25 feet, is known only from records of test holes, wells, and shafts. The section seems to be largely shale with some bands of ironstone or hard limestone probably containing considerable pyrite or iron carbonate, and with layers of sandstone. A few records show streaks of coal interbedded with the shale. The massive sandstone found in the upper part of the series between coals No. 2 and No. 5 in Fulton County does not seem to be generally present at least in eastern Peoria County.

NO. 5 COAL

No. 5 coal is a single bed without partings or bands and varies from about 4 feet to 4 feet 8 inches in thickness. The bed is cut by numerous clay "veins" which also penetrate the strata above the coal for an undetermined distance. When narrow and not filled with clay gouge, the vertical fractures are commonly cemented by a pyritic vein material. The coal contains several varieties of "sulphur" or pyrite, such as sulphur balls, lenses of gray and brown sulphur, sulphur spars or vein filling noted in the preceding sentence, and "blackjack" or pyritized mother coal. Of these forms probably the gray to brown lenses of laminated pyrite which occur in special abundance near the horsebacks constitute the most characteristic variety. The coal displays no physical characteristics in itself that serve to distinguish it from other coals in the State. It has the usual banded appearance of Illinois coals due to interlamination of dull and bright coal.

Distribution of No. 5 coal.—As No. 5 coal lies above the level of the present drainage lines in a considerable part of the county, it is consequently absent within the Illinois valley and for some distance

[1]Op. cit., p. 26.

up the larger tributary valleys. Above Kramm, the coal outcrops along the sides of Kickapoo Creek and is mined by drift mines.

The distribution of the coal is further limited by pre-glacial drainage lines which apparently correspond in general with those of the present, though the earlier valleys are wider and deeper than those now existing. A map of the pre-glacial surface for the whole of the county is not possible with the information now available, but Plate VI reproduced here from Doctor Udden's report[1] shows the pre-glacial surface for the Peoria quadrangle. The following description of the bed-rock surface in the Peoria region is also reprinted from the same report.

Erosion in pre-glacial time had produced a land surface which differed considerably from the present topography. Since that time the land has been rebuilt by glaciation, the general effect of which has been to reduce the relief. The old land surface has undergone some changes by post-glacial agencies, but these are small. The present surface of bed rock is known mainly from wells and other excavations that have penetrated the drift. These data are not very numerous, but an attempt has been made to present the general features of the rock surface in the quadrangle by contour lines on a separate map (Pl. VI). Where data are wanting, the probable course of these contours is indicated by interrupted lines.

In the area west of Kickapoo Creek and Illinois River, the old rock surface closely parallels that of the land today. In Limestone Township it reaches an elevation of 675 feet in secs. 5 and 6. From here it descends southward to an average height of 550 feet in the uplands of Hollis Township. The two Lamarsh creeks and Kickapoo Creek above Pottstown occupy valleys which were eroded before the deposition of the drift. Below Pottstown the last-named stream evidently has been lately crowded up on the east slope of the old upland to the west, and from Horseshoe Bottom to Bartonville it has cut a new and comparatively narrow valley on this slope.

Under Peoria, and also under the upland for a distance of 3 miles north from the city, and on the east side of the river north of Farm Creek, the rock surface has an average altitude of about 400 feet above sea level. This is 200 feet lower than the same surface in Limestone and Hollis townships. It rises, however, north from Pottstown, so as to bring the "Coal Measures" again into view in some of the creeks immediately north of the north boundary of the quadrangle. South from Farm Creek, on the east side of Illinois River, bed rock rises and reaches its highest altitude of 600 feet above the sea in sec. 7, Groveland Township. Under the upland to the south it gradually sinks to an average height, as far as known, of about 525 feet in the south part of Elm Grove Township. Two wells on the lowland south of Pekin reached altitudes of 430 and 420 feet above sea level without entering bed rock. In and near the present valley

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1Op. cit., p. 51.

of the river the surface of bed rock is lower than in other localities, as shown by an altitude of 355 feet above sea level at the Colean factory well, 345 feet near Iowa Junction, and 340 feet in the Pekin waterworks wells.

It is not improbable that beyond the boundary of the Peoria quadrangle similar irregularities in the pre-glacial surface also exist and it is quite possible that in places lines of pre-glacial or inter-glacial drainage might have developed in positions not now occupied by streams. Such is the case in the eastern part of Fulton County and it is not improbable that some of these drainage lines extend into western Peoria County.

A third limitation upon the distribution of this coal is an intraformational sandstone which apparently occupies channels cut through the coal some time after the No. 5 coal was deposited but prior to the deposition of No. 6 coal. In other words it is believed that after the accumulation the peat and overlying muds which later became No. 5 coal and its roof shales, land streams came into existence and cut channels into and in many places through the muds and peat; and that eventually the channels were filled with sand, which later became sandstone. The channel deposits apparently have a fairly definite alignment similar to an ordinary stream channel and probably have the usual branches or tributaries, and gradient. Along such channel lines, the coal is now absent, the bed terminating laterally against a massive sandstone, the sandstone in places presenting a nearly vertical wall, and in other places appearing first in the roof and gradually pinching the coal out toward the bottom.

In parts of Peoria County it has been possible to outline the position of the channel deposits (fig. 22), but for most of the area information on which to base a map is insufficient. As this sandstone is younger than No. 5 coal, further discussion is reserved for the following section on the strata between No. 5 and No. 6 coals.

It may well be emphasized here, however, that in exploring new properties in Peoria County the determination of the position and depth of the lines of pre-glacial drainage and the location of channel sandstones which may cut through the No. 5 coal become matters of great importance. It is not safe to open any property in the county without learning the facts in regard to these two uncertain elements. Carelessness in this regard may result in the operator suddenly finding himself without adequate roof and even without coal.

STRATA BETWEEN NO. 5 AND NO. 6 COALS

Over No. 5 coal is a black fissile shale ("miners' slate") similar to that of Fulton County. In the course of Doctor Udden's more de-

tailed description,[1] he mentions the whitish streaks found in this shale as shown in figure 14, and describes small calcareous nodules and the larger "niggerheads" which characterize this bed. Above the roof shale is a layer of limy shale which merges into the limestone caprock above. When the clay and limestone above is soft, it is generally known as clod and is very fossiliferous.[2] At the top of the clod in many places is a bed of sulphur (marcasite) 2 to 6 inches thick, the lower surface of which is very irregular due to protuberances 1 to 3 inches in height and width, called by the miners, "cat" or "cat claw." Where the marcasite is more calcareous and clayey, it is called the "iron band."

Above the clod is a shale which in most places measure 4 to 8 feet but which reaches a thickness of 20 feet locally, due to its uneven upper surface. This is overlain by a sandstone averaging 55 feet in thickness, the lower surface of which conforms with the irregularities of the uneven surface of the shale, as described above. It is this sandstone that in places continues down through the horizon of No. 5 coal, forming what have been alluded to above as the channel sandstones; and it is described by Udden as the most conspicuous unit in the exposed section of the "Coal Measures" in this region. It is present almost continuously in the west bluffs of Kickapoo Creek from Bartonville to Pottstown and in the bluffs of the same stream south of Edwards. It appears along almost every stream which drains the upland on the west side of Illinois River and Kickapoo Creek and also in some creeks near East Peoria in Tazewell County.

The sandstone just described changes somewhat abruptly into shale and fire clay above.[3] There is generally 3 to 4 feet of dark or gray, slightly sandy shale above the sandstone, which is overlain by 2 to 3 feet of fire clay of greenish-gray color. The fire clay immediately underlies No. 6 coal.

By way of summary, a section of the outcropping strata from No. 5 coal to some distance above No. 6 coal is given below.

1Op. cit., pp. 29-30.
2Op. cit., p. 30.
3Op. cit., p. 32.

Section of the rocks in the west bluff of Kickapoo Creek, near the Schmidt mine near the south line of sec. 13, Limestone Township

Description of Strata	Thickness		Depth	
	Ft.	*in.*	*Ft.*	*in.*
Drift	40	....	40	....
Sandstone, thin bedded	10	....	50	....
Shale, black	....	6	50	6
Coal, impure, weathered	....	7	51	1
Coal	1	8	52	9
Clay, red	....	3	53	....
Coal (No. 6)	1	1	54	1
Fire clay	1	6	55	7
Sandstone, thin bedded and fine-grained, almost shaly	19	....	74	7
Sandstone, moderately coarse, homogeneous	2	....	76	7
Sandstone, thin bedded, soft, fine grained, with thin clay seams	13	....	89	7
Sandstone, thick bedded	23	....	112	7
Shale (near mine)	9	....	121	7
Shale ("slate")	1	....	122	7
Coal (No. 5)	4	4	126	11

Discussion of the channel sandstones.—The correct interpretation of the sandstone "faults" in No. 5 coal in Peoria County is a matter of some moment to the operators in the southern part of the area, because the accepted interpretation will have considerable control over the exploration methods. They are believed by the author to be channel sandstones, but the older alternative view of Doctor Udden, presented in his report on the Peoria quadrangle and outlined below, must be taken into consideration.

The manner in which the sandstone cuts out the coal has been described very briefly in the preceding section of No. 5 coal, and additional facts about the phenomenon are to be gathered from the accompanying illustrations (figs. 15-20) and the following notes on variations in coal thickness on fractures adjacent to the "faults":

In two of the mines along the east side of the channel sandstone or "fault" in Hollis Township (T. 7 N., R. 7 E.), the coal shows unusual variations in thickness, the bed increasing rather than diminishing in thickness, as compared with the average thickness. Sketches and figures from the mine of the Leitner (formerly German) Coal Company, indicating that in places in this mine the coal thickens to 10 feet, apparently due to duplication or overthrusting of the bed produced by lateral pressure. A similar thickening of the coal has been observed in Brewster and Evans

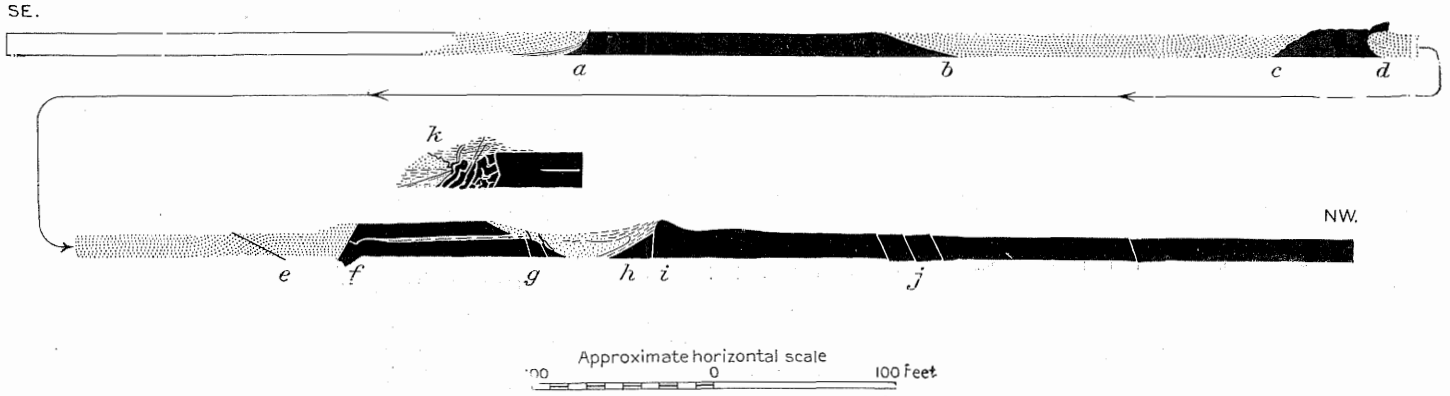

FIG. 15.—Sections of the main entry of the Leitner (formerly German) Coal Company's mine, showing the relations of the channel sandstone to the coal. See Fig. 16 for photograph at *d;* Fig. 17, at *f;* Fig. 18, at *g;* Fig. 19, at *k*, opposite *g;* and Fig. 20, opposite *h*.

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(Walben) mine in the short distance north of the Leitner mine. In the Walben mine no evidence of overthrusting was observed but the coal increased in thickness gradually from a general average of 4 feet 6 inches to 5 feet 3 inches at the edge of the "fault."

In these same mines evidence of disturbance is also seen in the folding, fracturing and shattering which affects the coal, as illustrated in figures 15 to 20. In some instances the coal is so brecciated and broken that it may be easily worked with pick and shovel.

After describing in accurate details the fractures, disturbances,

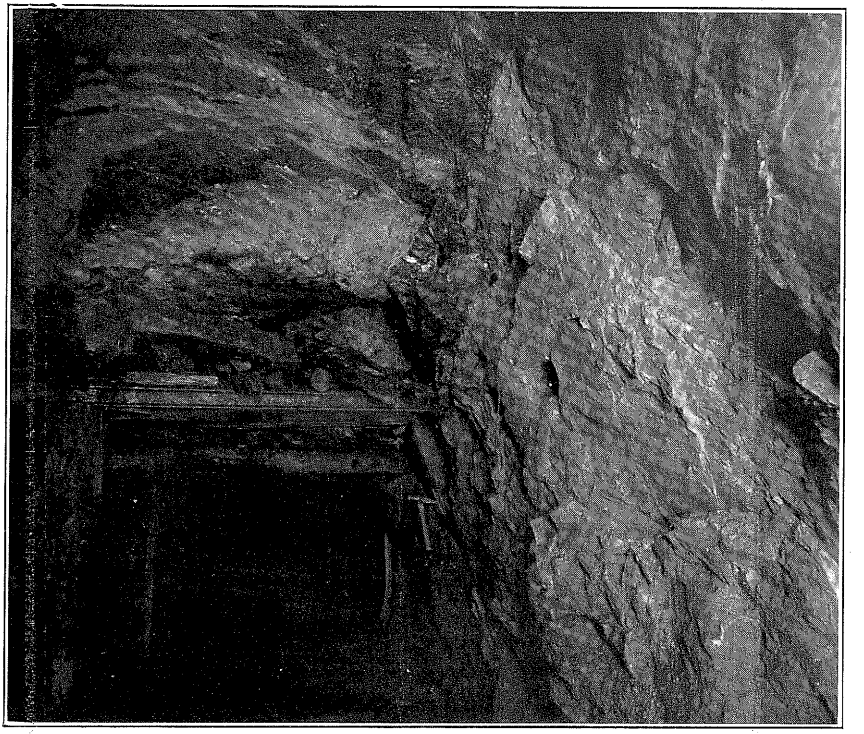

FIG. 16.—Photograph of the roof and southwest wall of main entry of the Leitner Coal Company's mine in the SE. ¼ sec. 2, T. 7 N., R. 7 E. Looking southeast. (See fig. 15, *d*.) A projecting flange of the coal is seen in the center rising in the roof over the timbers. Several of the shearing joints show indistinct horizontal striae or flutings.

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and thickening of the coal at the contact of the coal and the channel sandstone, as summarized above, Udden [1] assigns the phenomena to glacial fracturing:

"The author believes that the fractures are disturbances in the upper part of the soft bed rock, caused by the pressure and motion of a continental ice sheet in Pleistocene time; that they are planes marking the outlines of immense blocks of the uppermost rock strata, tens, or possibly hundreds of acres in extent, which have been dislodged from their original position, displaced, fractured, rotated horizontally and in places vertically, and partly ground into the till. He regards the region as having been a locus of incipient glacial abrasion. Instead of thoroughly triturating the grist, the glacial mill here merely blocked it out of the old land on which it spent its force."

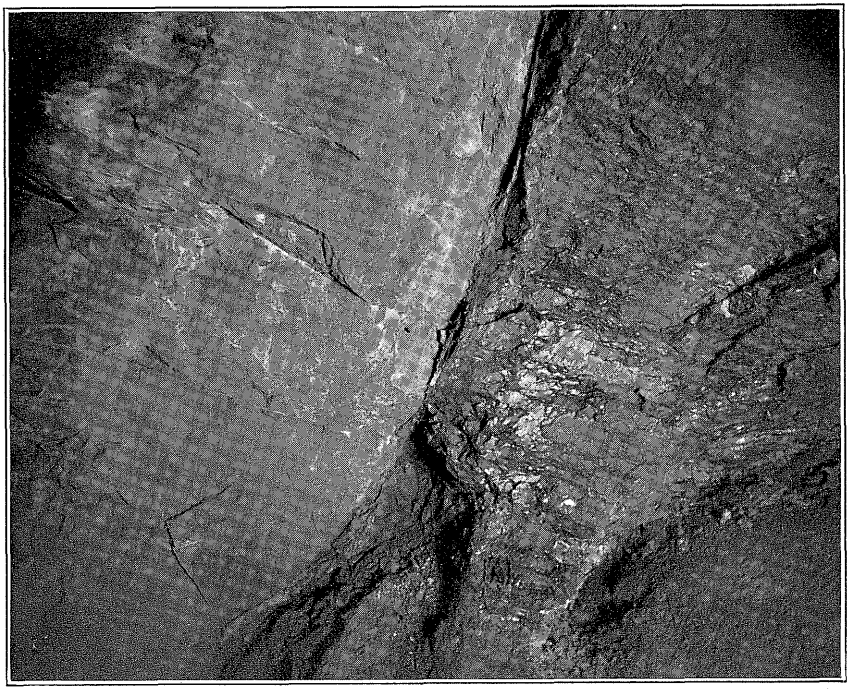

FIG. 17.—Photograph of the left (southwest) wall of the mine entry shown in Figure 16.

Looking southwest. (See fig. 15, *f*.) A fracture runs diagonally across the center of the field separating the sandstone on the left from the coal on the right. Near the sandstone the coal is shattered and mixed with fragments of shale and sandstone.

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[1] Udden, J. A., Geology and mineral resources of the Peoria quadrangle: U. S. Geological Survey Bull. 506, p. 77, 1912.

In support of Udden's theory, it is true that along the lines of the pre-glacial valleys, especially where cut into deeply by the present streams, there is abundant evidence of local dislocation by what may be called ice push. And it is also true that such localities in some instances happen to be in areas corresponding to or contiguous to the area occupied by the channel sandstone in the Lamarsh Creek basin. However, in the author's opinion, to assign the absence of the coal and other phenomena observed at the sandstone "faults," to glacial dislocation seems to call for an unusual and almost improbable exhibition of glacial activity.

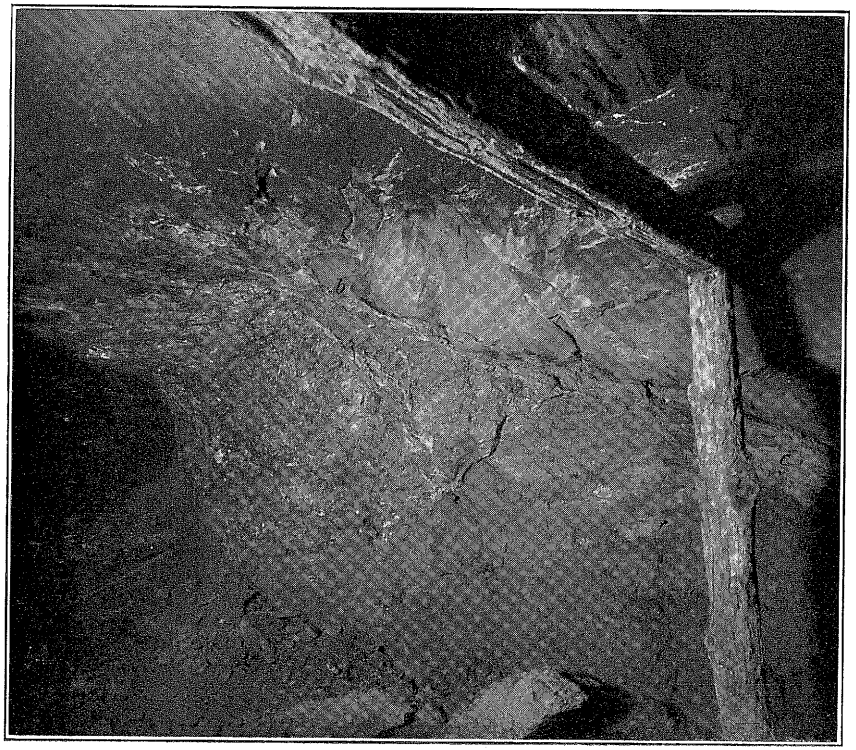

FIG. 18.—Another view of the mine wall shown in Figure 17. (See fig. 15, *g*.) An S-shaped sheared fracture is indicated by the letters *a*, *b*, *c*. Somewhat irregular indistinct horizontal flutings appear to the right of a line joining *a* and *b*.

