STATE OF ILLINOIS DEPARTMENT OF REGISTRATION AND EDUCATION

DIVISION OF THE STATE GEOLOGICAL SURVEY M. M. LEIGHTON, Chief

> Cooperative Mining Series BULLETIN 29

COAL RESOURCES OF DISTRICT III (Western Illinois)

BY

HAROLD E. CULVER

ILLINOIS MINING INVESTIGATIONS

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



PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

URBANA, ILLINOIS

1925

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 determine the methods to be employed in the conduct of the work and exercise general editorial supervision over the publication of the results, but each party to the agreement directs the work of its agents in carrying on the investigation thus mutually agreed on.

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





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DIVISION OF THE STATE GEOLOGICAL SURVEY

M. M. LEIGHTON, Chief

Committee of the Board of Natural Resources and Conservation

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FIG. 1. Index map of Illinois showing area included in District III.

COAL RESOURCES OF DISTRICT III By Harold E. Culver

PART I-GENERAL RELATIONS WITHIN DISTRICT III

INTRODUCTION

Importance of the Area

This report covers an area of about 11,000 square miles in the western part of the State, comprising all or parts of the following counties: Adams, Brown, Calhoun, Cass, Fulton, Greene, Hancock, Henderson, Henry, Jersey, Knox, Madison, Mason, McDonough, Mercer, Morgan, Pike, Rock Island, Schuyler, Scott, Warren, and Whiteside (fig. 1). This district, one of eight into which the State is divided for purpose of coal investigation, is defined as the area lying west of the Longwall (District I) and Springfield-Peoria (District IV) districts, and underlain by Rock Island (No. 1) and Colchester (No. 2) coals.

Coal mining has long been one of the minor industries of western Illinois, but at no time has it been the chief industry. Nor, indeed, has the production of coal from this district ever been a large percentage of the total for the State, as indicated in Table 1. Nevertheless,

	FIOUU	etion		
Year	District III Tons	State Tons	Percentage of total for State	
	524,832	2,624,103	20.	
	528,000	2,937,776	18.	
	494,007	15,274,727	3.24	
	741,311	25,153,929	2.94	
	480,573	48,717,583	0.98	
	435,436	73,920,653	0.59	
	Year	Year District III $Trout Trout Trout Trout Trout$	YearDistrict III TonsState Tons $\dots \dots $	

TABLE 1.—Relative importance of District III in Illinois coal production

the production in certain parts of the district has been noteworthy at times, and at present as in the past is not an unimportant factor in supplying local needs.

Acknowledgments

In presenting this compilation of available data, the writer is glad to acknowledge his indebtedness to many citizens of the western counties of the State. Landowners, drillers, and the men of the coal industry have furnished much of the information for this report, and their courteous cooperation in the work of the Survey is greatly appreciated.

Free use has been made of the early reports on the western part of the State by Worthen and of the Cooperative Mining Investigations bulletins, as well as of the published and unpublished data gathered by various members of the Survey. The miscellaneous notes of G. H. Cady, J. A. Udden, K. D. White, and others have been of especial assistance. For statistics of production and data on early mining, the annual reports of the Department of Mines and Minerals have been most valuable.

In the field work the writer has enjoyed the competent assistance of Messrs. W. F. Netzeband, John S. Ivy, and Paul T. Post. Mr. Post has also aided in the preparation of maps and diagrams for publication. In addition, the writer had the distinct advantage of cooperation with Mr. D. M. Collingwood, formerly of the Survey staff, to whose detailed structural studies in Greene, Jersey, and Madison counties reference is made in the text of this report.

Topography

The area lies along the west margin of the State, and is, in large part, level prairie land. Sharp incision by streams in some parts of the area has resulted in considerable roughness and marked relief. This is particularly true in the southwestern portion, including parts of Adams, Schuyler, Brown, and Pike counties.

The elevations range from below 500 feet in southern Calhoun and western Fulton counties to over 800 feet in northeastern Mercer County. In general, the surface rises to elevations above 800 feet in both northern and southern parts, with low areas along prominent drainage lines throughout the district. The Mississippi and Illinois control the drainage of the area. In the north, the major tributaries are Rock River, Edwards River, and Henderson Creek; in the central part, Spoon River and Crooked Creek, and in the southern part McGees, Apple, Macoupin, and Piasa creeks.

The topographic character of the area is of importance in considering the availability of the coal. Deep incision by streams lowers the drainage lines below the coal beds in places, making possible exploitation of the beds by drifts or slopes, where otherwise shafts would be required.

The district is well supplied with railways, but these are not of importance in the exploitation of coal in this area because under present conditions, very little coal is shipped by rail.

STRATIGRAPHY

PRE-PENNSYLVANIAN FORMATIONS

Because of the overlap relation of the Pennsylvanian to earlier formations, the rocks beneath the Pennsylvanian are not of the same age over all parts of the district. In the northeastern part of the district in Henry County, Niagaran limestone of Silurian age underlies the Pennsylvanian at shallow depth, while a few miles farther west it is replaced by the younger Devonian beds. Similarly, in central Mercer County, the Devonian base gives place to the still younger Mississippian rocks which appear to underlie the Pennsylvanian uniformly throughout the rest of the district, even in the structurally deformed area of southern Calhoun County. Sufficient drilling has not been done to demonstrate the precise position of the boundaries of these three systems of rocks, although there is some reason for believing that the Devonian rocks underlie the Pennsylvanian in most of Henry County, while the Mississippian beds form the base throughout most of Mercer County.