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The author's interpretation of the sandstone "faults" is indicated by the use of the term "channel sandstone" and is outlined here in historical form:

After the accumulation of the peat and overlying muds now represented by No. 5 coal and its roof shales, land streams came into existence and cut channels into the muds and peat, thereby removing both mud and peat along their courses (fig. 21A). Eventually a layer of sand at least a score of feet thick and in many places much thicker

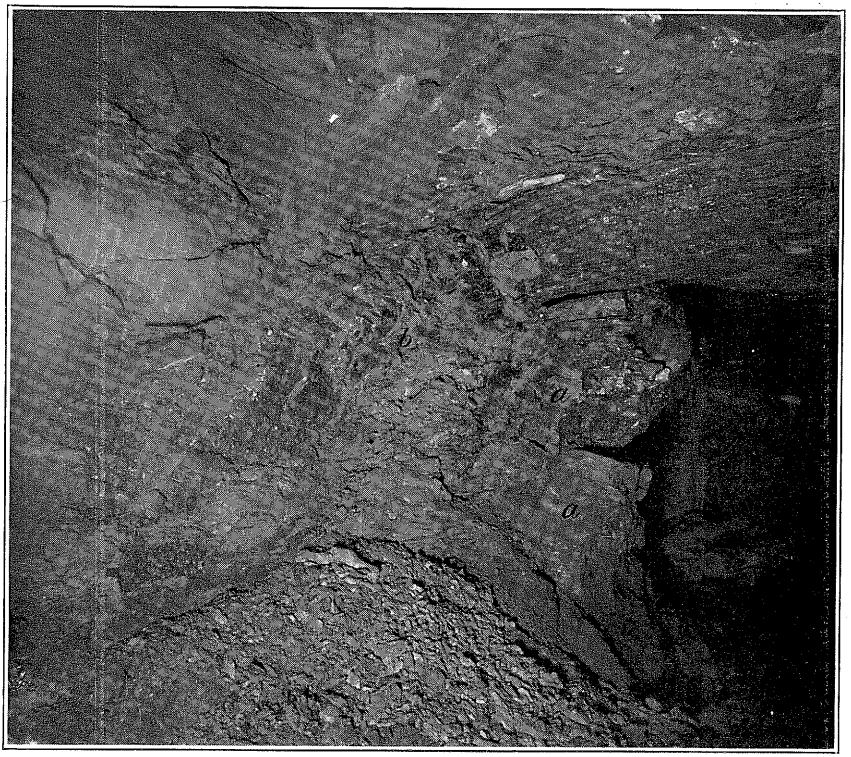

FIG. 19.—View of the right (northeast) wall of the same mine entry as Shown in figures 15, 16, 17, and 18.

Looking northeast. (See fig. 15, *k*, opposite *g*.) The fractured face of the coal appears above and to the left of the receding entry in the lower right-hand corner of the view. Horizontal flutings appear on the face of the coal at *a*. An S-shaped belt of fissured coal and shale separates the coal from the sandstone on the left, and other fissures, roughly parallel to this belt, appear indistinctly at *b*.

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was spread widely over the region, thickest of course along the positions of the channels and thinner over the intervening areas (fig. 21B). Subsequently the sand was covered over by the muds and silts upon which the peat for No. 6 coal was still later deposited. With the burial of the peat and overlying muds and sands under an increasing load of still younger sediments, the peat changed gradually into coal and the muds and sands into shales and sandstones. In such a process of consolidation, the muds and shales shrink comparatively little, but the peat is reduced to some such fraction as one-fifth of its original thickness. The consequent differential shrinkage between the strata away from the channel lines resulted in the setting up of pressures and strains which were relieved in such a way that the fracturing, coal

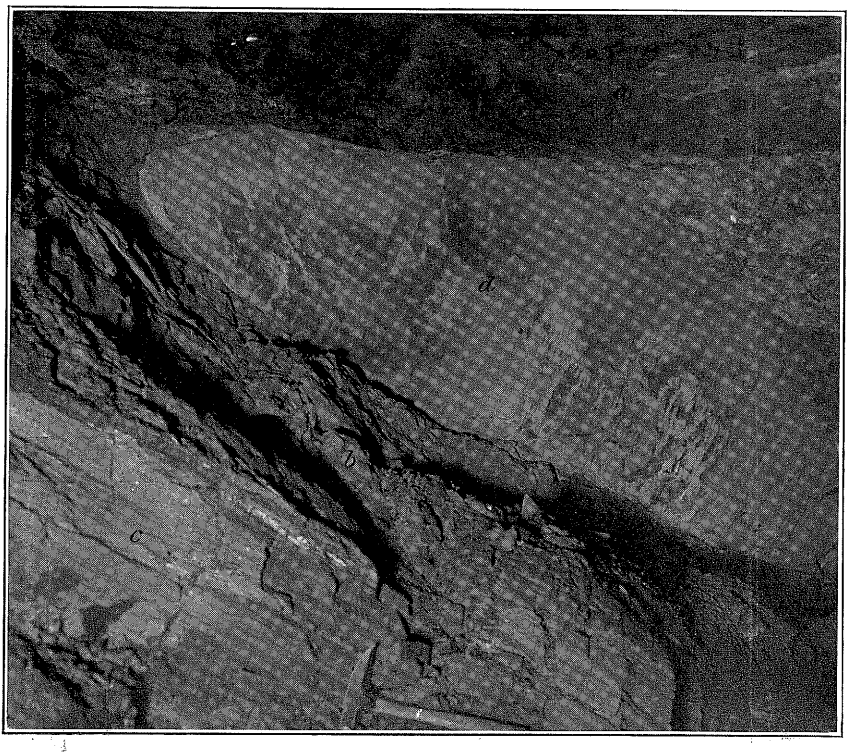

FIG. 20.—Another view of the mine wall shown in Figure 16. (See fig. 15, opposite *h*.) Bed *a* is dark shale with some streaks of coal, somewhat shattered, possibly the same as *b*; *b* is the roof shale of No. 5 coal; *c* is No. 5 coal; *d* is sandstone.

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thickening, and attendant phenomena exhibited at the "faults," were developed. Figure 21C is an attempt to present diagrammatically the author's idea of the way in which the forces probably acted in effecting the readjustments made necessary by the differential shrinkage.

The economic bearing of the correct interpretation of the phenomena rests upon the importance of determining the nature of the

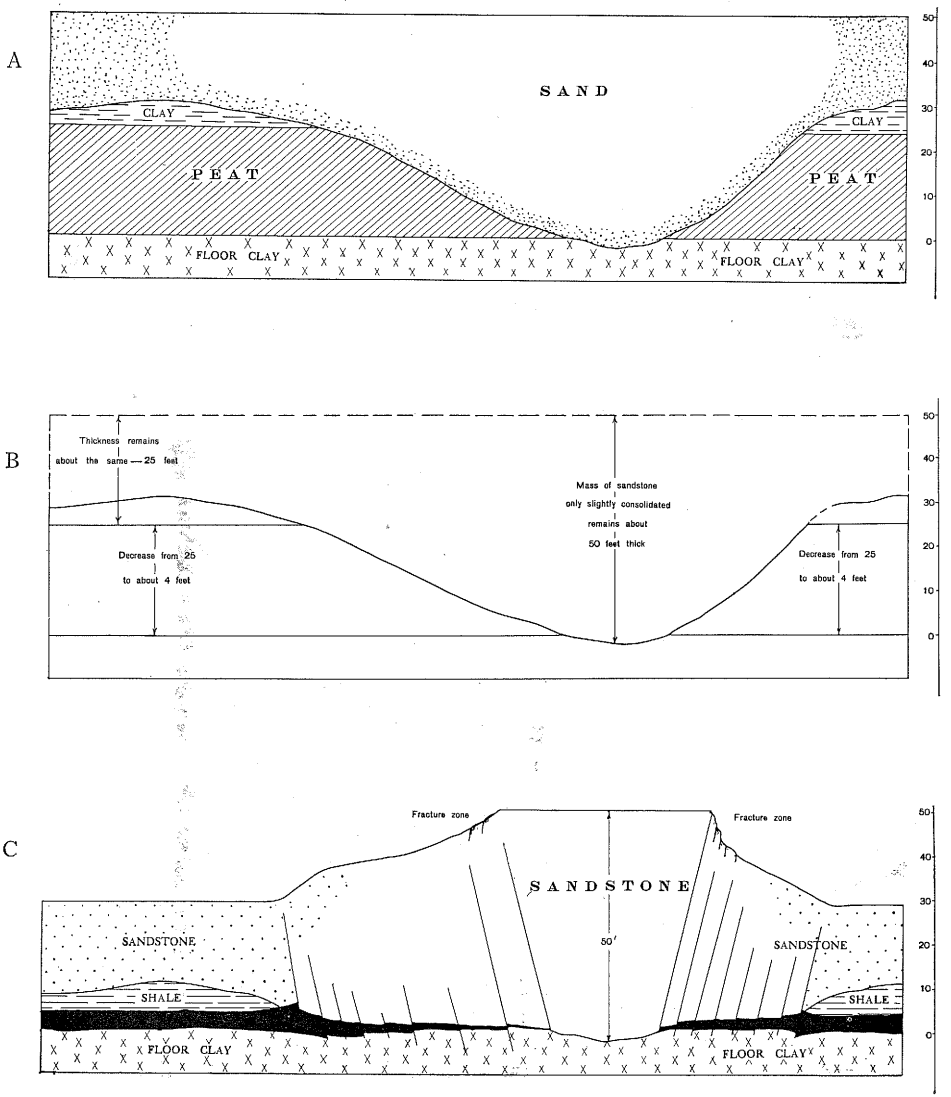


FIG. 21—Diagrammatic sketch, indicating probable original conditions, movements, and results, in the formation of the channel sandstones ("faults") of Peoria County. See text for explanation.

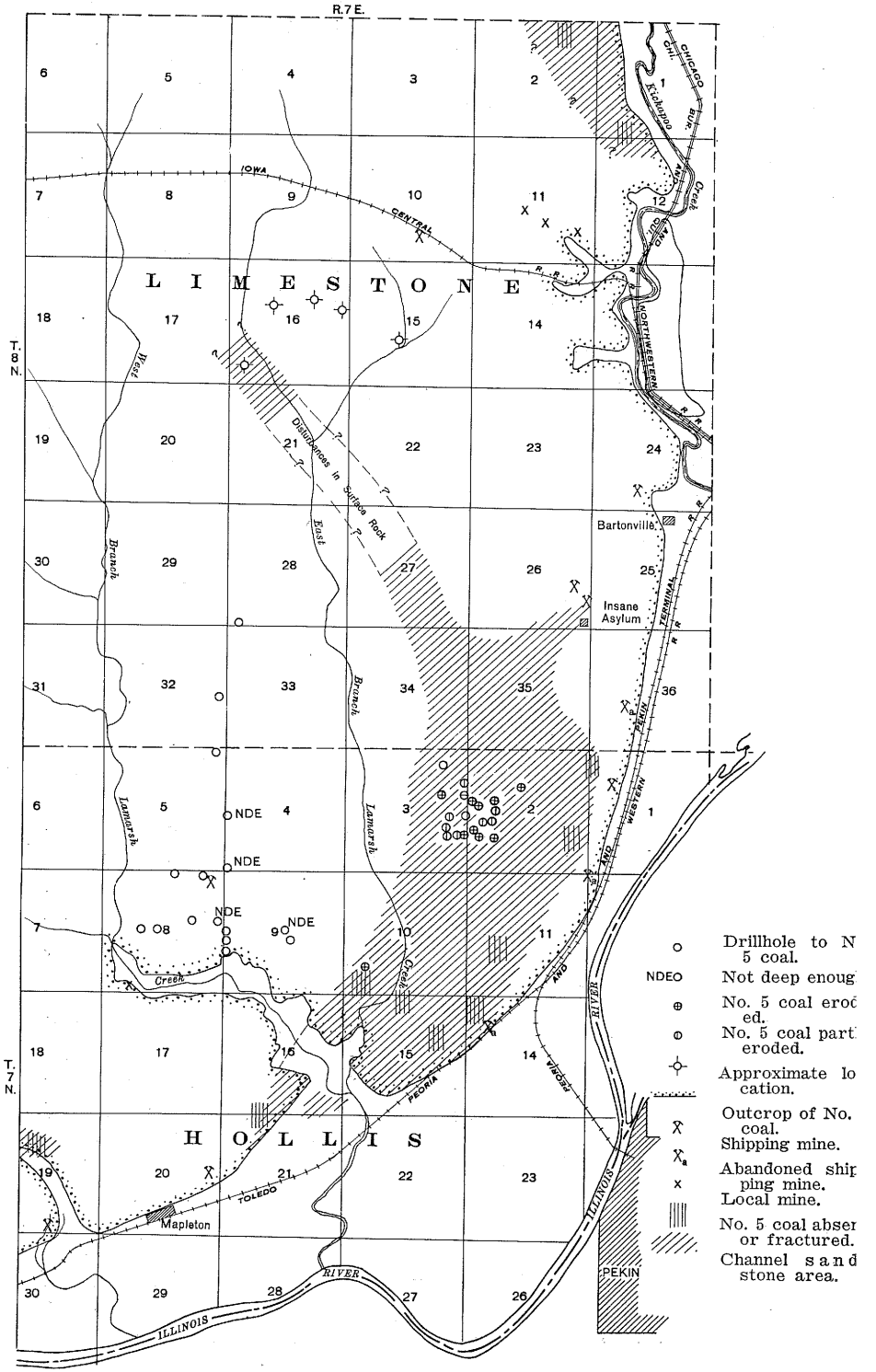
"fault." If this is a purely glacial phenomenon related to ice shove, as proposed by Udden, then the delineation of areas where such a phenomenon is to be found becomes very difficult. But if on the other hand the disturbance can be traced to the existence of a channel sandstone, it becomes a matter of reasonable possibility to locate the position and trend of such a deposit. Without examining the "channel sandstone" interpretation at length, two points may well be mentioned here in its support, the first very briefly, but the second in somewhat more detail and with a map because of its weight and its practical application to the "fault" problem.

1. The pressures and strains developed by differential settling of the magnitude assumed, would seem to be entirely adequate to the production of the features now observed at the "faults."

2. As a result of the past ten years' investigation, drilling, and mine operations, engineers and operators have analyzed the "faults" as masses of sandstone penetrating below the horizon of the coal and have blocked out their extent over an area sufficient to indicate that they have the general alignment of stream channels.

The position of the channel sandstones over the whole of the Peoria region is not very definitely known. Many of the mines south of Peoria and those in Tazewell County near East Peoria have felt out the edge of the "faults" so that some idea of the position of one of the sandstones is available. South of Peoria the Leitner Coal Company's mine, and the Walben mine, M. E. Case Coal Company have worked up to the edge of the sandstone. The Wolschlag mine is reported to lie immediately to the east of the "fault." Numerous drill holes to test the coal have penetrated the sandstone in the area lying between the east branch of Lamarsh Creek and the Illinois. Additional drilling has been recently completed west of the east branch of Lamarsh Creek. The area of coal affected by the sandstone seems to be confined to a strip of territory lying along the east side of the valley of the east branch of Lamarsh Creek and extending south of Lamarsh Creek along the bluff of the Illinois as far as Mapleton. A similar area where the sandstone cuts out the coal is reported in the vicinity of Wesley in Tazewell County.

The accompanying map (fig. 22) shows the status of information concerning the position of the channel sandstone south of Peoria and in Hollis and Limestone townships as worked out largely by Mr. W. C. Evans of Peoria by drilling and observation in mines.


R.7E.
T. 8 N.
T. 7 N.
LIMESTONE
HOLLIS
Bartonville
Insane Asylum
Mapleton
PEKIN
Disturbance in Sulphur Rock
West Branch
East Branch
Lamoarsh Creek
Lamoarsh Creek
Creek
IOWA CENTRAL
CHICAGO PEKIN & SOUTHWESTERN
CHICAGO TERMINAL
NORTHWESTERN
WABASH
TOLEDO PEORIA & WESTERN
PEORIA & PEKIN TERMINAL
ILLINOIS RIVER
ILLINOIS RIVER
NDE
Drillhole to N 5 coal.
Not deep enoug
No. 5 coal eroc ed.
No. 5 coal part eroded.
Approximate lo cation.
Outcrop of No. coal.
Shipping mine.
Abandoned ship ping mine.
Local mine.
No. 5 coal absen or fractured.
Channel sand stone area.

With the meager reports that are in existence concerning the succession of strata in the part of Peoria County outside of the Peoria quadrangle it is impossible to say that there are no other areas of channel sandstone in the county, penetrating the horizon of No. 5 coal. None of the mines located at Hanna, Glassford, or Kramms reports such "faults" in the area under operation. However, exploration of undeveloped coal land should be guided by the possibility of such an irregularity being present.

NO. 6 COAL

No. 6 coal lies in two benches, separated by a layer of clay known as the "blue band." Part of Udden's description [1] of this coal is cited herewith:

"The lower bench varies from 1 foot 3 inches to 1 foot 8 inches thick. The 'clay band' as the 'blue band' is also called by the miners, is uniform and persistent, being absent in a few places, and is 2 to 3 inches thick. The upper bench of the coal is in many places partly destroyed. * * * Where intact, it measures 2 feet 1 inch to 2 feet 6 inches thick. In addition to this there is in places about 6 inches of bony coal, which was probably only locally deposited. * * * In places the lower part of the coal has two interrupted bands of marcasite, one about 5 inches from the bottom and the other 9 inches higher up. These measure one-fourth to one-half inch thick."

Field investigations, drilling, and some mining of this bed demonstrate that No. 6 coal is more uncertain in its distribution than No. 5. The seam varies greatly in thickness and in places seems to be entirely missing. The cause of its irregular distribution seems to be erosion subsequent to deposition rather than failure of deposition. In the case of No. 5 coal, the removal of the peat and absence of the coal was along rather well-defined lines of what were apparently the courses of stream channels. But the removal of No. 6 coal was seemingly along less definitely organized lines suggesting that possibly the irregularities in the coal are actually inheritances of irregularities in the original bog in the low parts of which there may have been open-water ponds and sluggish streams, these channels and ponds being ultimately filled with silt and sand. These conditions of deposition seem to have persisted over the entire area in which No. 6 coal was deposited in the State. The coal seems to have been more commonly affected by the irregularities in this region than in some parts of the State, but the general nature of the irregularities seems to be everywhere the same.

1Op. cit., p. 33.

MC LEANSBORO FORMATION

STRATA BETWEEN NO. 6 AND NO. 7 COALS.

In Peoria County the strata composing the McLeansboro formation include all the rocks between the drift and No. 6 coal. No. 7 coal, one of the widespread coal beds of the State, which in the Danville and Longwall districts is of workable thickness, occurs 25 to 30 feet above the base of the formation, but in this district is nowhere of commercial thickness.

The strata overlying No. 6 coal vary considerably. The normal succession, occurring where the entire section is present, consists of a gray shale, in places dark gray, 18 inches to 2 feet thick, overlain by limestone averaging a little more than 2 feet and in sixteen measurements, according to Udden, ranging from 3 inches to 4 feet. In many places the shale above the coal is replaced by a variable sandy deposit known among the miners as "white top." Udden expresses the opinion that this deposit is of much later age than the strata it replaces or between which it is inclosed and suggests that it originated as cave wash in solution cavities located in the under part of the limestone cap-rock, erosion in which also affected the upper part of the coal bed.[1] The present writer, on the other hand, is of the opinion that the sandy shale composing the "white top" represents deposits in depressions in the original peat bog. It is believed that the lack of well-defined bedding in these deposits and the presence of slickensided surfaces and partings and the conchoidal fracture of the material which Udden cites as evidence of the "cave" origin, were produced as a result of the "kneading" to which the deposits were subjected because of the differential shrinkage of areas of the peat of considerably different thickness. The shrinkage of a bed of peat to coal now about 4 feet thick would be in some proportion ranging between 32 to 1 and 3 to 1, 5 to 1 being apparently the approximate average proportion that holds for Illinois coals. It is clear that if the coal in places is 4 feet thick and in other places because of the presence of a lenticular body of shale embedded in its upper part only half as thick or less, movement must have taken place to adjust the strains that resulted from differential shrinkage of the thick and thin peat. As a result of the readjustments that must take place in the lens of sandy shale or "white top" this material will be "kneaded" and fractured and will tend to lose much if not all of its originally laminated structure. The material will accordingly furnish a very treacherous roof because of lack of coherence. Not uncommonly the strains are carried downward into the coal, fracturing and displacing it, especially along the edge of the "white top" masses.

1Op. cit., pp. 84-85.

The cap-rock of No. 6 coal is fairly continuous, apparently even more continuous than the coal itself. The rock is an impure argillaceous limestone, the lime content of which does not appear to comprise much more than half the rock. It does not have the appearance of a rock that would develop large cavities by the action of ground water. Udden[1] describes the rock as follows:

"Clay seams separate it into four or five beds of unequal thickness. In places the middle beds weather into blocks a foot and a half thick. The thin top layer is in places separated from the other beds by a seam of clay measuring several inches.

"The rock is light gray in color. In places it exhibits an indistinct nodular or concretionary structure, the nodules measuring one-half to one inch in diameter, but this is not general. With the aid of a lens nearly one-third of the mass of the upper beds is seen to consist of organic fragments, representing mostly brachiopods, crinoids, and *Fusulinas*. These lie embedded in an apparently structureless calcareous matrix. Many of the shell fragments are appreciably rounded. Fragments of *Fusulina* can be found in every piece of rock. Another constant characteristic is the presence, especially in the upper beds, of black nodular lumps impregnated with bituminous material. They are sharply delineated from the matrix and exhibit a rough exterior surface. In many places they contain fragments of shells and appear to conform to the structure of the limestone itself. In size they vary from a mere speck to masses 2 inches in diameter. Generally they are three-fourths of an inch in diameter and slightly flattened. In the upper beds there are in places rounded pieces of calamarian stems, which are also black from impregnating bituminous material and exhibit a coarse cellular tissue."

In Illinois the fossil *Fusulina* (now known as *Girtyina*) mentioned in the foregoing quotation is apparently restricted in its occurrence to the limestone cap-rock of No. 6 coal and to a limestone supposed to occur several hundred feet above No. 6 coal and found only in the eastern part of the State. The fossil has somewhat the appearance of a short thick oat grain. Because it is almost invariably present in every piece of the rock down to the size of a walnut and is rather readily found, it serves as an accurate and practical method of identifying this limestone and the coal a short distance beneath it.

Above the limestone is light-gray or greenish shale or "soapstone" above which is a massive sandstone, but which ranges in thickness from 10 to 25 feet but averages about 20 feet. Between the sandstone and the fire clay of No. 7 coal is generally clay shale 1 to 8 feet thick. In some places this is dark greenish gray, and in others dark red or brown. This red clay Udden regards as an infallible guiding stratum for the coal beds of this region. Where present, it lies from 8 to 16

[1] Op. cit., p. 34.

feet under coal bed No. 7 and no other red clay is exposed in the Pennsylvanian system in the Peoria region. It is noteworthy that a bed of variegated shales is also reported to be present in District VII[1] within 50 feet above No. 6 coal. As a rule in that area they lie a short distance above No. 7 coal.

NO. 7 COAL

No. 7 coal is generally present in the county except where it has been removed by erosion. It maintains a very uniform thickness of about 18 inches, which is insufficient to make the coal of commercial value, at least for many years.

Udden states that the coal is especially characterized by lenses of mineral charcoal commonly found near the top of the bed. In places the charcoal is impregnated with pyrite and appears as "sulphur cakes" or "blackjack."

STRATA ABOVE NO. 7 COAL

The roof of No. 7 coal consists of a few inches of gray soft shale resting upon the coal and above this, black shale in varying thickness from 6 inches to 2 feet. In some places the black shale rests directly upon the coal. Above the black shale there are in most places a few feet of slightly siliceous and micaceous shale. The overlying sandstone rests upon an uneven surface of sufficient relief to entirely eliminate the upper shale in many places so that it rests upon the underlying black shale and even upon the gray clay below. The sandstone varies in texture from sandy shale to sandstone. Generally the lower beds are coarser. Udden states[2] that about a mile west of Bartonville this sandstone is nearly 40 feet thick.

At the top of these sandy beds is about 6½ feet of dark shale, part of which is thought by Udden to represent an old soil. This is followed by a 20-foot limestone ledge, known as the Lonsdale limestone from its exposure at the old Lonsdale quarries. "The lower 5 feet of this rock consists of a firmly cemented largely organic limestone, in beds varying in thickness from 6 inches to 1½ feet." In places part of the rock consists "of a calcareous mud-lump breccia, in which regular lumps of a dark compact structureless carbonate of lime are embedded in a less pure, greenish-gray matrix. In this matrix fragments of fossils also occur." Above these firm beds there are 15 feet of a slightly argillaceous and more flaggy rock, in which concretionary structure can nearly always be detected.[3]

Above the limestone is a 15-foot sandstone which has only a

1Kay, F. H., Coal Resources of District VII: Illinois Coal Mining Investigations Bull. 11, p. 24, 1915.
2U. S. Geol. Survey Bull. 506, p. 38.
3Op. cit., p. 40.

limited distribution as has also the overlying dark shale, which is the uppermost Pennsylvanian stratum in the Peoria quadrangle. The general dip of the rocks toward the southeast makes it probable that the youngest "Coal Measures" rocks will be found in the southeast part of the county.

Deposits Above the Coal-bearing Rocks

The material overlying the Pennsylvanian strata consists either of alluvium or glacial drift, that is unconsolidated stony clay, and sand and gravel. Because the bed-rock surface was a land surface before glaciation, except for a relatively thin covering of soil and of alluvium along streams, it was affected by the ordinary processes of stream action which produced the usual organized lines of drainage with divides separating them. The glacial drift left by the continental ice sheet tended to cover up the inequalities in the surface overridden by the ice, and to produce a new surface with a relief originating in the unequal distribution and thickness of the drift. The drift has a bearing on mining operations because it conceals the form of the underlying rock surface and the character of the outcropping rocks, and renders the distribution a single stratum, such as a coal bed, difficult to determine without drilling.

The alluvium is confined to the valleys. The river which occupied the valley of the Illinois before glacial time flowed at a much lower level and at a position slightly different from that of the present river. The map of the pre-glacial surface (Pl. VI) shows the position of the pre-glacial valley and the altitude of the channel. It will be noted that the deepest part of this valley had an altitude of about 350 feet above sea level. As No. 2 coal lies at an altitude of about 300 feet in the vicinity of Orchard Mines and Pekin, it follows that this coal is probably very lightly covered with drift if not removed within the pre-glacial Illinois valley in the southern part of the county. What is possibly this coal is reported to outcrop below the valley fill beneath the bed of the river about opposite Kingston Mines.[1]

The wide area of deep filling at Peoria and up Kickapoo Creek and a similar area of thick drift across the Illinois in Fondulac Township, Tazewell County, and the general slopes of the old pre-glacial upland surface in Kickapoo, Limestone, and Hollis townships and in Groveland Township, Tazewell County, suggest to Udden[2] the possibility that the old upland was continuous across the valley at the position of present narrows between Bartonville and Hollis. This

1Cooley, Lyman E., The Illinois River; physical relations and removal of the navigation dams: Sanitary District of Chicago, Chart opposite page 42, 1914.

2U. S. Geol. Survey Bull. 506, p. 52.

upland in that case would represent a divide between a stream crossing the course of the present Illinois in a northwest-southeast direction at about the position of Peoria and Kickapoo Creek and another stream farther south. Udden, however, presents another hypothesis to account for the narrows. "If the Illinois River valley antedates the glacial epoch, its narrow course between Iowa Junction and Pekin may be due to the comparatively more resistant sandstone above coal bed No. 5 which prevented as rapid recession of the bluffs on both sides of the valley as has taken place elsewhere."

The character and position of the pre-glacial valleys in Peoria County that may exist outside of the area of the Peoria quadrangle have not been reported.

Outcrops along the west bluff of the Illinois are nearly continuous southward from Kickapoo Creek, and northward from Senachwine Creek at Chillicothe. Between Peoria and Chillicothe, however, the bluffs are composed of glacial till, representing remnants of the filling in the pre-glacial Illinois valley.

The Minable Coal of Peoria County

Udden states that no less than seven coal beds occur in the Pennsylvanian rocks of the Peoria region, of which only three are exposed. Of these seven, but four have commercial value, and of these four only three have been operated during the last calendar year. The beds of workable thickness are No. 1, No. 2, No. 5, No. 6, and No. 7. Of these only No. 5 is worked extensively on a commercial scale. One commercial mine has reopened workings in No. 2 coal, and several wagon mines operating No. 6 and No. 7 coal. The general character of these coals has been described in the section devoted to the geological succession in Peoria County. It remains to consider the coals from an economic viewpoint and to review the factors that affect its commercial value. These are distribution, thickness, chemical character of the coal, nature of impurities and irregularities, and character of roof and floor. The coals will be described in an order the reverse of that just used in discussion of the strata of the Pennsylvanian system.

No. 7 coal

No. 7 coal is not of workable thickness in the central and southern part of the county. Udden[1] states that the coal averages 1 foot 5 inches in the Peoria quadrangle, and that the uniformity of its thickness is remarkable in that area. Worthen[2] states in regard to this coal that:

1Udden, J. A., Geology and mineral resources of the Peoria quadrangle: U. S. Geological Survey Bull. 506, p.36, 1912.
2Worthen, A. H., Geological Survey of Illinois, Vol. 5, p. 249, 1873.

"In the northern portion of the county, No. 7 is the principal coal outcropping above the valleys of the streams, and the lower seams can only be reached by shafts, or by an inclined tunnel carried down to their level. This seam ranges from two and a half to three feet in thickness in this part of the county, and its outcrop may be found on most of the small streams. It is very regular in its development, and affords a coal of fair quality where it is mined beyond the influence of atmospheric agencies."

The thickening of No. 7 coal northward in the northern part of the county and thence toward the Longwall District parallels a thinning of No. 6 coal in the same direction. In the northern district No. 6 coal is apparently absent, whereas No. 7 has a thickness of between 4 and 5 feet. In northeastern Peoria County north of Chillicothe, No. 7 coal has been worked at a number of wagon mines. In this vicinity the coal is about three feet thick. The Survey has little definite information in regard to the area underlain by No. 7 coal of workable thickness, or of the general mining conditions.

MINE NOTES, NO. 7 COAL

The following notes taken in Crew Brothers' mine north of Chillicothe in 1909 are given in lieu of more adequate data.

CREW BROTHERS' LOCAL MINE, NEAR CHILLICOTHE

Entrance: Drift; No. 7 coal.
Thickness of coal: Varies from 2 feet to 3½ feet; averages 3 feet.
Section of the coal:

Section of No. 7 coal in Crew Brothers' mine, near Chillicothe

	Thickness	
	Ft.	*in.*
Roof: Black slate, or soapstone	..	..
Coal	..	10¾
Trace of clay	..	..
Coal	..	6½
Trace of clay	..	..
Coal	..	6
Parting	..	..
Coal	..	7¼
Mother coal and trace of pyrite	..	1
Coal	..	4
Floor: Fire clay	..	..
	2	11½

Character of the coal: The seam is fairly uniform throughout. The bottom coal, below the mother coal, and the coal just above the mother coal are somewhat harder than the other benches. The trace of pyrite in the mother coal is persistent throughout the mine. It was called the "blue band," but is not to be confused with the well-known "blue band" so characteristic of No. 6 coal.

Character of the roof and floor: The roof is a black shale or "slate" which is in places replaced by "soapstone." There was no limestone present as a cap-rock. The floor is fire clay.

NO. 6 COAL

As No. 6 coal lies at an altitude of about 550 feet in the Peoria region, it is consequently above the level of the Illinois and of Kickapoo Creek for a considerable distance above the mouth of the Kickapoo. In western Peoria County at Elmwood No. 6 coal is below stream level and has an altitude of about 575 to 600 feet. It has about the same altitude at Princeville. It is apparent that most of the county is underlain by this coal, that it is generally under sufficient cover and with roof undisturbed, so as to be accessible for drift mining in many places, especially along Kickapoo Creek.

The coal possesses certain characteristics which stand in the way of its general exploitation. It is more irregular in its development than any of the other coals and principally for this reason it is generally neglected. Worthen states in regard to this coal that "When fully developed it is quite as thick as No. 5, but the miner who commences drifting into this coal on a promising outcrop from four to five feet in thickness, will frequently, in a distance of a hundred yards or less, find the coal gradually thinning out to one-half its original thickness."[1] Apparently the coal is more persistently developed in workable thickness in the northwestern part of the county than in the southern or eastern part. Along the Illinois valley northward from Chillicothe it seems to be thinner than No. 7 and has not been much worked.

Roof conditions also present difficulties in the working of the coal that are not easily overcome. The regular normal roof is shale, commonly gray, but in places nearly black, 6 inches to possibly 3 feet thick, above which is a persistent cap-rock, averaging about 2 feet thick in the Peoria quadrangle but ranging from 3 inches to 4 feet. It is possibly considerably thicker in some places in the northern part of the county. Notes taken about ten years ago in a mine located near Brimfield state that 25 to 30 feet of limestone are present in that locality. Under normal roof condition no serious difficulties are encountered. The roof shale, which is commonly a foot or less in thickness, usually falls soon after the coal is extracted, leaving a good hard limestone roof. The expense of removing the shale is considerable, of course, but the cost of its removal can be fairly well estimated, so that it can be anticipated before a project is started. The usual roof, however, is in many places replaced by "white top," the nature and possible cause

[1]Worthen, A. H., Geological Survey of Illinois, Vol. 5, pp. 249-250. 1878.

of which were discussed on an earlier page. It is sufficient to restate here that this material appears to be the sand and sandy mud filling of depressions existing in the original peat swamp, later covered along with the rest of the area, by the limestone cap-rock. Adjustments that were necessary because of the differential shrinkage during the change of the peat and sands to coal and rock destroyed the original structure of the sandy lens, "kneading" and crushing them until they now lack coherence and are very difficult to hold. Moreover, the adjustments commonly produced fractures in the coal and weakened the overlying limestone. The total result is a roof condition generally above thin coal that is extremely undesirable, as it is dangerous and costly to provide for. No system of distribution of the "white top" has been discovered. It is usually present to some extent in any body of coal large enough to be worked, and mines have been worked until the poor roof conditions exist in half or more of the workings. Profitable mining is impossible, however, under these conditions.

It is apparent that commercial exploitation of No. 6 coal in this region is not to be considered while No. 5 coal is present in large blocks suitable for mining. It is possible that some system more suitable for operating the No. 6 coal than the room-and-pillar method can be employed, designed to meet the uncertainties that exist, and it is possible also that careful investigation of white top in the region may reveal some system of distribution the discovery of which will assist in devising a suitable method for the extraction of the good coal. At present no block of this coal should be considered for development without intensive drilling to determine the roof conditions and the thickness of the coal.

No. 6 coal is characteristically divided into beds or benches wherever it occurs in the State. Partings and seams of clay, mother coal, or pyrite are generally present and in this county apparently always present to subdivide the bed into benches. Udden describes the bed as subdivided into only two benches by the clay seam or "blue band," a seam of clay or shale ½ to 3 inches thick, found 12 to 14 inches from the bottom and 33 to 46 inches from the top of the coal. Where the white top is present more or less of the upper bench is absent, so that the thickness of this bench varies considerably. As a general thing it is believed that the bottom bench is undisturbed. Observations in various local mines indicate that bedded impurities other than the clay or blue band are very persistent at least locally. A rather continuous band of "sulphur" of clay lies in the lower bench generally in the upper half. It is not always possible to identify blue band with certainty

where both of these bands are present, as they are commonly quite similar. The upper bench, above the blue band, commonly contains several thin partings. One, 12 to 18 inches from the top, seems to be fairly persistent in the mines in the northern part of the county, others are of local distribution, not being persistent even throughout the workings of a single small mine. The total effect of these various impurities is to make the coal as produced rather dirty, although the individual benches between the partings are clean coal. The task of mining clean coal by carefully separating the dirt from the coal in the mine is rather exacting upon the miner and it is doubtful whether it can generally be effectively accomplished. Mechanical separation by washing or other means would probably produce much cleaner coal than the usual mine-run output.

The occurrence of pyrite ("sulphur") in bands and thin lenses is characteristic of No. 6 coal nearly everywhere in the State except in the area of low-sulphur coal in southern Illinois. This sheet or plate pyrite is commonly of either a bright or a stony dull variety, compact and structureless. As its separation from the coal is comparatively easy, this coal is more readily cleaned of its sulphur than other beds in which lenticular laminated gray or brown pyrite is found. The fact that the pyrite commonly occurs in the partings makes it all the more readily extracted at the face.

Observations in a few of the local banks indicate that this coal like No. 5 is cut by clay veins or horsebacks. They are not so common, however, as to be typical of the bed, and do not represent a serious impurity in the coal as is commonly the case in No. 5.

The floor of this coal is fire clay, with no peculiar characteristics so far as is known.

MINE NOTES, NO. 6 COAL

The following observations were made in a few mines in the county operating No. 6 coal. Some have since been abandoned and all were local operations at the time the observations were made.

BERRY BROTHERS' WAGON MINE, NEAR BRIMFIELD IN THE SW. ¼, NW. ¼, SEC. 5, T. 10 N., R. 6 E.

Entrance: Shaft; depth to No. 6 coal about 35 feet.

Thickness of coal: Varies from 2 feet to 4 feet 9 inches; averages 3 feet 3 inches.

Section of the coal:

Section of No. 6 coal, Berry Brothers' mine, near Brimfield

	Thickness	
	Ft.	*in.*
Coal (top coal)	1	6
Pyrite	..	½
Coal	1	..
Clay band ("blue band")	..	2
Coal	1	..
Pyrite	..	½
Coal	1	..
	4	9

The best coal in the above section is the upper 30 inches. The two bands of pyrite noted are persistent throughout the workings.

Character of the coal: The general succession is indicated by the above generalized section. Clay slips or "horsebacks" are common and there is considerable "white top" present. The coal dips to the northeast about 1 per cent, and one small fault with 2½ feet displacement was noted.

Character of the roof: The normal roof is gray to black shale which falls with the coal, with a limestone cap-rock above. The small fossil Girtyina was identified in fragments of this rock, which establishes the identity of the coal.

Character of the floor: The floor is described as fire clay. No unusual characteristics were noted.

TAYLOR AND SONS' WAGON MINE AT PRINCEVILLE, NW. ¼, NW. ¼, SEC. 24, T. 11 N., R. 6 E.

Entrance: Shaft; depth to No. 6 coal about 75 feet.

Thickness of coal: Varies from 2 feet to 5 feet 2 inches; averages 4 feet 8 inches.

Sections of the coal:

Section of No. 6 coal in Taylor and Sons' local mine at Princeville
1st room off 1st west entry, 500 feet from shaft

		Thickness	
		Ft.	*in.*
1.	Coal	..	2½
2.	Parting	..	..
3.	Coal	..	10
4.	Clay parting	..	⅛
5.	Coal	..	¼
6.	Clay	..	⅛
7.	Coal	..	10
8.	Pyrite	..	¼
9.	Coal	..	4½
10.	Clay	..	¼
11.	Coal	..	6¾
12.	Clay ("blue band," called clay band)	..	2¼
13.	Pyrite	..	½
14.	Coal	..	7
15.	Clay (called "blue band")	..	½
16.	Coal	..	6
17.	Pyrite	..	½
18.	Coal	..	7
		4	10½

Character of the coal: Of the partings noted in the preceding section of the coal, numbers 4, 8, 12, 15 and 17 are persistent. As the section indicates, the coal is rather dirty because of the numerous bands of impurity. The coal between the bands, however, is clean.

Character of the roof: The immediate roof is a black to gray carbonaceous shale spoken of as "ramble." This is about 6 inches thick and above it is the limestone cap-rock. The shale falls with the withdrawal of the coal, leaving a firm hard limestone roof. No record is made of the presence of "white top" in this mine.

Character of the floor: An impure coal composed of a mixture of mother coal and shale commonly is present in the bottom of the bed to a thickness of 6 inches or less. Below this material fire clay is reported to be present.

WAGON MINE, LOCATED BETWEEN GLASFORD AND HANNA, SW. ¼ SE. ¼ NE. ¼, SEC. 34, T. 8 N., R. 6 E.

Entrance: Drift; No. 6 coal.

Thickness of coal: Average 3 feet 10 inches.

Section of coal:

Section of coal in local mine, north of Glasford

	Thickness	
	Ft.	*in.*
Limestone with many *Girtyina*.....3 feet to	4	..
Shale, gray .....4 inches to	..	8
Coal	2	..
Blue band.....1½ to 3 inches, average	..	1
Coal	..	3
Pyrite lenses .....up to	..	3
Coal	..	5
Clay band .....¼ inch to	..	½
Coal	..	9½
Fire clay	..	..
	3	10

NO. 5 COAL

No. 5 coal is the most valuable bed in the county. Its desirability rests upon its fairly widespread occurrence, its uniform thickness, the satisfactory mining conditions under which much of it can be worked, and the absence of impurities that can not be removed by careful mining. In places, however, conditions exist that render the cost of mining prohibitive of profit, or that affect the quality of the coal in such a way as to render it unmarketable. These conditions are local, however, being far from common enough to condemn the whole body of coal.

Conditions which affect the distribution of the coal have already been described at some length earlier in this bulletin, in the discussion of the strata between No. 5 and No. 7 coals. The attention of the reader who is especially interested in the irregularities in the distribu-

tion of the coal is therefore directed to the discussion on pages 161 to 163, and 165 to 175. It may be repeated here that uncertainties with respect to the distribution of the coal that are of significance in the development of new properties are of two sorts. One results from the lack of definite information with regard to the position and depth of lines of pre-glacial drainage, and the other from the undetermined extent and distribution of certain bodies of sandstone, which have been termed channel sandstones, and which lie across the position of No. 5 coal.

Udden states that the average thickness of No. 5 coal is 4 feet 4 inches for the Peoria quadrangle. This is probably a fairly accurate estimate for the entire county, although no figures are available concerning the thickness of this coal in the northern part where No. 6 rather than No. 5 coal is being mined at local banks. The coal shows a variation in thickness of not over 5 to 6 inches in each area where it is worked. In the places where it departs from the usual thickness, the bed more commonly tends to be thinner rather than thicker than the average. The more common variations in thickness, however, are apparent rather than real, being due to small faults accompanied by a slight displacement at the position of the clay slips or horsebacks. When the plane of movement is inclined, the result is to produce an apparent thinning of the bed when measured vertically across the fault plane (fig. 23). Such slight displacements at horsebacks are the most frequent cause of variations in thickness of the No. 5 coal.

The irregularities in No. 5 coal that are the most continual source of difficulty and expense are the horsebacks, both clay slips and "sulphur spars." The number of these differs considerably in different parts of the county, some mines encountering them in great numbers, whereas other mines find so few that they are of little consequence. The mines in Hollis and Limestone townships, except those west of Mapleton, seem to be more troubled by the horsebacks than those farther west at Glasford, Hanna, and Edwards.

The Peoria County horsebacks are similar to those described in Fulton County and to those that occur elsewhere in this district. At least for a short distance above the coal the coal bed and overlying strata have been fractured and in some instances offset along the fracture. The planes of fracture are generally nearly vertical and rarely if ever inclined more than 45 degrees. Opposite sides of the fractures, along which there has been no movement to offset the bed, are roughly parallel. The fractures themselves have been filled with clay, which apparently has been forced into them, or with vein pyrite

where they are very narrow. The upper layers of the coal next to the fractures that are clay filled have commonly been forced downward, and fragments of roof shale are found in the fissures below the top of the coal, indicating that the clay has been forced in from above. This relationship possibly does not always hold and possibly is of no great significance, for whether the clay originated below or above the coal it obviously is forced into the fissures in the coal as an adjustment of inequalities in pressure which probably are responsible for the fracturing.

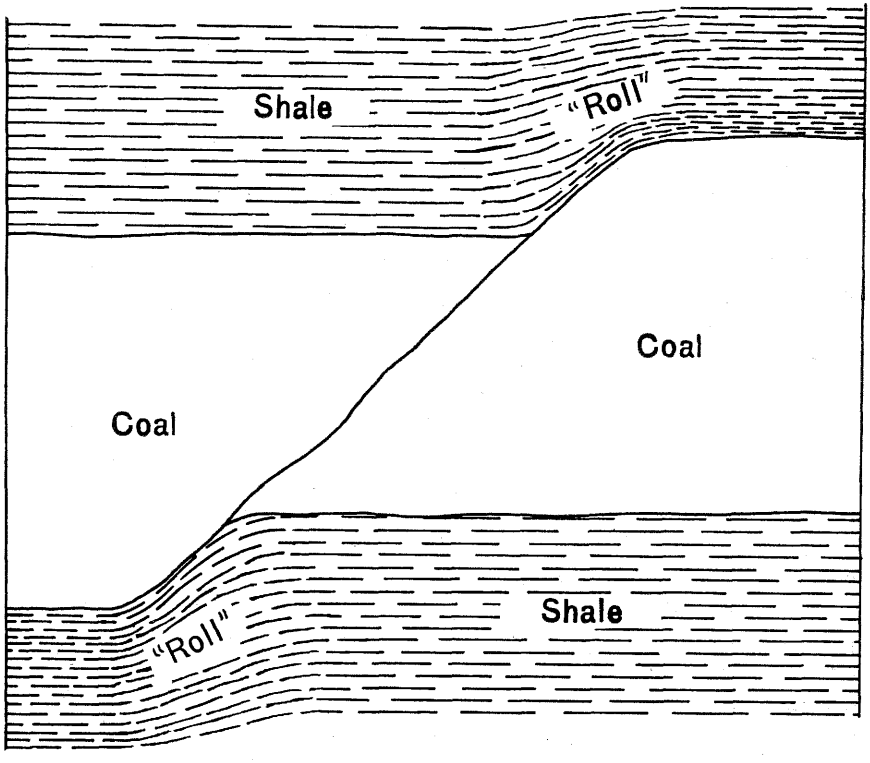


FIG. 23.—Diagrammatic sketch showing the manner in which faulting along a horseback will effect an apparent thinning of the coal bed.

Where these horsebacks are present, production of clean coal and the support of the roof near the fractures are difficult. The first difficulty is met by discarding all the coal affected by the horseback. The clay veins are generally rather heavily impregnated with pyrite which also fills many of the smaller cracks in the coal adjacent to the main fissure, so that the horseback and some attached coal on either side is usually removed in large pieces. The expense of removing the horse-

backs is indicated by the following agreement between the operators and miners of the Second Sub-District, dated April 1, 1918:

"Eighteen—That all horsebacks, rolls, or slips, marking the coal two to six inches average width in the center of such horseback, roll, or slip, whether coming from top or bottom, shall be $2.80, and 23 cents for each additional inch thereafter.

"When a slip, roll, or horseback continues with the working place more than the width of such working place, it shall be paid for at the same rate, as long as it continues with the said working place."

The coal removed and wasted by this method of handling the horsebacks amounts to a very considerable proportion of the coal mined in some operations.

The second difficulty noted above, that of supporting the roof near horsebacks, is a very serious one. If the cracks are numerous and rather wide, so that the cohesion of the cap-rock is weakened, the strata are almost impossible to hold. Horsebacks that run with an entry not

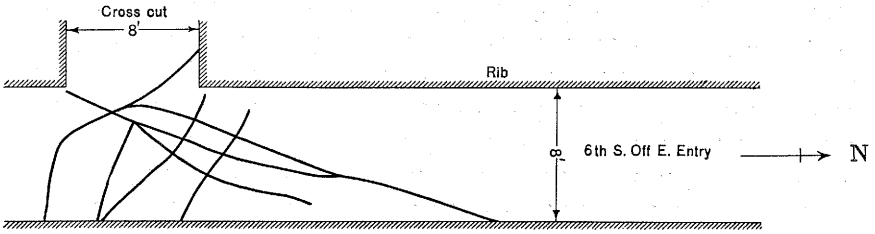


FIG. 24.—Sketch showing the cracks cutting the roof along the 6th southeast entry of the Leitner Coal Company's mine.

uncommonly cause "falls" their entire length of many feet. Such conditions of course make the expense of mining very high. There is apparently no systematic attempt in any of the mines to remedy the conditions. They are met as they arise and the success or failure of a mining enterprise depends largely upon the company's fortune in striking a good or bad piece of coal. Unfortunately drilling does not assist much in determining the frequency of the horsebacks. The prospector for new resources is dependent upon information gained at outcrops, in local banks, and in mines adjacent to the property under consideration.

The accompanying sketch (fig. 24) of the cracks cutting the roof along one entry of the Leitner Coal Company's mine will give some idea of the frequency of the horsebacks in some mines in the region.

The "sulphur spars" are nearly as expensive and possibly more troublesome to handle than the clay veins. The pyrite is true vein filling which not only occupies the space opened by the fissure but

ramifies the adjacent coal along small cracks and cleavage planes. The result is a mass of hard coal commonly extending as much as four inches either side of the main vein. This material is exceedingly hard to cut and is more objectionable to the miner than the clay veins, although the latter are larger.

"Sulphur" or pyrite other than that found in the sulphur spars is an impurity of varying importance. In some mines it is very common and its removal a matter of considerable difficulty. In other mines it is of small consequence. In general the sulphur is more common in those mines in which the coal bed is crossed by numerous horsebacks. The pyrite is principally of two kinds: the bright brassy variety commonly found near the roof or in the upper part of the coal; and the brown or gray pyrite lenses. The former is present in about the same amount in all the mines irrespective of the number of horsebacks present; the latter is distributed in greater abundance near horsebacks, and especially near the clay veins. The gray or brown sulphur occurs as lenticular masses with indistinct outline and grayish color, and apparently consists of interlaminated pyrite and carbonaceous material. Many of the gray pyrite lenses widen out toward a contiguous clay vein, attaining their greatest size at the contact. The lenses are not uncommonly 4 inches thick at the thickest part and extend laterally as much as 3 or 4 feet. This material is supposed to be rejected by the miner, a docking system being in force to encourage the loading of clean coal. The laminated pyrite seems to have an origin dependent in some manner upon the fissuring and therefore constitutes additional difficulty with which the mines having numerous horsebacks must contend. In themselves, however, they are not a very serious impurity, and do not greatly affect the value of the coal.

Some of the mines, in addition to the varieties of pyrite already described, have a streak or thin lens of pyrite from one-eighth to one inch thick and about half an inch above the bottom of the coal. This sulphur comes up with the bottom coal and is then broken off, together with more or less attached coal. Not uncommonly, likewise, the lens or mass of limestone lying between the coal and the "slate" and carrying many fossils is generally replaced to considerable extent by pyrite so that the fossils and texture of the rock are preserved in pyrite rather than limestone. The "niggerheads" in the black "slate" are also pyritized, though commonly only in a zone at the surface. In some of the mines south of Peoria a discontinuous layer of "brown" pyrite is present about midway in the bed.

The typical roof of No. 5 coal in this county as elsewhere is a

succession of black "slate" about 1 foot thick, above which is about 12 inches of gray clay or clod, and 8 to 12 inches of cap-rock. The thickness of the cap-rock may vary considerably from this figure, but as it usually stays up, its general thickness is not accurately determinable. Except where broken by fissures the roof is very satisfactory.

Over part of the coal is a massive, substantial sandstone roof. This roof is most commonly found near the "faults" or channel deposits that have been described. The coal is not essentially different under the sandstone from what it is under the shale. Under each variety of cover it has the usual horsebacks and other irregularities, the fissures continuing up into the roof whether it be sandstone or shale.

The floor is a fire clay of the usual character and gives no special difficulties.

MINE NOTES, NO. 5 COAL

The following observations are presented with the idea that they will throw light on conditions in local areas in the field.

LOGAN COAL COMPANY'S NO. 1 MINE AT HANNA CITY

Entrance: Shaft; about 236 feet to No. 5 coal.
Thickness: About 3 feet 4 inches.
Sections of the coal:[1]

Sections of coal bed in Hanna City mine

Section	A		B		C		D	
Laboratory No.	22982		22983		22984		22985	
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Roof, shale 2½ feet.....	..	..	..	..	..	..	..	..
Coal, bony	..	6*	..	..	..	..	..	6*
Coal, bright	1	6	1	0	3	3	1	0
"Sulphur" to "mother coal"	Streak		..	¼*	..	..	Streak	
Coal, hard	1	4	2	3¾	..	..	1	10
Floor, underclay	..	..	..	..	..	..	..	..
Thickness of bed.....	3	4	3	4	3	3	3	4
Thickness of coal sampled	2	10	3	3¾	3	3	2	10

*Not included in sample.

Character of the roof and floor: Roof is a hard gray shale about 2 feet 6 inches thick; the floor is underclay 3 to 5 feet thick.

Samples were collected at the places where the sections were made and analyzed by the U. S. Bureau of Mines,[2] and the results are reprinted as a part of Table 3 of this report.

CLARK COAL AND COKE COMPANY'S EMPIRE (NO. 2) MINE AT PEORIA

Entrance: Shaft; depth to No. 5 coal, 180 feet.
Thickness of coal: Varies from 3 to 4½ feet; average 4 feet.
Sections of the coal:

[1] U. S. Bureau of Mines Bull. 123, p. 179.
[2] U. S. Bureau of Mines Bull. 123, p. 35.

Empire Mine

Sections of No. 5 coal in the Clark Coal and Coke Company's

Section 1—First butt entry off 11th east entry

	Thickness	
	Ft.	*in.*
Coal	..	7½
Soot seam	..	..
Coal	..	11½
Soot seam	1	10
Coal	..	8½
	4	1½

Section 2—Face 13th entry off main south entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, clean	..	11
Mother coal parting	..	⅛
Coal, clean	..	3
Mother coal	..	⅛
Coal, fairly clean	2	¾
Floor: Fire clay	..	..
	3	3

Impurities: Pyrite in vertical streaks and a few horizontal streaks of mother coal.

Section 3—Room 3, 7th south entry off 11th west off straight south

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, fairly clean	3	5
Bone	..	⅜
Coal, clean	..	1¼
Bone	..	⅜
Coal, clean	..	5½
Floor: Shell coal and fire clay	..	..
	4	1

Impurities: Bone and mother coal in horizontal streaks; calcite in vertical streaks.

Section 4—Face, 3d north entry off 1st west off straight south

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, clean, bright	1	1¾
Mother coal	..	¼
Coal, fairly clean, slightly streaked	..	11½
"Sulphur"	..	½
Coal, fairly clean	1	½
Bone, lens	..	½
Coal, fairly clean	..	11
Floor: Fire clay	..	..
	4	2

Impurities: Calcite in joint cracks; pyrite in vertical streaks; mother coal and pyrite in horizontal streaks.

Character of the coal: The coal is described by the observer who measured section No. 1 as tough, hard to break, and uniform in quality throughout with no definite line of impurity. Occasional sulphur balls and the clay slips characteristic of No. 5 are present, but not common.

Character of the roof: Above the coal is 2 inches of "draw slate" followed by 1 to 2 feet of dark "slate," in places containing a limestone band or cap-rock up to 18 inches in thickness. Sandstone overlies the black shale and where the shale is thin it always falls. Niggerheads are common in the roof shale.

CRESCENT COAL COMPANY'S NO. 1 MINE ABOUT 3 MILES NORTH OF BARTONVILLE

Entrance: Shaft; 195 feet to the top of No. 5 coal.
Thickness of coal: Average thickness 4 feet 2 inches.[1]
Sections of the coal:

Sections of No. 5 coal in the mine of the Crescent Coal Company

Section 1—Face of the 5th southeast entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, fairly clean	..	10
Mother coal and dirt	..	¼
Coal, dirty	3	6
Floor: Dark gray shale	..	..
	4	4¼

Impurities: Coal contains pyrite, mother coal and dirt in horizontal streaks with calcite in the joint cracks.

Section 2—Face off room 22, off 6th north entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, fairly clean	1	10½
Pyrite parting	..	⅛
Coal, fairly clean	1	2
Mother coal, soft	..	⅜
Coal, dirty	1	..
Floor: Dark gray shale	..	..
	4	1

[1]Thirty-sixth Annual Coal Report of Illinois: Department of Mines and Minerals, 1917, p. 84.

Section 3—Face of 10th south, off west entry

	Thickness Ft.	in.
Roof: Black shale	..	..
Coal, clean	..	10½
Mother coal	..	⅛
Coal, dirty, dull	1	2
Mother coal	..	⅜
Coal, dirty, dull	1	2
Mother coal	..	⅜
Coal, fairly clean	2	1
Floor: Dark gray shale	..	..
	4	2

Impurities: Pyrite, mother coal and dirt in horizontal streaks; pyrite in vertical streaks.

COLLIER CO-OPERATIVE COAL COMPANY'S NO. 1 MINE, AT BARTONVILLE

Entrance: Slope; 110 feet to floor of mine.

Thickness of coal: Varies from 4 to 4½ feet; averages 4 feet 3 inches.

Sections of the coal:

Sections of No. 5 coal in mine of Collier Co-operative Coal Company

Section 1—Room 45 off 10th entry off main north; 3,300 feet southeast of shaft

	Thickness Ft.	in.
Roof: Black shale	..	18
Coal, clean	4	1
Floor: Fire clay	1	8
	7	3

Section 2[1]*—At face of 6th north entry off main west entry*

	Thickness Ft.	in.
Roof: Dark shale	..	..
Coal, conchoidal fracture	..	5
Coal, rough fracture	3	7
Coal and "sulphur"	..	1*
Floor: Brittle clay	..	..
	4	1

Section 3[1]*—At face of room 1, 4th north entry in by 3d north parting*

	Thickness Ft.	in.
Roof: Dark shale	..	..
Coal, conchoidal fracture	..	7
Coal, rough fracture	1	1
Coal and "sulphur"	..	¼*
Coal	2	6¾
Floor: Brittle clay	..	..
	4	3

*Not included in sample.

[1]See footnote 1, page 195 opposite.

Section 4[1]—At face of 5th north entry off main west entry

	Thickness Ft.	in.
Roof: Dark shale	..	..
Coal, conchoidal fracture	..	6
Coal, rough fracture	3	7
Coal and "sulphur"	..	½
Floor: Brittle clay	..	..
	4	1½

Character of the coal: The bed is reported to be fairly uniform with few horsebacks and no rolls or faults.

Character of the roof and floor: The roof is dark shale about 10 feet thick, above which is a limestone cap-rock, having an irregular surface. The floor is a brittle underclay.

The analyses are of samples collected where the sections Nos. 2, 3, and 4 were measured by the U. S. Bureau of Mines.[2]

M. E. CASE COAL COMPANY'S NO. 1 (WALBEN) MINE, SOUTH OF PEORIA

Entrance: Drift; about 16 feet to the top of No. 5 coal.

Thickness of coal: Averages 4 feet 7 inches. The coal thickens greatly near the sandstone "fault," but elsewhere its thickness is very uniform.

Sections of the coal:

Sections of No. 5 coal in Walben mine of the M. E. Case Coal Company

Section 1—Room 43, 7th south off 6th west

	Thickness Ft.	in
Roof: Sandstone	..	..
Coal	1	8¾
Clay and pyrite	..	½
Coal	..	6½
Clay and pyrite interlaminated	..	¼
Coal	2	..
Floor: Fire clay	..	..
	4	4

Section 2—End of 7th south off 6th west

	Thickness Ft.	in
Roof: Black slate	..	..
Coal	1	9
Pyrite and clay intimately laminated	..	½
Coal with some streaks of clayey mother coal	2	½
	3	10

[1]Fieldner, A. C., Smith, H. I., et al, Analyses of mine and car samples of coal collected in the fiscal years 1913 to 1916: U. S. Bureau of Mines Bull. 123, pp. 178, 179, 1918.

[2]U. S. Bureau of Mines Bull. 123, p. 35.

Character of the coal: The coal is uniform in its general characteristics. The bed commonly carries a layer of intimately interlaminated pyrite and carbonaceous clay known as brown "sulphur" about 2 feet below the top, but this impurity is not persistent. Horsebacks are common and are of some special interest because the breaks generally continue up into the sandstone which lies upon or a short distance above the coal. In the 3d west entry off the 4th south, the sandstone at one place showed an open crevice above a horseback out of which the gage has fallen for a height of 15 to 20 feet. Clay shale shows in the top of the crack. It was not clear whether the clay was a continuation of the filling or a shale bed above the sandstone. The crack looked like a crack that had been produced or at least widened by weathering, the sides being rounded, or smoothed rather than clean and sharp. There was essentially no offset of any of the beds.

Below the horseback the clay floor is commonly raised in a ridge suggesting that probably there was some movement of the floor clay into the crack when it opened. The character of the lower clay is quite dif-

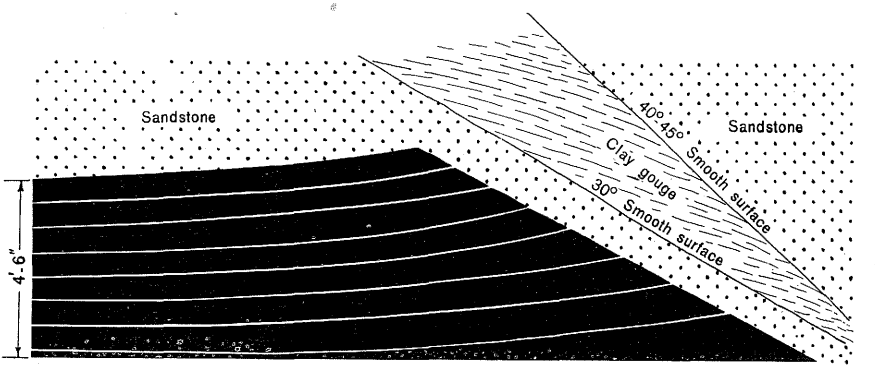


FIG. 25.—Sketch of the contact of coal and "fault" in the 6th west off main north entry of the M. E. Case Coal Company's No. 1 (Walben) mine

ferent from that filling the larger part of the fissure, this material apparently coming from some strata above the coal. These rolls in the floor clay are taken up by the miner, for which extra pay is given.

The operation of this mine is limited on the west by a sandstone "fault" which cuts out the coal (fig. 22). The sandstone apparently occupies a channel which penetrates the coal bed. The rock is a gray micaceous sandstone of about the same character as that forming the roof of much of the mine. At some places the coal feathers out under the sandstone and at others it terminates very abruptly against the sandstone. The nature of the contact at one place along the "fault" is shown by the accompanying sketch (fig. 25).

Character of the roof: The immediate roof varies from the usual succession of black "slate," clod and cap-rock to merely sandstone. The sandstone apparently lies irregularly upon the underlying strata, in places resting directly upon the coal and in other places separated from the coal by a greater or less thickness of the typical roof.

Character of the floor: The underclay, about 18 inches thick, is underlain by an "iron band" 10 inches thick. The clay heaves somewhat in wet places, and the clay tends to "roll" up in the floor beneath the horseback fissures, rising nearly 12 inches in some cases.

LEITNER COAL COMPANY'S NO. 1 MINE, NORTHEAST OF ORCHARD MINES

Entrance: Drift mine; No. 5 coal.

Thickness of coal: Varies from about 4 feet to 6 feet; averages 4½ feet. The coal thickens markedly near its contact with the sandstone "fault" (fig. 15); elsewhere it is practically uniform in thickness.

Sections of the coal:

Sections of No. 5 coal in the Leitner Coal Company's mine

Section 1—6th south entry

	Thickness	
	Ft.	*in.*
Roof: Black slate	..	..
Coal, laminated, and with thin streaks of mother coal	1	7½
Pyrite; mixture of clay, organic matter and pyrite. Called "brown sulphur" by miners	..	3
Coal, like top coal	2	10½
Pyrite or clay, hard	..	½
Coal	..	½
Floor: Fire clay	..	..
	4	10

Section 2—5th south entry.

	Thickness	
	Ft.	*in.*
Roof: Black slate with coal stringers	..	..
Coal	..	11½
Pyrite and clay	..	2
Coal	1	½
Pyrite and clay	..	2
Coal	2	11
Pyrite streak in bottom	..	..
Floor: Fire clay	..	..
	5	3

Section 3—Face main west entry

	Thickness	
	Ft.	*in.*
Coal	1	4
Pyrite and clay	..	2½
Coal	2	6
	4	½

Section 4—Room 12, back west entry

	Thickness	
	Ft.	*in.*
Roof: "Slate"	..	..
Coal	1	1
Pyrite band	..	1½
Coal	..	11½
Pyrite and clay	..	2
Coal	2	..
Floor: Fire clay	..	..
	4	4

Character of the coal: The bed contains a fairly continuous band of "brown sulphur" about 18 inches to 2 feet from the top. Not uncommonly two such bands are present.

The horsebacks in this mine are very numerous. The mine map shows that the "fault" is encountered on the west side, trending about northeast-southwest from the S. W. cor. sec. 2, Hollis Township (T. 7 N., R. 7 E.). The same or another body of sandstone is also present at the usual horizon of the coal in section 11.

Character of the roof: The ordinary roof consisting of black shale, clod, and cap-rock is present except where the sandstone has cut down to the coal. The parting between the coal and the shale roof is poor and commonly the lower 4 to 6 inches of the roof comes down with the coal. It is rather difficult to separate the shale from the coal, so that the waste material thrown into the gob contains considerable coal.

MAPLETON COAL COMPANY'S NO. 1 MINE, AT MAPLETON

Entrance: Slope; No. 5 coal.

Thickness of coal: Uniform; varies between about 4 feet 4 inches and about 4 feet 10 inches; averages 4 feet 6 inches.

Section of the coal:

Section of No. 5 coal in the mine of the Mapleton Coal Company
Measured in a room off the main west back entry

	Thickness	
	Ft.	*in.*
Coal with streak of pyrite in upper inch	2	6
Coal, dirty	..	1/16
Coal	1	2 11/16
Mother coal	..	¼
Coal	1	..
	4	9

Character of the coal: The coal is very uniform and clean. About the only impurities are a few "horsebacks" and a few discontinuous clay and mother-coal bands 1/16 of an inch thick or less. Because of the great regularity of the coal, no special description of the seam is necessary.

Character of the roof: The roof is constant in character. The succession consists of the usual black "slate," clod, and cap-rock. The first is 12 to 14 inches thick, the second 14 to 16 inches, and the last 2 to 6

inches, lying from 24 to 30 inches above the coal. Above the cap-rock is gray shale. Although in places the cap-rock is rather soft and shaly, generally it forms a solid roof. The black shale or "slate" roof carries a few niggerheads lying in the "slate" and coal.

Character of the floor: The floor is fire clay; it heaves some where damp and rolls up under horsebacks.

EAST MAPLETON COAL COMPANY'S "EAST" MINE, AT MAPLETON

Entrance: Drift; No. 5 coal.

Thickness of coal: Varies from 4 feet 6 inches to 5 feet 8 inches; averages 5 feet.

Character of coal: The coal is very irregular due to horsebacks and persistent pyrite bands. The coal runs nearly 12 inches thicker than in other mines and the irregularities in thickness are greater. The horsebacks, commonly 2 to 3 feet through, are present almost constantly in the face. The cracks running up into the roof cut it up like a mosaic. The floor below is offset along lines matching the cracks in the roof, giving a relief of 8 to 12 inches.

The sulphur bands consist largely of the "brown" laminated pyrite. An almost continuous streak, generally 1½-inch thick and in places 6 to 9 inches lies about 24 inches from the top. These impurities and irregularities make mining very expensive, as it is probable that about half the material taken out of the mine is rock waste.

The sandstone "fault" of the region is reported to lie a short distance north of the present workings of the mine.

NEWSAM BROTHERS' NO. 4 MINE, AT GLASFORD

Entrance: Shaft; 148 feet to the top of No. 5 coal.

Thickness of coal: Practically uniform; varies from 4 feet 4 inches to 4 feet 6 inches.

Character of the coal: The coal lies in a single bench with few irregularities. Horsebacks though present are not especially numerous. Some pyrite is encountered in streaks, balls, and lenses. Pyrite lenses averaging about 1 inch thick by 6 to 7 inches across are especially common near the horsebacks. They begin to appear 6 to 8 feet back from the fissure. Some of the horsebacks have a large per cent of pyrite in them and are very hard to mine.

Character of the roof: The roof consists of 6 to 14 inches of black "slate," 6 to 8 inches of clod, and 8 to 10 inches of limestone cap-rock. The parting between the coal and black shale is poor, due to the presence of pyrite balls and lenses at this position. The pyrite tends to bind the coal to the "slate" so that either the upper few inches of coal is left in the roof or else the lower part of the shale comes down with the coal. In the latter case the shale with 3 or 4 inches of attached coal is usually thrown into the gob.

Character of the floor: Fire clay, which is reported to heave when wet, forms the floor.

NO. 2 COAL

The coal which has been reopened during the last year in the mine at Pottstown, and the coal formerly mined by the Third Vein Coal

Company at Orchard Mines, and which is encountered in several drill holes in the county 117 to 140 feet below No. 5 coal, is believed to be the No. 2 bed.

The thickness of the coal averages about 2½ feet, or about two-thirds the thickness of No. 5 in this region and about 1 foot thinner than No. 2 coal in the La Salle and Spring Valley region. Here as elsewhere the coal is apparently regular in thickness, and uniform in character over large areas. Impurities that could seriously affect the value of the coal are lacking. The brassy nodules of pyrite typical of this coal are present, but because their contact with the coal is sharp and clean, they can be readily removed at the face. The pyrite impregnates the surrounding coal little if any, in contrast with the many pyrites lenses in other coals, and it is therefore generally unnecessary to discard much coal with the sulphur balls.

Roof conditions are normal for No. 2 coal. The "soapstone" or gray shale and black "slate" found in succession above the coal in the Longwall District[1] seems to be very widespread. The succession in this field seems to be the same as that in the northern district. The gray shale or "soapstone" is 9 to 12 feet thick on the average, which is a few feet thinner than at La Salle, and the black "slate" is about 2 feet thick. The "slate" carries large niggerheads or limestone concretions as in other regions. Above the black shale is a limestone about 2 feet in thickness. In places the black shale comes down on the coal cutting out the soapstone.

This coal is always mined by the longwall system, and except for the fact that the coal is thin, conditions are favorable for mining. There is little question but that eventually this bed will be extensively mined in this region, though probably not until the best areas of No. 5 coal are exhausted.

The chemical character of No. 2 coal is discussed briefly in Part I and an analysis of the bed is included in Table 3.

MINE NOTES, NO. 2 COAL

The following notes are based upon observations in two mines operating in No. 2 coal. Of these the Third Vein Coal Company has not been in operation for several years, the observations having been made in 1908.

THIRD VEIN COAL COMPANY'S ABANDONED MINE IN NW. ¼ SEC. 14, T. 7 N., R. 7 E.

Entrance: Shaft; 162 feet to the top of No. 2 coal.

Thickness of coal: Varies from 2½ to 3½ feet; averages about 2 feet 11 inches.

[1]Illinois Coal Mining Investigations Bull. 10, 1915.

Section of the coal: The coal was measured southwest of the shaft in room No. 5 off the first straight south (?) entry. The coal was 32 inches thick, with gray shale roof and fire-clay floor.

Character of the coal: The coal contained one sulphur lens which in the face measured 1 by 6 inches. Such lenses were reported to be rare and to occur at any place in the bed. The coal is described as "long grain."

Character of the roof: The shale or "soapstone" is a slabby dark-gray shale with small lenses of light-gray, sandy shale 1 inch thick. The gray shale is generally 8 to 12 feet thick, but is absent in places, the black "slate" resting on the coal. The "soapstone" is slabby, dark gray, and contains small 1-inch thick lenses of light-gray sandy shale. The black "slate" above is thin, shelly, hard, and brittle, with half-inch lumps on the bedding planes, and is reported to be about 10 feet thick. It contains niggerheads commonly as large as 12 by 6 by 24 inches.

Character of the floor: The floor is fire clay which is at least 6 feet thick. At one place it has been drilled into to a depth of 12 feet.

JOHN A. HOFFMAN'S "BLUE FLY" (WANTLING) MINE, AT POTTSTOWN

Entrance: Shaft; 107 feet to the top of No. 2 coal.

Thickness of coal: Varies from 2 feet 4 inches to 2 feet 8 inches; averages 2½ feet.

Sections of the coal:

SECTIONS OF NO. 2 COAL IN THE "BLUE FLY" MINE, AT POTTSTOWN

Section 1

	Thickness Ft.	in.
Roof: Gray shale or "soapstone" containing small lime and pyrite concretions, 9 feet or more	..	..
Coal, clean	1	9 7/16
Pyrite streak	..	1/16
Coal	..	3
Clay band	..	½
Coal	..	4
Floor: Fire clay	..	..
	2	5

Section 2—50 feet south of shaft

	Thickness Ft.	in.
Roof: Gray shale	..	..
Coal, containing one sulphur ball 4 inches thick	2	6
Floor: Fire clay	..	..
	2	6

Section 3—End of southwest entry

	Thickness Ft.	in.
Roof: Gray shale	..	..
Coal	2	6
Floor: Fire clay	..	..
	2	6

Character of the coal: The seam is practically uniform throughout the mine. The few partings are not persistent, but sulphur lenses and balls occur at various positions. Many seem to be pyritized parts of plants. These average in size about ¼ by 8 to 10 inches; some are as large as 4 by 12 to 14 inches. The amount of pyrite present is estimated to be between 1 and 2 per cent by weight of the coal.

The coal is rather hard and bright. Some cleat is developed, the fracture being north and south, and at right angles. Vertical sheets of pyrite are present but are not persistent in some of the joint cracks.

Character of the roof: The roof rock is typical "soapstone" about 9 feet thick. Above this is 2 feet of black "slate" which is capped in turn by a 2-foot limestone.

Character of the floor: The floor clay is a gray, even-textured clay which is reported to be 3 to 4 feet thick. Its character is not well known. It probably will heave if wet.

NO. 1 COAL

No. 1 coal has been worked in the mine at Pottstown at a depth of 240 feet, 133 feet below No. 2 coal. Udden[1] states that the lower bed consists of a lower bench varying in thicknes from 2 feet 2 inches to 3 feet, a parting of shale less than 3 feet thick, and an upper bench, 1 foot 2 inches to 1 foot 4 inches thick. Where the parting between the two benches was not too heavy, both were mined. The coal is of fairly good quality, but the mining was too expensive for the market at the time, and operations ceased more than ten years ago.

In general it is believed that this seam of coal is probably too thin to be of commercial importance for many years. It is possible, however, that there is beneath it a clay of commercial value, which if mined with the coal could be profitably extracted. Unfortunately, information in regard to the quality of the clay is not definite. Clays of commercial importance, however, are known to underlie the horizon of No. 1 coal in other parts of the State, especially in the counties west and south of Peoria County, so that exploration might be rewarded by discovery of similar clays in this county.

[1] U. S. Geological Survey Bull. 506, p. 80.

SANGAMON COUNTY

Production and Mines

Production in tons from No. 5 and No. 6 coals, year ending June 30, 1920	6,844,049
Production in tons from No. 5 coal, year ending June 30, 1920	4,485,434
Average production from No. 5 and No. 6 coals, 1916-1920, inclusive	6,696,458
Average production from No. 5 coal, 1916-1920, inclusive	4,564,363
Total production, from No. 5 and No. 6 coals, 1881-1920	129,054,297
Total production from No. 5 coal, 1881-1920	85,000,000±

The total production of coal from Sangamon County for the year ending June 30, 1920, was a little more than 9 per cent of the State's entire output. The production of No. 5 coal in the county was about two-thirds of the combined production from No. 5 and No. 6 coal. Six shipping mines in the southern part of the county report a production of 2,358,615 tons of No. 6 coal; and 22 shipping and 4 wagon mines in the northern part of the county produced 4,485,434 tons of No. 5 coal. Sangamon County as a whole ranked fourth among the counties of the State. The shipping mines in operation in 1920 are listed in Table 6.

Coal Bearing Rocks

Information concerning the geological succession of the northern part of Sangamon, where No. 5 is the important coal mined, is contained in a report on the Springfield quadrangle by T. E. Savage[1], and in an earlier report on the geology and mineral resources of the Tallula and Springfield quadrangles by E. W. Shaw and T. E. Savage.[2]

These two publications will be largely drawn upon in describing the coal-bearing rocks and the character of the coals.

The record of a deep hole is included in Part I and used in Plate II.

The following extract from State Geological Survey Bulletin 20 describes particularly the rocks underlying the Springfield quadrangle but applies generally to all that part of the county covered by this report.

1Savage, T. E., The Geology and mineral resources of the Springfield quadrangle: Illinois State Geological Survey Bull. 20 pp. 97-130, 1915.

2Shaw, E. W., and Savage, T. E., U. S. Geological Survey Geol. Atlas: Tullula-Springfield folio (No. 188) 1913.

KINDS OF ROCK IN THE AREA

"The rocks of the Springfield quadrangle consist of: (1) surficial materials, composed of unconsolidated beds of glacial till or drift, loess, sand, and alluvium which have been derived from the breaking down of pre-existing rocks; and (2) sedimentary rocks, which underlie the surficial materials and consist of more or less consolidated beds of sandstone, shale, limestone, and seams of coal, arranged in nearly horizontal layers.

SURFICIAL MATERIALS

"The surficial materials in this area comprise glacial, aeolian, and fluvial deposits, which cover the sedimentary rocks to an average depth of about 35 feet. They are thinnest over the areas that formed the highlands in the pre-glacial time and are thickest above the valleys of the early Pleistocene streams. Sangamon River follows such an old valley along its northward course near the west side of the quadrangle. Over this valley a well in the NW. ¼ sec. 23, T. 18 N., R. 6 W. was put down 170 feet without reaching the bottom of the surficial materials. The altitude of the bottom of this drilling was 125 feet lower than the surface of the consolidated rocks two miles farther east.

INDURATED ROCKS

GENERAL DESCRIPTION

"The hard rocks of this region have been studied in natural exposures through a thickness of 225 feet. By means of test borings for coal and oil they have been explored to a depth of 1,500 feet. Columnar sections of the logs of representative coal shafts and test borings are given in Plate VII. These show in detail the character and sequence of the strata that underlie the surface materials as far as they have been explored in this region. All the information concerning the rocks underlying the Pennsylvanian strata in this area is obtained from a drilling near Springfield, a log of which is shown in section 1, Plate VII. The succession and geological position of these rocks are also shown in the following generalized section.

Generalized section of hard rocks known in the Springfield quadrangle

	Thickness *Feet*
Pennsylvanian system—	
McLeansboro formation—including all of the Pennsylvanian strata above the top of No. 6 coal, and composed of shales, sandstones, some impure limestones, and thin coals.....	46–225
Carbondale formation—embracing all of the strata between the base of No. 2 coal and the top of No. 6 coal; and consisting of shales, sandstones, limestone, and productive coal beds; about	243
Pottsville formation—comprising the strata between the bottom of the Pennsylvanian and the base of No. 2 coal, and composed mostly of sandstones in the lower and shales in the upper part, with interbedded thin coals; about.....	278
Mississippian system—	
Salem and St. Louis formations—predominantly limestones with some shales; about.....	215
Keokuk and Warsaw formations—dominantly shales with some limestones; about	164
Burlington formation—cherty limestones and chert; about....	106
Kinderhook formation—greenish to bluish-gray shale, limestone and red shaly limestone; about.....	155
Devonian system—	
Upper Devonian series—dark shale with spores of *Sporangites* abundant; about	133
Middle Devonian series (Hamilton of Iowa or Northwest province)—gray limestone; to bottom of boring.....	28+

POTTSVILLE FORMATION

"Pottsville strata comprising the base of the Pennsylvanian system have been explored in three deep borings. They consist of coarse, gray sandstone and some conglomerate in the lower part, and shales or sandy shales predominating in the middle and upper portions. A thin coal bed lies 140 feet from the base and a somewhat thicker coal about 100 feet above the former and 33 feet below the bottom of No. 2 coal.

CARBONDALE FORMATION

"It has seemed desirable by the Survey to use the name Carbondale as a substitute for, and to make it embrace all the strata that were included in, both the Petersburg and the La Salle formations as described in a previous report.[1] This is the important coal-bearing formation in the State. Its basal member, No. 2 coal, consists usually of two thin beds separated by about 4 feet of dark shale. Above this coal

[1]De Wolf, F. W., Introduction to studies of Illinois coal: Illinois State Geological Survey Bulletin 16, p. 180, 1910.

is a shale which is followed by sandstone, and that succeeded by dark-colored shale up to an 18-inch coal bed, about 80 feet above coal No. 2. Between this coal and the next higher coal bed is an interval of about 55 feet, occupied almost exclusively by dark shale. Above this coal gray or blue to black shales extend to coal No. 5 which lies about 54 feet above the next lower coal.

"No. 5 (Springfield) coal is the important coal seam in this region and has an average thickness of about 6 feet. It contains numerous

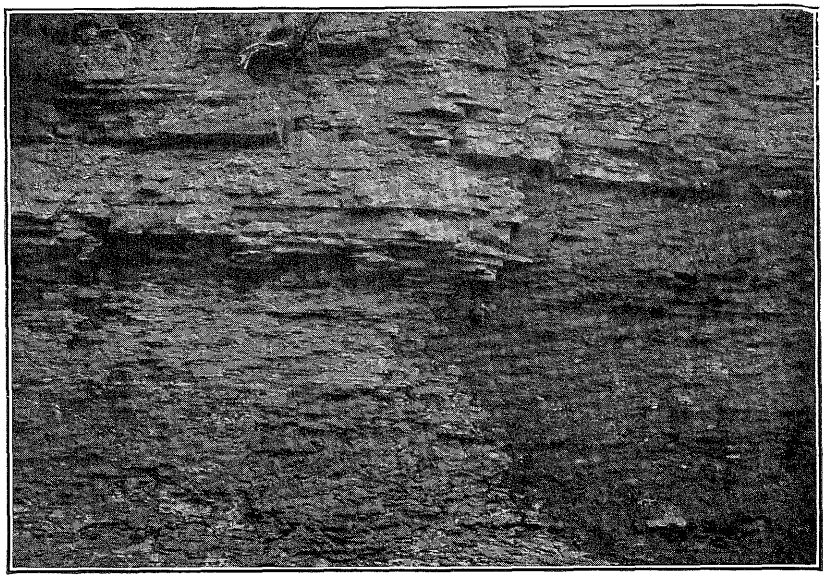


FIG. 26.—Photograph of a shale bed a short distance above No. 7 coal, exposed in the south bank of Spring Creek, NE. ¼ sec. 25, T. 16 N., R. 6 W.

characteristic clay seams or 'horsebacks' which extend down into it, or through it, in a more or less vertical direction. The roof of this coal consists of 3 to 5 feet of black, laminated, fissile shale bearing numerous shells of *Orbiculoidea missouriensis* and other fossils, and containing in the lower part numerous rounded nodules ('nigger-heads') of calcareous pyritic shale. A limestone cap rock, generally about 12 inches thick, overlies the black shale, and is followed by 1 to 4 feet of light-colored shale. No. 6 coal lies about 50 feet above No. 5 coal and, with the exception of No. 5 cap rock, the strata lying between these coals are mostly shale.

"Within the quadrangle No. 6 coal is only 2 to 14 inches thick, but it becomes thicker and has been mined at Mechanicsburg to the east and at Chatham to the south, only a short distance from the borders of this area.

MCLEANSBORO FORMATION

"The roof shale of No. 6 coal, the basal member of the McLeansboro formation, is 3 to 5 feet thick. It is followed by about 6 feet of limestone which contains *Fusulina ventricosa* as the characteristic fossil. A thin coal (No. 7) 3 to 4 inches thick, occurs about 45 feet above the No. 6 bed. Between these coals are several feet of red, mottled shales which are exposed at Ralls Ford on Sangamon River, and con-

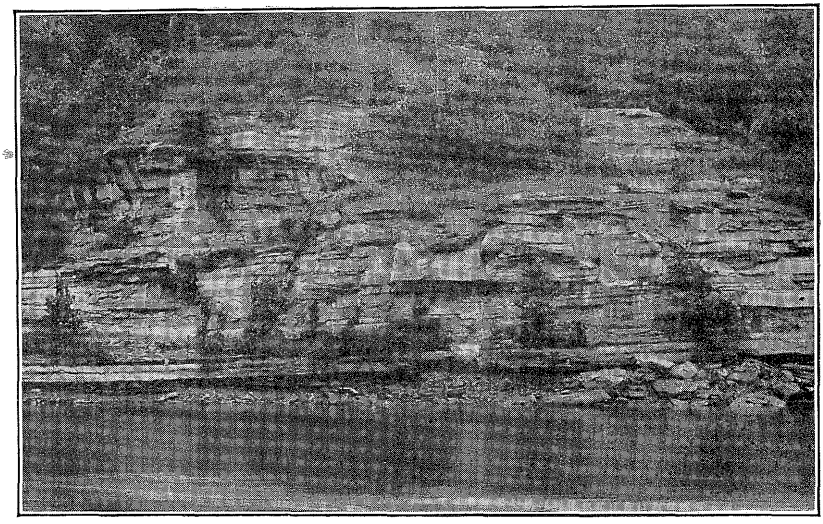


FIG. 27.—View of sandstone below No. 8 coal, exposed in the north bank of Sangamon River at Carpenter's bridge, NW. ¼ sec. 1, T. 16 N., R. 5 W.

stitute a very characteristic and easily recognized horizon throughout this region. The shale may, for convenience, be called the Ralls Ford shale member. Above No. 7 coal there follows a bed of bluish-gray shale with occasional sandy layers about 45 feet thick, exposed in the south bank of Spring Creek in the NE.¼ sec. 25, T. 16 N., R. 6 W., and shown in figure 26.

"Over a very limited area near the extreme northwest corner of the quadrangle there outcrops along Indian Creek about 6 feet of hard, gray, partly brecciated limestone which is better exposed in the banks of Rock Creek a few miles west of Athens. This limestone is thought to correspond with the Lonsdale quarry limestone in the Peoria quad-

rangle. Over the greater portion of the Springfield area this limestone is wanting, but its place appears to be at the top of the shale bed above No. 7 coal.

"Above this shale are 30 or more feet of sandstone exposed in the north bank of Sangamon River at Carpenter's bridge, NW. ¼ sec. 1, T. 16 N., R. 5 W. (see figure 27). A few feet of shale separates this sandstone from No. 8 coal and associated beds.

"No. 8 coal, the underclay below, and the roof shale and cap rock above, comprise a succession of strata that are easily recognized in the logs of mine shafts and test borings in the central and eastern portions of the area. They outcrop in the west bank of Sugar Creek, sec. 13, T. 15 N., R 5 W.; in the south bank of the Sangamon River, sec. 6, T. 16 N., R. 4 W.; and in the east bank of Fancy Creek, sec. 13, T. N., R. 4 W.

"Above the limestone overlying No. 8 coal is 40 or 50 feet of shale exposed in the shale pit of the Springfield Paving Brick Co. near Springfield. This is followed by about 35 feet of sandstone which outcrops along Sangamon River near the middle of sec. 4, T. 15 N., R. 4 W., and in the south half of sec. 27, T. 16 N., R. 4 W.

"Belonging a few feet above this sandstone is the Crow's Mill limestone, exposed in the old quarry near Crow's Mill along Sugar Creek about 3 miles south of the quadrangle. This is a hard limestone, bearing large shells of *Productus, Spirifer,* and *Composita.* It occurs in heavy layers, large masses of which, more or less shifted by the ice sheets of the glacial period, are present in the area under discussion." [1]

Structure

The structure of that part of Sangamon County which is included within the Tallula and Springfield quadrangles has been determined with as great detail as possible and the lay of the rocks as determined by the altitude of No. 5 coal is shown by maps in the U. S. Geological Folio 188.[2]

The structure map of the county, Plate VIII, is relatively detailed for the area included within the Tallula and Springfield quadrangles; but the structure for the part of the county east of the quadrangles is based on very scattered data and estimated elevations, and accordingly is shown by dashed contour lines.

The following statement from the Tallula-Springfield folio summarizes the structure in that area. The description includes the adjacent southeast portion of Menard County.

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[1]Savage, T. E., The geology and mineral resources of the Springfield quadrangle: Illinois State Geological Survey Bull. 20, pp. 102-107, 1915.

[2]Shaw, E. W., and Savage, T. E., Geological Survey Geol. Atlas: Tallula-Springfield Folio (No. 188), 1913.

STRUCTURE OF THE TALLULA AND SPRINGFIELD QUADRANGLES

"As a rule the strata of the Tallula and Springfield quadrangles dip somewhat south of east at the rate of about 10 feet to the mile, but this general dip is modified by low folds and minor irregularities, most of which are too-ill defined to be described separately but which are shown on the maps by contours drawn at intervals of 25 feet on the base of the Springfield coal. These irregularities are the product of irregularities in the surface upon which each layer was deposited and of differential settling and warping since deposition. The prevalent eastward dip is, in part at least, the result of deformation. It carries the base of the Carbondale formation from a position about 200 feet below the surface at the western side of the area to one nearly 600 feet below the surface on the eastern side. This general dip is modified by a syncline just east of Tallula, by an anticline extending southwestward from Springfield, and by many minor irregularities. The syncline east of Tallula is steeper on its west side, as might be expected on account of the prevailing eastward dip. In the mine of the Tallula Coal Co. the dip is so steep that the mine cars on an eastward trip must be 'spragged' or otherwise held in check. However, even where steepest, the dip dos not exceed 60 feet to the mile. In the northeastern part of the area the predominant dip is eastward and is about 10 feet to the mile. In the southern part the general dip is southeastward but is modified by a syncline and anticline which enter the area near the middle of the southern side. The anticline extends northeastward as far as Springfield, whence it curves to the southeast, passing near the village of Keys. West of Springfield the strata in the flanks of the arch dip 15 feet to the mile, but east of Springfield they be- progressively flatter on both sides of the axis, for the anticline plunges southeastward in conformity to the general dip.

"In some areas the Springfield coal is almost level throughout several square miles; in others it dips more than 20 feet to the mile. In some places its dip differs from the general slope or is even opposite to it. In most of the mines, however, it has almost no perceptible dip, and throughout a considerable area between Pleasant Plains and Salisbury the coal bed and the other strata seem to lie practically horizontal. In the southeast quarter of the Tallula quadrangle the beds so far as is known dip regularly southeastward at the rate of about 15 feet to the mile, but in that district few borings have reached the coal and some of the structural features may have not yet been brought to light. Indeed, throughout a considerable part of this quadrangle no borings have reached recognizable strata, and the structure map therefore lacks many details which can be shown when the coal has been

worked more extensively, but the mine shafts and borings already sunk are rather uniformly distributed, so that the major structural features as shown are believed to be approximately correct." [1]

Coals

COALS BELOW NO. 5

"A fairly persistent coal bed about 2½ feet thick lies about 58 feet below No. 5 coal. Another bed, which seems persistent, occurs about 120 feet below No. 5 coal, and averages about 2 feet in thickness. Two other coal beds which are locally present, aggregating about 3 feet in thickness and separated by a few feet of shale, lie at a depth of about 191 feet below No. 5 coal. In the Riverton section a 32-inch coal was reported 250 feet below the No. 5 bed, but in the Springfield boring the corresponding coal is much thinner. A few other thin bands occur locally in the Pennsylvanian strata below No. 5 coal. At some future time one or more of these lower coals may be of economic importance, but until the No. 5 bed becomes practically exhausted, the deeper and thinner coals will not be exploited.

No. 5 Coal

CHARACTERISTICS OF NO. 5 COAL

"The coal known as No. 5 (Springfield) is the only bed at present worked in the quadrangle. Its thickness varies but little in the different mines, the range within the area being from 5½ to 6⅝ feet. It lies entirely below drainage, being found at depths from 150 to 273 feet below the surface. The depth to the coal at any one place depends both upon the altitude of the surface and the altitude of the coal at that place. No. 5 coal is remarkably uniform and persistent, being found at every place where borings have been put down to its level, and it is also present in the State over an extensive territory to the west and south of the area.

CLAY SEAMS IN NO. 5 COAL

"One of the conspicuous features of No. 5 (Springfield) coal is the occurrence in it of numerous "horsebacks," as they are called by the miners. These are more or less irregular and branching fissures filled with clay or shale, extending downward from the overlying beds into or through the coal. They range in width from 2 of 3 inches to 3 or 4 feet, the walls not being very nearly parallel, and are considerably and abruptly wider in the coal than in the overlying roof shale. (See fig. 28.)

1 Op. cit.

"The clay or shale filling the fissures is light gray and generally soft. Rarely it is hard enough to emit sparks when struck with a hammer, but as a rule it soon slakes down into an incoherent mass on exposure to the air. The clay in many fissures contains fragments of black shale derived from the roof of the coal, reaching down 29 inches below the top of the coal. A few fragments of limestone from the cap rock are also found in this clay below the top of the coal bed. In horsebacks that cut through the coal bed pieces of coal have been found as much as 9 inches below the bottom of the bed. No fragments of coal have been found higher than the top of the coal bed.

"The fissures show no regularity of spacing or of direction. In some mines they are 40 to 60 feet apart; in others they are separated

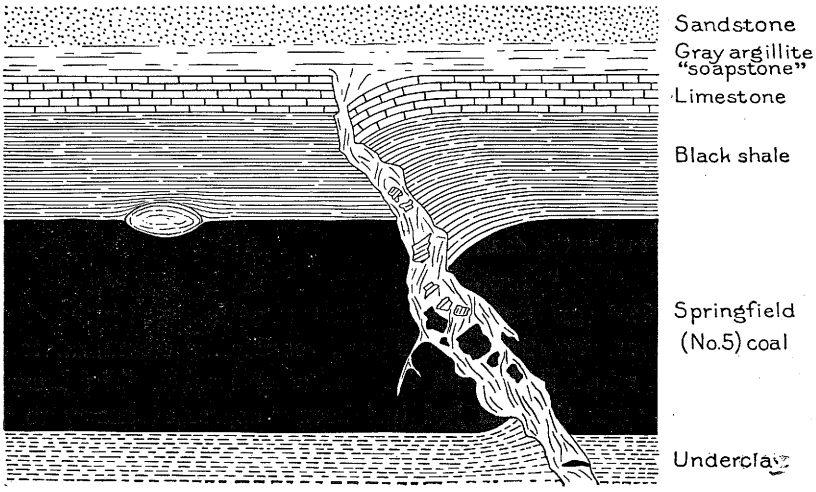

FIG. 28.—Sketch of typical clay seam or "horseback" seen in the Springfield Coal Mining Company's No. 5 mine, near Springfield.

by 200 to 400 feet or more. They trend in various directions, no one direction predominating, even in the same mine. All are either vertical or steeply inclined, with irregular walls which gradually converge downward within the coal. They have a very slight vertical range. In the Mechanisburg mine a coal bed, formerly worked, lies about 35 feet above No. 5 coal, which is the coal now mined. Although No. 5 coal is cut by numerous horsebacks, none were encountered in the higher bed.

"The walls of the fissures are slickensided but show no traces of weathering. Slickensided planes are also common in the clay filling the fissures. If the fissure is inclined, the uppermost laminae of the coal adjacent to the fissure on the overhanging side are bent somewhat

steeply downward, the distortion fading out laterally within a few feet from the fissure, and in a few places the lowermost laminae of the coal on the other side of the fissure are bent upward, but to a much less degree. If the fissure is vertical, or nearly vertical, the uppermost laminae of the coal are bent downward on both sides of the fissure, but the more nearly vertical the fissure the less the amount of bending. In no fissure is there a true fault or a relative displacement of the middle part of the coal bed on the opposite sides of the fissure.

"The material filling the fissures appears to have been derived chiefly from the gray shale overlying the cap rock of the coal bed and to have been forced downward into the coal through breaks in the cap rock, as is indicated by the downward bending of the edges of the cap rock and of the coal laminae, by the occurrence of the fragments of the cap rock below the top of the coal, and by the continuity of the material of the fissures with that of the bed of gray shale.

"The coal appears to have yielded readily in a lateral direction, as shown by the greater width of the fissures in the coal bed than in the overlying and underlying strata. That the coal afforded accommodation to the strains causing the fissures is also indicated by the fact that many of the smaller fissures divide within the coal bed into branches which eventually die out in the coal.

"*Origin of Clay Seams.*—The formation of the clay-filled fissures in the Springfield coal was probably determined in part by the character of the overlying strata and in part, possibly, by the character of the underclay, which is dry and does not creep readily. The fissures were formed after the coal bed had been compressed nearly to its present volume, as is shown by the fact that the clay seams are not so deformed as they would be if the coal had been greatly compressed after they were developed. In some places clay from the fissures has penetrated joints in the adjacent coal, indicating that joints had been developed in the coal prior to the formation of the clay seams. Campbell[1] suggests that the carbonization of the coal beyond the lignitic condition depends on the presence of joints and cleavage planes along which gases may escape. If so, the bed should have undergone considerable compression and contraction after the joints were formed before it became bituminous.

"It is assumed that as the mass was slowly transformed into coal the contraction in its different parts was somewhat unequal, owing to its lack of homogeneity, and that the contraction continued long after the coal had been greatly consolidated. As long as the material possesses some degree of mobility the unequal shrinkage in the different

1Campbell, M. R., Econ. Geology, Vol. I, No. 1, p. 30, 1905.

parts of the bed was equalized by the movement of some of the mass toward points of least resistance. When the consolidation reached a certain stage such adjustment was no longer possible, so that continued unequal shrinkage of the mass produced unequal strains in the roof of the coal under its load of superposed rocks. Where the roof of the coal bed was a somewhat plastic shale the mobility of the particles of the shale permitted an adjustment of the inequalities of strain, resulting from the unequal contraction of the coal bed, the adjustment being accomplished by the formation of rock rolls such as are common at the top of the No. 6 (Herrin) coal in the Carterville-Zeigler region of southern Illinois. The roof shale in the vicinity of the rolls is cut by slickensided zones for several feet from the center of the roll, indicating a considerable lateral movement in the shale during the adjustment necessitated by the strains. The roof of the Springfield coal, however, is a hard, brittle shale without the mobility requisite for such adjustment. If the limestone cap rock had been very thick it might have withstood, without fracture, the strain due to unequal contraction in the underlying coal, but its average thickness is only 12 or 14 inches. The roof shale and the cap rock were together not strong enough to withstand the unequal strains to which they were subjected and broke under the pressure, at places marked by fissures.

"Immediately above the cap rock is a bed of rather soft gray shale, the material of which was squeezed downward through the fissures into the coal until the inequalities of pressure were adjusted. The adjustment was limited to a narrow zone below the fractures in the roof shale and cap rock, and its effects are of slight horizontal extent but penetrate to considerable depths.

CONCRETIONS ABOVE NO. 5 COAL

"Rounded concretions of calcareous, pyritic shale, called pyrite balls or 'niggerheads' and varying in size from one inch to four feet or more in diameter, are in places numerous along the contact zone of the black shale with the top of the coal. These concretions have been compressed less than either the overlying black shale or the underlying coal, and hence the laminæ of the black shale arch upward over the 'niggerheads,' and those of the upper part of the coal bend downward beneath them. The continued contraction of the coal seam, after the partial consolidation of the coal and of the overlying black shale, permitted a sufficient amount of movement to take place around and above the 'niggerheads' to give their surface a slickensided appearance, and to cause them to fall readily from their matrix after the underlying coal has been removed.

NO. 6 COAL

"No. 6 (Belleville or Herrin) coal is known only from the records of mine shafts and test borings, and as far as known is too thin to be profitably worked within this area. This bed was formerly mined at Mechanicsburg some distance east of Springfield and it is mined extensively 20 miles south. The coal where first penetrated by the Mechanicsburg shaft was about 6 feet in thickness, but it thinned rapidly northward, and was abandoned when No. 5 coal was discovered below it. In two of the shaft sections it was reported absent, but in these the horizon was marked by a black shale underlain by fire clay. This coal lies at an average distance of 49 feet above No. 5 coal, the distance increasing in general toward the north.

"In this quadrangle No. 6 coal varies in thickness between 2 and 14 inches, the average being 4½ inches. The thickness increases rapidly in a southerly direction. Near Waverly it is 3½ feet thick. At Chatham the thickness is between 5 and 6 feet, and at Divernon it is nearly 8 feet thick. This coal is mined extensively in the southern portion of Sangamon County, and farther south in the vicinity of Belleville, Duquoin, Carterville, and Herrin.

NO. 7 COAL

"No. 7 coal is not thick enough to be of economic importance, measuring generally only 2 or 3 inches. In three of the shaft records the horizon is known only by the associated fire clay and black shale strata, the coal itself not being present. The position of this coal is 50 feet above No. 6 coal, and about 100 feet above No. 5 coal.

NO. 8 COAL

"The thickness of No. 8 coal varies from 18 to 31 inches. The bed lies above drainage over the whole of the area except in a belt around 3 miles wide along the east border, and it has been eroded away from a strip of about equal width along the west side of the quadrangle. For several years before the deeper and thicker bed, No. 5, was discovered, this was the only coal worked in the Springfield region. The mining was done by drifts run into the hillsides at points where the bed outcropped above the level of the streams. Traces of such workings may be seen along a branch in W. ½ sec. 32, T. 16 N., R. 5 W.; along the west bank of Sugar Creek in sec. 12, T. 15 N., R. 5 W.; and they are numerous along the south bank of Sangamon River in sec. 5 and 6 T. 16 N., R. 4 W. The greatest measured thickness of this coal was at the Sangamon River localities where it reached

TABLE 7.—*Thickness of the several coal beds in the Springfield and Tallula quadrangles and the distance between them in mine shafts and borings* [a]

Name of mine	Thickness of coal No. 5	Distance between coals No. 5 and No. 6	Thickness of coal No. 6	Distance between coals No. 6 and No. 7	Thickness of coal No. 7	Distance between coals No. 7 and No. 8	Thickness of coal No. 8	Total distance from top of coal No. 5 to base of coal No. 8
	Inches	*Feet*	*Inches*	*Feet*	*Inches*	*Feet*	*Inches*	*Feet*
Riverton Mine No. 1	72	43½	5	39	2	93	24	175
Barclay Coal Mining Co.	73	63	2	48½	?	89½	8	201
Williamsville Coal Co.	68	60	6	52	0	65½	18	179½
Test hole Springfield Colliery Co.	68	43½	0	62	0	54	?	160½
Springfield Colliery Co.	70	43	14	45½	3	76¾	24	169
Escape shaft Capitol Coal Co.	72	48½	0	56	0	58	24	164½
Spring Creek Coal Co.	72	41½	4	48½	2	79+	?	172
Boring ½ mi. SW. of Springfield	76	39	6	43	2	97	18	179½
Total averages	71	48	6	50	2	77	19½	175

[a] Reprinted from Ill. State Geol. Survey Bull. 20, p. 121.

31 inches. No. 8 coal lies at an average distance of about 77 feet above No. 7 coal, and about 175 feet above No. 5 coal.

"No swamp conditions or soil beds seem to have been developed in the interval between No. 5 and No. 6 coals. Between coal beds No. 6 and No. 7 there is generally reported one, and in some instances two, layers of black shale with underclays. In a few places there is a thin bed of coal at one of these levels. Between No. 7 and No. 8 coals there is less frequently reported a clay-shale succession with a rare occurrence of a thin coal bed.

"A comparison of the thicknesses of the coal beds from No. 5 to No. 8, inclusive, and of the distances separating them in various mine shafts and borings is given in Table 7." [1]

Mine Notes

DAWSON COAL MINING COMPANY'S MINE, AT DAWSON

Entrance: Shaft, about 250 feet to No. 5 coal.

Thickness of coal: Average thickness, 5 feet 2 inches.

Character of the coal: The upper foot and the lower foot of the seam are free from pyrite but there are small discontinuous lenses in the middle part. "Horsebacks" and niggerheads are fairly numerous. Some of the "horsebacks" contain much pyrite and are very hard. The coal has a general dip to the east which is interrupted by small rolls or arches, the dimensions of which were not reported.

Character of the roof: The roof is black "slate," 1 to 4 feet thick, and commonly underlies a cap-rock which attains a known thickness of 4 feet and which in turn underlies soapstone 1 to 20 feet thick.

Character of the floor: The underclay is 1½ to 5 feet thick. It is reported to heave.

BARCLAY COAL COMPANY'S ABANDONED MINE, AT BARCLAY

Entrance: Shaft; depth to No. 5 coal about 247 feet.

Thickness of coal: Averages about 5 feet 10 inches.

Character of the roof: The immediate roof is black slate about 3 feet thick, underlying a sandstone cap-rock 2 feet in thickness. The roof is reported to be good.

SANGAMON COAL COMPANY'S NO. 3 MINE, AT CANTRALL

Entrance: Shaft, 206 feet to the top of No. 5 coal.

Thickness of coal: Averages 5½ feet in thickness, with a maximum of over 6 feet.

Character of the coal: The coal is uniform in character and contains thin streaks of pyrite and some pyrite nodules as the principal impurities. These occur in no great abundance. The coal is mostly bright and finely

[1] Savage, T. E., Geology and mineral resources of the Springfield quadrangle: Ill. State Geological Survey Bull. 20, pp. 115-120, 1913.

laminated. Clay veins or "horsebacks" are the only important interruption in the continuity of the bed.

Character of the roof: The immediate roof is commonly black "slate." Locally the "slate" is absent and the cap-rock rests upon the coal. The usual thickness of the limestone cap-rock is about 1 foot, and the "slate" varies up to about 4 feet. Commonly a streak of pyrite occurs in the shale just above the coal, which "freezes" the coal to the shale so that in mining about 1 inch of the coal stays up. This is said to be desirable, as it protects the shale from the air. The slate also contains "niggerheads" which make the roof rather irregular.

Character of the floor: The underclay is about 3 feet thick. It heaves somewhat when wet.

CITIZENS COAL MINING COMPANY'S MINE "A," ½ MILE WEST OF SPRINGFIELD

Entrance: Shaft, 207 feet to No. 5 coal.

Thickness of coal: Where measured the coal had a thickness of 5 feet 4 inches.

Character of the roof: The immediate roof in the mine is black "slate," 1½ to 5 feet thick, but averaging 3½ feet. The cap-rock is a nodular limestone 12 to 14 inches thick; it is followed above by bluish-gray shale about 15 feet thick. Between the coal and black "slate" is commonly a band of pyrite with many fossils. "Niggerheads" are present in the black shale and "horsebacks" cut through the coal.

PEERLESS COAL COMPANY'S MINE, AT SPRINGFIELD

Entrance: Shaft; 223 feet to top of No. 5 coal.

Thickness of coal: Varies from 5 feet to 6 feet 2 inches.

Sections of the coal:

Sections of No. 5 coal in Peerless mine, Peerless Coal Company

Section 1—Room 18, 1st A east entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, fairly clean	2	7
Pyrite parting	..	..
Coal, fairly clean	3	4
Floor: Fire clay	..	..
	5	11

Section 2—Room 1 off 4B south off east entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Pyrite	..	1
Coal, fairly clean, dull	2	3
Pyrite parting	..	..
Coal, dirty, streaked with pyrite	3	5
Floor: Dark underclay	..	..
	5	9

Section 3—Room 11, 1st C west entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, fairly clean	5	10
Floor: Underclay	..	..
	5	10

Character of the coal: The coal is rather hard, bright, hackly, banded, and contains a small amount of pyrite in plates along joint cracks and in lenses parallel to the bedding. Although the bed is uniform in appearance throughout, it is somewhat harder at the bottom and the bottom coal is slightly "bony" in places. The clay veins or "horsebacks," which are rather common, vary in width up to more than 3 feet.

Character of the roof: The immediate roof is black shale about 3 feet thick, and the cap-rock is limestone 2 inches to 2 feet thick, averaging 1½ feet. The black sheety shale of the roof contains "niggerheads" of all sizes up to several feet in diameter, which in most cases project from the roof down into the coal, and around which the coal is always bent. Between the coal and the black shale there is generally an inch or so of black shale and coal, representing a gradation from the coal to the "slate" above. Locally, however, the parting between the coal and the "slate" is sharp.

Character of the floor: The underclay is a dark-gray clay, 6 feet thick at the sump, which heaves when wet.

MECHANICSBURG COAL COMPANY'S MINE (NOT OPERATING), AT MECHANICSBURG

Entrance: Shaft; 300 feet to the top of No. 5 coal.

Thickness of the coal: Average thickness 5 feet.

Character of the coal: The coal is uniform in character from top to bottom with no persistent partings or bands. There is some gypsum along the vertical joint cracks. The coal is finely laminated with more mother coal than is commonly found in the mines near Springfield.

Character of the roof: The roof shale or "slate" is 1½ to 1 foot 10 inches thick, and the cap-rock above, where it is present, is limestone varying up to 1 foot in thickness.

Notes on No. 6 coal: About 27 feet above the bed being operated at the time the above observations were made (1912) is the bed thought to be No. 6 coal which was worked two years before. This upper bed has a 4- to 5-inch blue band near the middle. It is about 5 feet thick and at the shaft lies at a depth of 277 feet. To the west it is higher and is only 2½ feet thick. East of the shaft it becomes 6 feet thick at a distance of 140 feet, dipping 11 feet in the first 55 feet, after which it becomes level. At the air shaft, which is 346 feet north of the main shaft, the coal is 81 feet above its altitude at the hoisting shaft and is only 1 inch thick.

PEABODY COAL COMPANY'S MINE NO 6, AT SHERMAN

Entrance: Shaft; depth to No. 5 coal 198 feet.

Thickness of the coal: Average, 6 feet.

Character of the coal: The coal is laminated, free of dirt band, but contains considerable mineral charcoal. It shows a few pyrite bands as much as 1 inch thick, but these are not persistent. Thin plates of calcite or gypsum occupy the joint cracks. "Horsebacks" or clay slips are numerous. These are generally 2 to 4 inches across and extend various distances into the coal from the top, some cutting entirely across the seam. The filling of some of the horsebacks shows slickensided or smoothed surfaces, and cementation of the filling by calcite or possibly by pyrite is not uncommon.

Character of the floor: The underclay is hard and locally at least is "frozen" to the coal. Practically no bottom was taken up at the time the observations were made (1912).

SANGAMON COAL COMPANY'S MINE NO. 2, AT STEARNES (SPRINGFIELD)

Entrance: Shaft; 250 feet to the top of No. 5 coal.

Thickness of the coal: The coal averages almost 6 feet in thickness.

Sections of the coal:

Sections of No. 5 coal in mine No. 2, Sangamon Coal Company[1]

Section 1—Room 30, off south entry 21, one mile southeast of shaft

	Thickness	
	Ft.	*in.*
Roof: Shale	..	..
Coal	2	..
Mother coal	..	⅛
Coal	1	5
Shale	..	⅛
Coal	2	4
Floor: Fire clay	..	..
	5	9¼

Section 2—Entry 16 off stub entry 4, 4,000 feet northeast of shaft

	Thickness	
	Ft.	*in.*
Roof: Shale	..	..
Coal	1	3
Mother coal	..	⅛
Coal	1	5
Shale	..	¼
Coal	3	3
Floor: Underclay	..	..
	5	11⅜

Character of the coal: The coal is of the usual character for this district. Horsebacks are numerous, with a filling of hard white clay which is somewhat limy and carries small bits of coal. The coal is well jointed.

Character of roof: The roof is a limy shale, 1½ to 4½ feet thick, with a cap-rock 6 inches to 2 feet thick. The shale roof holds up well and

[1] U. S. Bureau of Mines Bull. 22, p. 510.

is not generally taken down. It carries the usual "niggerheads" which form "pots" projecting down into the coal and which are smoothed or slickensided around their surfaces.

Character of the floor: The floor is a hard gray underclay.

SANGAMON COUNTY MINING COMPANY'S JEFFERSON MINE, AT SPRINGFIELD

Entrance: Shaft; depth to the top of No. 5 coal about 240 feet.

Thickness of the coal: Varies from 3½ to 6½ feet, averaging 5 feet 9 inches.

Character of the coal: The "horseback" or clay veins are very numerous, so that they seriously interfere with mining operations. Many extend in a northwest-southeast direction; the miners, however, say that there is no predominant direction in which they run. The coal is commonly faulted down on one side of the "slips," the laminae being bent down on the downthrow side for a few feet back from the break. The similarity of the clay which fills the fissure to the soapstone above the cap-rock indicates that it apparently came from the soapstone through this latter bed. Pieces of the black roof shale are also common in the "clay veins," but no coal fragments are found in the clay above the top of the coal seam. The "horsebacks" commonly extend only part way through the coal, unless they are large. The fissure generally widens in the coal from a narrow opening in the cap-rock.

Character of the roof: The immediate roof is black laminated shale or "slate." At the bottom of the "slate" and extending up into the shale and down into the coal, are many large niggerheads, some of them large enough to extend across an entry. In places a band of ferruginous limestone, 2 to 6 inches thick, which carries numerous fossils, lies between the black shale and coal. This occupies the same position as the "niggerheads" and is composed of similar material.

Character of the floor: The coal is underlain by an underclay.

SPRINGFIELD DISTRICT COAL MINING COMPANY'S CORA OR NO. 51 MINE, AT ANDREW

Entrance: Shaft; 145 feet to No. 5 coal.

Thickness of coal: Average, 6 feet.

Roof and floor: Clay below coal, and 4 feet or more of limestone above.

SPRINGFIELD DISTRICT COAL MINING COMPANY'S MINE NO. 52, AT RIVERTON

Entrance: Shaft, depth to No. 5 coal 232 feet.

Thickness of coal: Varies from 5 feet 9 inches to 6 feet 2 inches; averages 5 feet 11 inches.

Sections of the coal:

Sections of the No. 5 coal in mine No. 52 of the Springfield District Coal Mining Company

Section 1—Room 2, off 2d north stub off 3d east north, 2,100 feet from the shaft

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, bright	2	..
Blackjack	..	1
Coal, bright	1	4
Pyrite streak	..	⅛
Coal, bright	1	..
Floor: Fire clay	..	..
	4	5⅛

Section 2—No. 6 room off 10th west off main south entry, 5,600 feet from the shaft

	Thickness	
	Ft.	*in.*
Roof: Black slate	..	..
Coal, bright	1	7
Pyrite streak	..	¼
Coal, bright	3	11
	5	6¼

Section 3—Back entry at face of main south entry, 5,700 feet from shaft

	Thickness	
	Ft.	*in.*
Coal, bright	1	..
Pyrite streak	..	½
Coal, bright	2	10
Pyrite	..	¼
Coal, bright	2	3
	6	1¾

Character of the coal: The coal has no unusual characteristics. The main cleat is southeast to northwest and the prevailing dip about 2½ per cent to the east.

Character of the roof and floor: The roof consists of black "slate" 2½ to 4 feet thick, cap-rock about 1 foot thick, and gray shale above the cap-rock. The floor is clay about 4 feet thick, resting upon 14 inches of hard rock below which is more shale.

SPRINGFIELD DISTRICT COAL MINING COMPANY'S MINE NO. 53 (WOODSIDE), AT SPRINGFIELD

Entrance: Shaft, about 245 feet to No. 5 coal.

Thickness of the coal: Varies from 4½ to 6¼ feet; averages 5 feet 10 inches.

Sections of the coal:

Sections of the No. 5 coal in mine No. 53 of the Springfield District Coal Mining Company

Section 1—Room 1 off the 9th west entry off the main south entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, clean, bright	..	3⅞
Mother coal	..	⅛
Coal, fairly clean	5	4
	5	8

Section 2—Room 5, off 8th south entry off southeast entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, fairly clean	2	6
Pyrite	..	⅛
Coal, bright, fairly clean	2	9⅞
	5	4

Section 3—Room 5, off 19th north entry off straight east entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, very hard, bright, clean	4	4¾
Bone and little pyrite	..	¼
Coal, hard, dull, clean	1	4
	5	9

Character of the coal: The coal is reported to lie in three benches; top bench about 1 foot thick, middle bench 3½ feet, and bottom bench 1½ feet. The coal has the usual laminated appearance due to dull and bright layers. Bedded impurities are inconspicuous. The chief irregularities in the coal are the clay veins ("horsebacks"). They vary in width, the maximum being about 6 feet, and consist of gray or white clay in which coal and limestone fragments are embedded.

Character of the roof and floor: The roof is black shale, 2 to 4 feet thick. The cap-rock when present varies in thickness, but is not more than 18 inches generally. The coal rests on underclay. It is reported that the clay beneath the horsebacks is harder and more pyritic than it is elsewhere.

SPRINGFIELD DISTRICT COAL MINING COMPANY'S MINE NO. 55, AT SPRINGFIELD

Entrance: Shaft; 250 feet to the top of No. 5 coal.

Thickness of the coal: Varies from 5 feet 9 inches to 6 feet 3 inches; averages 5 feet 11 inches.

Character of the coal: No unusual features noted. Horsebacks are common and these commonly show a downward bending of the coal laminae on the side of the downthrow. The downthrow of one clay vein amounted to 13½ inches, and of another, 15 inches. At a number of slips, a slight upward bending of the coal at the bottom of the bed opposite the downthrow side is evident. In general the more nearly vertical the "horseback," the less the displacement of the coal on either side.

Character of the roof and floor: The shale which forms the roof varies in thickness from 2½ to 4 feet. The limestone cap-rock present in some places is commonly 3 to 6 inches thick. Gray soapstone overlies the cap-rock. Locally a 2- to 10-inch bed of pyrite-bearing limestone containing numerous fossils lies between the black shale and the coal. The floor is underclay.

BISSELL COAL COMPANY'S MINE AT BISSELL [1]

Entrance: Shaft; about 235 feet to No. 5 coal.

Thickness of the coal: Two measurements of the coal in this mine show a thickness of 5 feet 9 inches and 6 feet 1½ inches, respectively.

Character of the coal: "Horsebacks" are common, and thin pyrite lenses are present in small amount in the middle of the bed.

Character of the roof: The roof is black shale 1½ to 4 feet thick, with locally a pyrite band ⅓ to 1 inch thick between the coal and the "slate." "Niggerheads" are not common. The cap-rock varies from 2 inches to 4 feet in thickness.

UNION FUEL COMPANY'S MINE NO. 2, AT KEYS

Entrance: Shaft; 220 feet to the top of No. 5 coal.

Thickness of the coal: Average thickness between 5½ and 5⅔ feet.

Character of the coal: The upper 2 feet of the bed is said to furnish the best coal; the next foot carries thin streaks of pyrite, and the lower coal is good. The main cleat is northeast-southwest, and the bed dips mainly to the southwest. On the extreme east, however, there is an eastward dip. The coal is cut by "horsebacks."

Character of the roof: The roof is black "slate," 1 foot 2 inches to 5 feet thick, with a cap-rock present in places and varying in thickness up to about 1 foot.

UNION FUEL COMPANY'S MINE NO. 5, AT SELBYTOWN

Entrance: Shaft; 267 feet to the top of No. 5 coal.

Thickness of the coal: Average, 5 feet 8 inches.

Character of the coal: The coal has a cleat which is directed near east and west. "Horsebacks" are not numerous.

Character of the roof and floor: The roof is black shale or "slate" with an average thickness of 3 feet but varying from 6 inches to 4½ feet. It is reported to make a good roof and to have but few "niggerheads." The limestone cap-rock is from 4 inches to 2 feet thick. The floor is fire clay 2½ feet or more in thickness, which heaves considerably.

[1] Formerly Standard Washed Coal Company, Mine No. 2.

SCHUYLER COUNTY

Production and Mines

Mining operations in Schuyler County are all by nonshipping (or wagon) mines, and are confined to two beds, No. 2 and No. 5, of which probably No. 2 is the more important. During the year ending June 30, 1920, there were 28 local mines in the county which produced a total of 17,737 tons. Five of these, all in the vicinity of Rushville, produced between 1,000 and 4,200 tons, and according to the mining inspector's reports, it is only in this vicinity that No. 5 coal is worked in Schuyler County.

Coal-bearing Rocks

Schuyler County is included within the area of District III as well

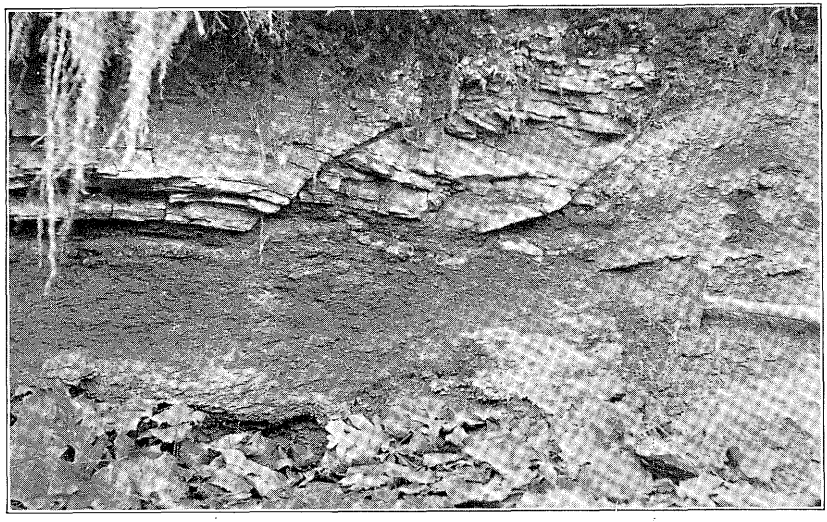

FIG. 29.—Photograph of No. 5 coal in outcrop northeast of Rushville, near the center of sec. 23, T. 2 N., R. 1 W.; the bed is cut by a small fault and a nearby "horseback."

as IV and, because of the larger area underlain by the No. 2 coal, as compared with the area underlain by No. 5 coal, will be discussed in greater detail in the report on District III than in this report. No. 5 coal underlies only the uplands near Rushville, for the most part in T. 2 N., R. 1 W., and the eastern part of T. 2 N., R. 2 W. In all cases it is worked by shaft, slope, or drift, and so far as known it has never been stripped to any extent in this region, though there are possibly

areas where it is under too light a cover to permit use of any other method.

Between No. 5 and No. 2 coals, Worthen reports an interval of 175 to 200 feet northeast of Pleasant View. Of these strata possibly the most conspicuous is a heavy sandstone and sandy shale member which is well exposed along the Chicago, Burlington and Quincy Railroad between Rushville and Ray, beginning a few feet below No. 5 coal and having a thickness of about 100 feet.

COALS

NO. 5 COAL

The upper or No. 5 coal in Schuyler County, outcrops near Rushville, with a thickness of 4 to 6 feet, and has the usual black shale roof with "niggerheads" and limestone cap-rock, and is cut by "clay veins" or horsebacks. A photograph of one of these "horsebacks" as seen in an outcrop northeast of Rushville is reproduced as figure 29. So far as known the coal partakes of all its usual characteristics displayed in Fulton County.

NO. 2 COAL

No. 2 coal is widespread at a uniform thickness in Schuyler County except where it has been eroded along streams. A map presented in Bulletin 31 of the State Geological Survey[1] indicates a general southward dip of the coal from 580 near Littleton to 510 at Frederick and near Ripley. Assuming a constant interval between coals No. 2 and No. 5 over the county, the altitude of the upper coal should vary from about 750 to 680 feet from north to south. As the surface altitude in Schuyler County rarely exceeds 700 feet, and as the surface of bed rock is somewhat lower on account of the cover of glacial drift, it is obvious that the upper coal can be present only in the southern part of the county.

The dip is not regular to the south but is interrupted by local anticlines and synclines which bring the coal above or below the level that might be expected on the basis of a perfectly regular dip.

For a more detailed account of No. 2 coal in Schuyler County the reader must await a later bulletin on coal resources of District III.

NO. 1 COAL

No. 1 coal is known to have a local distribution in the eastern part of the county. It is not being worked, however, so far as is known. Whenever seen it was thin, 18 inches to 2 feet, and in one area in two beds, each about 2 feet in thickness. This coal as well as No. 2 will be described in greater detail in a later report.

[1]Morse, W. C., and Kay, Fred H., The area south of the Colmar oil field: Illinois State Geological Survey Bull. 31, Plate I, 1914.

TAZEWELL COUNTY

Production and Mines

Production in tons, year ending June 30, 1920.....721,288
Average production 1916-1920, inclusive.....531,272

The production of coal from Tazewell County for the year ending June 30, 1920, was a little less than one per cent of the total production for the State and the county ranked twentieth. Six shipping mines and four local mines operated in that year. The names of the six shipping mines together with their production are given in Table 6.

Surficial Deposits

A large part of the surface of Tazewell County is morainic, and beneath the ridges of glacial material the drift is commonly thick. For instance, the preceding record of a drilling at Washington shows a depth to the rock of 335 feet 11 inches. It will be noted also that the unconsolidated material includes several water-bearing sandy horizons described as "quicksand." This record is probably representative of the more unfavorable conditions for exploration and development work that exist in the county, as it is not probable that a much greater thickness than 335 feet is generally present.

Coal-bearing Rocks

The coal bearing rocks of Tazewell County include strata of the Pennsylvanian system from the base up to some horizon above No. 7 coal but probably below the Lonsdale limestone. The youngest rocks in the county are adjacent to the Illinois from near Farm Creek to 5 or 6 miles south of Pekin. The slope of the rock surface is apparently eastward from this area, wherein it is at a relatively high altitude, and is sufficient so that the rock surface passes below the horizon of No. 5 coal. The rock surface also slopes to the north from this area wherein it is relatively high so that the surface of the rock passes below the bed of Farm Creek, the slope to the north accordingly being more abrupt than that to the east. It is probable that the rock surface in the northern part of the county is largely below the horizon of No. 5 coal. It appears, therefore, from the evidence at hand, that there is only a small area of rocks of the McLeansboro formation in the western part of the county, the greater part of the county being underlain by Pennsylvanian rocks belonging to the Carbondale and Pottsville formations.

Record of drilling in NE. cor. sec 23, T. 26 N., R. 3 W., near Washington, Illinois.

Altitude: Est. 745 feet.

Description of Strata	Thickness		Depth	
Quaternary system—				
Pleistocene and Recent—	*Ft.*	*in.*	*Ft.*	*in.*
Clay and loam	3	....	3	....
Gravel	83	....	86	....
Clay	24	....	110	....
Clay and gravel	20	....	130	....
Clay, light blue	15	....	145	....
Gravel	31	....	176	....
Clay	6	....	182	....
Gravel	7	....	189	....
Clay and gravel	10	....	199	....
Clay, light blue	8	....	207	....
Gravel	11	8	218	8
Sand	9	....	227	8
Quicksand	23	....	250	8
Gravel	7	....	257	8
Quicksand, gray	7	....	264	8
Quicksand, white	69	....	333	8
Gravel	2	3	335	11
Pennsylvanian system—				
Soapstone, light	25	....	360	11
Sandstone, light	15	....	375	11
"Slate," black	8	....	383	11
Coal	....	6	384	5
Fire clay	4	....	388	5
"Slate," light gray	26	....	414	5
"Slate," dark	17	6	431	11
"Slate," black	11	4	443	3
Coal (No. 2?)	3	8	446	11
Fire clay	3	....	449	11
"Slate"	8	9	458	8

Record of drilling about 6½ miles southeast of Pekin, Illinois.

Description of strata	Thickness *Feet*	Depth *Feet*
Quaternary system—		
Pleistocene and Recent—		
Clay, yellow	16	16
Clay, blue	140	156
Sand and gravel; some gas	10	166
Pennsylvanian system—		
Shale, dark	119	285
Fire clay	4	289
Shale, black	71	360
Shale, white	40	400
Shale, dark	20	420
Shale, white	45	465
Shale, dark	3	468
Coal (No. 2?)	4	472
Fire clay	9	481
Shale, white	34	515
Fire clay	4	519
Shale, white	84	603
Shale, dark	104	707
Sandstone	1	708
Shale, white	29	737
Sandstone	5	742
Limestone, blue	3	745
Sandstone	4	749
Limestone	2	751
Sandstone	3	754
Limestone	3	757

The operations in Tazewell County are all along or near the Illinois valley, where conditions are essentially the same as those described for Peoria County. The eastern part of the county is heavily drift covered, and rock exposures are very uncommon if they exist at all. So little drilling has been deep enough to penetrate the coal-bearing strata that except for a narrow strip between Pekin and East Peoria, the distribution and thickness of the coal beds is practically unknown in this county. There is little doubt, however, that No. 2 coal is widespread throughout the county in workable thickness, and probably No. 5 coal is also present in large areas.

Neither of these records gives sufficient detail to permit the accurate correlation of the coals. In one record the coal at a depth of 443 feet is considered as probably No. 2, since it is obviously too deep for No. 5. No. 2 coal lies about 150 feet below No. 5 in the Peoria region. The latter has an average altitude of 431 feet in Pekin Township. Thus No. 2 would have an altitude of about 290 feet. In

the second record given above, the surface altitude is about 680 feet and that of the coal correlated as No. 2 is 208 feet. This is lower than the average altitude for the coal noted above, but the difference may be accounted for by the eastward dip of the rocks. The upper coal, No. 5, was apparently missed in drilling this hole, whereas in the hole near Washington it has apparently been eroded, the base of the drift lying below the horizon of the coal.

POTTSVILLE FORMATION

Concerning the character of the Pottsville formation in this county the only available information is that afforded by several water well records near Pekin and East Peoria, supplemented by data concerning the strata in the eastern part of Peoria County. It is unnecessary to repeat the description of the formation as given for Peoria County. It may be pointed out, however, that near Peoria in the Pottstown mine, one workable coal lies 110 to 130 feet below No. 2 coal. This coal lies in two benches separated by nearly 3 feet of shale, the upper bench 1 foot 3 inches and the lower bench 2 feet 3 inches in thickness. It is thought to be the No. 1 coal of the Illinois coal, which has been mined extensively in the Rock Island region and in the mine at Parrville, Fulton County. Although this coal is too thin to be mined profitably at present, it represents a valuable resource which must be drawn upon some day.

Between No. 1 and No. 2 coals there are possibly two coals of workable thickness, one 30 to 40 feet above No. 1 coal and the other about the same distance below No. 2 coal. The lower of these coals in some of the wells drilled in the Peoria district was reported to be about 30 inches in thickness, and the other between 1 and 2 feet. It is physically possible to mine coals 18 inches thick, with the proper equipment, at a cost not greatly exceeding the cost of mining the thinnest of the coals now mined in the State. Eventually after the supply of thicker coal has been exhausted, these thin beds will doubtless be worked.

CARBONDALE FORMATION

At the base of the Carbondale formation lies No. 2 coal, which is very probably widespread in this county, and has a thickness of about 3 feet. It is present at Pekin and East Peoria and at Washington, and in the surrounding counties, and lies nearly level throughout a large area east of the Illinois. There is only about 50 feet difference in the altitude of this coal at Pekin, at Bloomington, and at Washington. This coal commonly has a "soapstone" or gray shale roof up to about 20 feet in thickness with a 3-foot black paper-shale overlying

the soapstone. The roof is especially adapted to the longwall method of mining which is employed in all cases where this seam is worked.

The details of the succession between this coal and No. 5 are not known. In surrounding counties the strata consist largely of shale with massive sandstone near the top of the section not uncommonly. The interval between these two coals in the Peoria region varies from 110 to 140 feet, and at Bloomington it is 130 feet, or essentially the same as at Peoria. It is not improbable, therefore, that the thicknesses and succession of strata are about the same in the intermediate region which includes Tazewell County. Details of the succession can be learned by reference to the chapters on McLean and Peoria counties.

No. 5 coal, which underlies at least the western part of the county in the vicinity of East Peoria and Pekin, and probably extends as far east as Groveland, varies in thickness from about 4 feet 4 inches at the north to about 4 feet 8 to 10 inches to the south. It has the usual characteristics of No. 5 coal; that is, it does not lie in benches, is characteristically cut by clay veins and by pyrite-filled veins ("spars"), and contains banded brown or gray pyrite and a few bright pyrite balls in the upper part of the bed. Within the area of its outcrop along the bluff and beneath the drift it is fairly continuous, but in places is interrupted by "faults" which are interpreted as channel sandstone just as are the "faults" on the Peoria side of the river. Just northeast and south of its outcrop the coal is apt to be affected by preglacial or glacial erosion, so that considerable areas may not be minable. Development work in this county and in this coal bed should be preceded by careful exploration by the drill.

The strata overlying No. 5 coal vary from the usual black slate, clod cap-rock, and gray-shale succession to sandstone. Especially in Groveland Township sandstone is apparently at no place a great distance above the coal, and locally cuts down into the black shale and rests upon the coal. In the vicinity of Wesley the sandstone in places cuts out the coal entirely, just as it does in Hollis Township in Peoria County.

The section between No. 5 and No. 6 coals is composed largely of sandstone and sandy shale, the interval between the two coals being about 60 feet.

No. 6 coal in western Tazewell County is irregular in thickness. As shown by the following sections[1] it is in some places over 4 feet and in others less than 1½ feet.

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[1]Udden, J. A., Geology and mineral resources of the Peoria quadrangle, Ill.: U. S. Geological Survey Bull. 506, pp. 45-46, 1912.

Section in the north bank of creek, one-fourth mile southwest of the NE. cor. sec. 24, Pekin Township

	Thickness Ft.	in.
Shale, light gray	1	..
Limestone, thinning rapidly to east	2	..
Shale, "white top"	..	6
Coal, thinning rapidly to east (No. 6)	1	6
Fire clay	3	..
Shale, arenaceous	15	..
	23	..

Section in west bank of Lick Creek, near junction of its two forks, Sec. 25, Pekin Township

	Thickness Ft.	in.
Sandstone	4	..
Sandstone, shaly	6	..
Limestone, discontinuous	1	..
Shale, "white top"	1	6
Coal, No. 6	2	6
Fire clay, with dark ferruginous band near middle	3	6
Shale, gray	2	6
Sandstone in somewhat shattered beds	3	..
Shale, light bluish-gray, arenaceous	23	..
	47	..

Section in west bank of Lick Creek, near wagon bridge, in NW. cor. Sec. 31, Groveland Township

	Thickness Ft.	in.
Shale, light gray	6	..
Clay, structureless residuum firm	1	2
Shale, dark fissile, with gray discontinuous laminations	1	..
Coal	2	9
Clay	..	2
Coal, with lenses of pyrite near middle	1	6
Fire clay, greenish gray	4	..
	16	7

Careful drilling in the area underlain by No. 6 coal may discover areas in which the coal is as much as 4 feet thick. However, just as in southern Peoria County, this coal very commonly is overlain by a loose, incoherent, grayish shale called "white top" which is very hard to hold and which makes mining very expensive, and also cuts out a considerable proportion of the bed. The "white top" roof has been described in greater detail in the discussion of the coal resources of Peoria County.

MC LEANSBORO FORMATION

So far as known, the rocks of the McLeansboro formation are restricted in this county to a small area between Pekin and East Peoria. They include No. 7 coal, which has a thickness of 14 to 18 inches and lies about 30 to 35 feet above No. 6 coal.

The lower part of the formation which constitutes the roof of No. 6 coal is normally dark fissile shale, 1 to 3 feet thick, or gray shale called "white top." Commonly the black or gray shale is overlain by limestone cap-rock, 1 to 4 or 5 feet in thickness. Marly or calcareous shale overlies the limestone and grades upward into sandy shale or sandstone, which continues nearly to No. 7 coal. No. 7 coal is underlain by a few feet of underclay and shale.

The McLeansboro formation seems to have been eroded down to some horizon below the Lonsdale limestone, which lies near the top of the section on the west side of the river.

MINABLE COALS OF TAZEWELL COUNTY

The coals in Tazewell County which at present are of commercial importance are probably only No. 2 and No. 5, and of these only No. 5 is being worked. Very little is known about No. 2, but its persistence throughout the northern part of the State is a basis for inferring its presence in this area. No. 7 coal is apparently too thin to mine at present and No. 6 unsatisfactory because of its irregular character and poor roof. Any statement in regard to the occurrence and distribution of No. 1 coal and the possible existence of coals between No. 1 and No. 2 is pure speculation. It follows, therefore, that interest is mainly in No. 2 and No. 5 coals.

NO. 2 COAL

No. 2 coal is mined extensively in the Longwall District and is found in the northern and central portions of the Illinois coal field wherever shafts or bore holes have been sunk to its horizon. Commonly the seam is about 30 inches thick, with a good soapstone roof, which is excellently suited for Longwall methods of mining. As a rule it has no seriously detrimental impurities and is of slightly better quality than higher beds in the same locality. It is believed that this coal is generally present in this county, but it has never been worked.

NO. 5 COAL

There are several operations in No. 5 coal in Tazewell County along the bluff of the Illinois between East Peoria and Pekin. The

coal has the same general characteristics as the seam in the Peoria district, described in the section on that county. The distribution of the coal is limited on the west by the Illinois valley, and in the other directions by pre-glacial or interglacial erosion. The rock surface slopes rather abruptly to the north at Farm Creek, so that it probably passes below the level of the coal; and although it slopes somewhat less abruptly to the east and south, still the grade is sufficient to cause the rock surface of the central and eastern parts of the county also to be probably largely below the horizon of No. 5 coal.

The coal in the East Peoria region is locally interrupted by sandstone "faults" especially in the vicinity of Wesley. These sandstone "faults" are thought by the writer to be the filling of channels cut into the peat deposit shortly after its deposition. In part of the area this same body of sandstone lies but a short distance above the coal, the base of it forming the roof of the coal in the places where the shale roof which is generally present has been eroded.

Mine Notes

The following detailed description of conditions in a few of the Tazewell County mines will serve to set forth the general character of the coal and of the mining conditions in this area.

Groveland Coal Mining Company's Mine No. 1, at East Peoria

Entrance: Shaft; depth to No. 5 coal, 85 feet.

Thickness of coal: Varies from 3 feet to 4 feet 8 inches; averages 4 feet 4 inches.

Sections of the coal:

Sections of No. 5 coal in Mine No. 1 of the Groveland Coal Mining Company

Section 1—Room 1 off 3d stub off the 6th east entry

	Thickness	
	Ft.	*in.*
Roof: Black fissile shale	..	..
Coal with thin streaks of clay and mother coal	4	3
Floor: Underclay	..	..
	4	3

Section 2—Room 6 off the 10th east entry

	Thickness	
	Ft.	*in.*
Coal	1	5
Pyrite (brown "sulphur")	..	1¾
Coal	2	10¼
	4	5

Character of the coal: The coal lies as a single bench without persistent partings. The thin bands of clay and mother coal, generally present in the face, are rarely more than ¼ inch in thickness, are not persistent at any one place, and not very important as impurities. On the east side of the mine pyrite bands of "brown sulphur" are commonly found near the horsebacks. These are generally about 1½ inches thick and may be 4 to 5 feet in length. They appear to be intimate interlaminations of pyrite and carbonaceous material.

The coal is practically uniform in thickness, the only departures from uniformity being near the "horsebacks" or clay slips. Where these fractures occur the coal is usually slightly displaced, the bed on one side of the fracture being somewhat lower than it is on the other (see fig. 30).

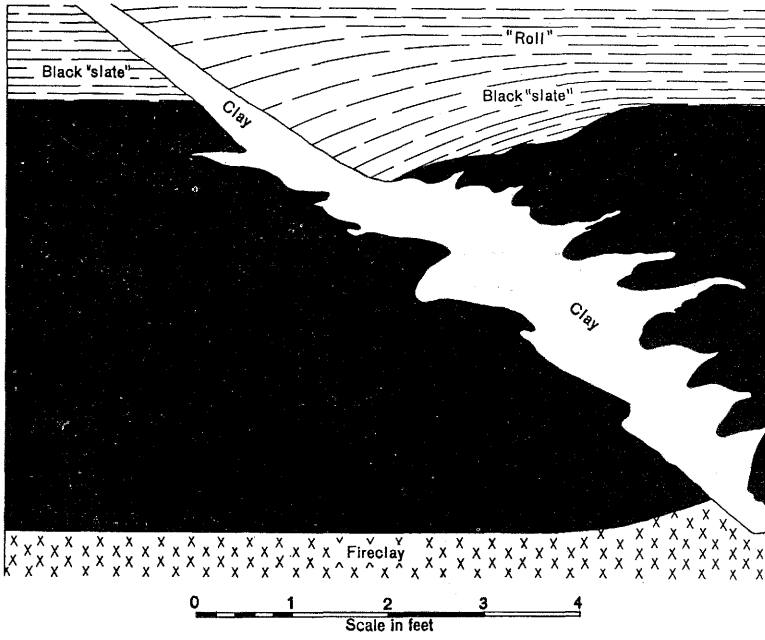

FIG 30.—Sketch of a "horseback" in No. 5 coal in the Groveland Coal Mining Company's No. 1 mine at East Peoria.

Commonly the fracture is at a fairly acute angle with the horizon of the bed, so that the roof on the downthrow side is much nearer the floor than under normal conditions. Similarly, the floor on the opposite side of the fracture is nearer the roof than usual. However, the floor does not commonly rise as high as the roof is down-faulted, there apparently being some compensation either in the coal or in the adjacent strata. These phenomena in the roof and floor are spoken of as "rolls."

The coal on the east side of the mine is badly fractured, but the fractures are not so generally filled with clay as they are elsewhere. Instead, pyrite-filled cracks, called "spar" by miners, are the common

thing. Although rarely more than ¼ inch thick, they are very hard to drill so that the miners do not like to work in the part of the mine where they are common. Furthermore, there are cracks ("blind slips") which penetrate the coal and pass up into the roof but in a fresh face are not discernable, and which produce an extremely treacherous roof that is practically impossible to control.

Character of the roof: Incidental to the preceding description of the coal some mention has been made of certain difficulties encountered in the roof of this mine. Other characteristics may be mentioned.

The massive sandstone which lies a short distance above the coal throughout much of this area as well as the area south of Peoria on the west side of the Illinois, is exposed above the coal in a number of places in this mine. The sandstone has a very irregular base and accordingly lies at various heights above the coal, in places very close to the bed or even resting on it. Apparently there are no places where the sandstone cuts out the coal, though this condition is reported to have existed in an old mine a short distance to the north.

The usual roof is black shale, 8 to 14 inches thick, with clod and limestone above. The lower 2 inches of black shale or "slate" is called "draw slate." This is commonly "frozen" to the coal. The break that takes place in mining near the top of the bed commonly occurs an inch or two below the slate. If the break occurs in the slate so that the "draw slate" parts from the overlying shale, the material that is left lacks coherence and is difficult to keep. In this mine when the "draw slate" comes down it is soon followed by all the rest of the material up to the sandstone. In some localities in the mine this means as much as 20 feet of material.

The so-called cap-rock is a layer of fossiliferous gray limestone 2 to 8 inches thick which in places is hard but more commonly is shaly, with no supporting strength. The clod lying between the black shale and the "cap-rock" is a massive, dark gray, loosely coherent shale, about 14 inches thick, that falls readily. Overlying the cap-rock is a gray shale which continues up to the sandstone a distance of about 18 feet or less.

Character of the floor: The floor is underclay. No unusual characteristics other than the rolls associated with the horsebacks were noted.

JOHNSTON CITY BIG MUDDY COAL AND MINING COMPANY'S NO. 3 MINE, AT PEKIN.

Entrance: Shaft; depth to the top of No. 5 coal 205 feet.

Thickness of coal: Reported to average 4 feet 8 inches.

Character of the coal: The following description is based upon information obtained from the mine manager. The coal has not been seen by a Survey member.

The coal lies in a single bed, without benches. The few discontinuous bands of "sulphur" near the horsebacks and the little hard pyrite balls and lenses, are said to be too infrequent to seriously damage the coal. Horsebacks are fairly numerous and their removal entails considerable waste.

Character of the roof: The roof succession consists of 6 to 12 inches of black shale, called "slate," which sticks to the coal so that presumably

either a few inches of coal is left in the roof or some of the shale comes down with the coal. Above the black shale is about 12 inches of clod, above which there is commonly 6 to 8 inches of limestone. This, however, is locally absent. A thick bed of shale overlies the limestone.

Character of the floor: Underclay about 18 inches thick. Below the clay is 12 inches of limestone which in turn is underlain by more clay.

The general characteristics of the coal in this mine are probably very similar to those of the coal in the Tazewell Coal Company's mine which is operated on an adjacent property.

TAZEWELL COAL COMPANY'S MINE NO. 1, AT PEKIN

Entrance: Shaft; 162 feet to the top of No. 5 coal.

Thickness of coal: Varies from about 4 feet to about 4 feet 10 inches; averages 4 feet 8 inches.

Sections of the coal:

Sections of No. 5 coal in mine of the Tazewell Coal Company

Section 1—Face of second entry off main south

	Thickness	
	Ft.	*in.*
Roof: Black slate	..	..
Coal, fairly clean	1	5¾
Pyrite	..	¼
Coal, clean and bright	1	11½
Bone	..	½
Coal, fairly clean	..	9
	4	3

Section 2—Face of room 5, 1st stub, 12th east off south entry

	Thickness	
	Ft.	*in.*
Roof: Black shale	..	..
Coal, left up	..	3 to 4
Coal, clean	..	1¼
Mother coal and pyrite	..	¾
Coal, very dirty	4	1
Floor: Underclay	..	..
	4	6

Section 3—Face of room 16, first stub east, 8th south off east entry

	Thickness	
	Ft.	*in.*
Roof: Black slate	..	..
Coal, slean, bright	1	2½
Pyrite lens	..	2½
Coal, clean, bright	..	8
Mother coal, soft	..	½
Coal, fairly clean and bright	2	3½
Floor: Underclay	..	..
	4	5

Character of the coal: The coal lies in a single bed with no benches, but contains discontinuous streaks of clay and mother coal, and near the horsebacks or clay slips lenses of pyrite are common. There is some calcite along the joints faces. "Horsebacks" are numerous and commonly so impregnated with pyrite that they are very hard. Fig. 31 is a reproduction of a sketch of a horseback. It will be observed that the clay vein plays out in the overlying shale into a number of cracks and that the underclay has been squeezed a short distance upward into the fracture. At the veins the cap-rock commonly shows a slight displacement. The

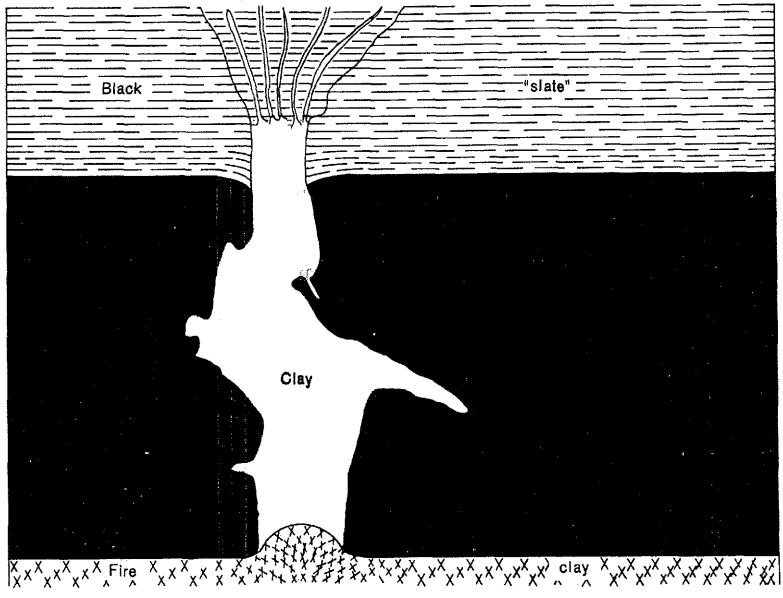

FIG. 31.—Sketch of a "horseback" in No. 5 coal in the Tazewell Coal Company's No. 1 mine at Pekin.

side of the fracture in the coal is generally irregular, but also commonly shows "smooths" or slickensides.

Character of the roof: The immediate roof is dark shale or "slate," 8 to 12 inches thick, which commonly sticks to the coal, so that either the upper 2 or 3 inches of coal is left up or the lower 2 or 3 inches or more of the shale comes away with the coal. This makes no particular difficulty. About 12 inches of clod lies between the black shale and the cap-rock. The latter is a limestone which is solid only locally and then is about 8 inches thick.

Character of the floor: The underclay is about 12 inches thick. It becomes hard 12 inches below the coal, but the upper part heaves badly in the air, and especially wnen it is wet.

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