Although the character and age of the underlying rocks are of relatively small importance in the development of the coal resources of this district, the character of the surface on which the Pennsylvanian beds were deposited is of considerable importance. It is obvious that the determination of the nature of this surface is closely bound up with the identification of the base of the Pennsylvanian. Because information regarding the beds of the lower Pennsylvanian is derived entirely from records of drilling, it is practically impossible to use the ordinary criteria, fossils and structural relations, to separate the Pennsylvanian from the Mississippian strata. In drilling, it is customary to rely on the identification of one of the two or three readily recognizable strata in the lower formation. Thus, for instance, in Mercer County the base of the Pennsylvanian is placed at the top of the first prominent limestone penetrated, although it is obvious that some of the overlying clastic beds with thin intercalated limestones may belong to the Mississippian and yet on this basis be classed as Pennsylvanian.

Another illustration of the difficulty encountered in fixing the base of the Pennsylvanian formations is found in western Henry County, where the uppermost Devonian includes 100 feet or more of black shale with thin limestone or sandstone above and below it, and where furthermore, the overlying Pennsylvanian in many places is known to include black shale of considerable thickness. In drilling. the top of the Devonian is commonly placed at the top of the thick Devonian limestone. Thus, one record in northwestern Henry County records Pennsylvanian to a depth of more than 600 feet, including coal at depths of 99, 238, 311, 354, 479, 522, and 584 feet. Examination of this unique record shows that below the uppermost coal at 99 feet are a few feet of sandstone, underlain by more than 100 feet of blue shale, which is in turn underlain by 20 feet of limestone. Nowhere else in this region is such a sequence recorded in the Pennsylvanian system, whereas in an adjacent area to the west may be found comparable thicknesses of shale and limestone belonging to the upper Devonian. A correlation of this part of the record as the Devonian of western Rock Island County is therefore suggested, and on this basis it is assumed that exceptionally carbonaceous shales were reported as coal at the lower horizons.

Less conspicuous and less readily explained discrepancies regarding the base of the Pennsylvanian are abundant in records of deeper drilling throughout the district, and have caused considerable difficulty in determining the base of the Pennsylvanian. It should be understood therefore that all statements in this report regarding thicknesses of the whole Pennsylvanian, or of the basal member, and regarding the character of the pre-Pennsylvanian surface are based on a somewhat arbitrary identification of beds which are not easily recognized either in drill records or from samples of drill cuttings.

The surface of pre-Pennsylvanian rocks appears to have been subjected to erosive processes for a time sufficient to permit the development of a fairly even surface throughout the district. This surface is modified by local upwarpings, as in the Colmar region, Mc-Donough County, and is also in places incised sufficiently to give rather marked roughness, although no great relief. It is impossible at the present time to draw even approximate contours on this whole surface, but its character for smaller areas will be noted in the county reports, where data permit.

STRATIGRAPHY

PENNSYLVANIAN SYSTEM

GENERAL RELATIONS

Rocks of Pennsylvanian age underlie the drift throughout the area of District III, except for small linear tracts along Illinois River, Crooked Creek, and McGees Creek, where deep erosion has removed them. The area arbitrarily placed in District III does not comprise a geologic unit, as the beds in this District constitute a fringe on the main coal field of the State. Because of this relationship, the beds have certain lithologic characteristics which serve to contrast them with those of the important coal beds of Districts IV and VII on the east.

In general, the Pennsylvanian beds range in thickness from a feather edge on the west to more than 250 feet on the east margin, beyond which Rushville (No. 5) and Belleville (No. 6) coals appear. Theoretically at least, the coals in District III extend beyond the limit set for District III, but lie at considerable depths below the surface. Insofar as this actually occurs, District III and the districts to the east coincide.

Structurally, the Pennsylvanian beds are essentially flat, having a regional dip to the east and south toward the center of the main coal basin, which lies in the southeastern part of the State. This gentle inclination is interrupted and modified by minor warps and folds visible in outcrops and mines in most parts of the district.

Over most of the area the bed rock is concealed by a mantle of drift ranging in thickness to a known maximum of 233 feet, so that the determination of stratigraphic relations, structure, and coal resources for the District is based primarily on mine examination and scattered drill holes.

The Pennsylvanian series in the Illinois basin is subdivided into three formations, which from the base upward are called the Pottsville, Carbondale and McLeansboro. Recognition of these formations is by means of certain fossils, which usually appear in the roof shales of Colchester (No. 2) coal and in the cap limestone of Belleville (No. 6) coal. The Carbondale, or middle formation, includes Colchester coal at the base and Belleville at the top. All beds above Belleville coal belong in the McLeansboro group, and all below Colchester coal belong in the Pottsville. Inasmuch as by definition District III includes the area in which Rock Island and Colchester coals are the principal coals, this report is concerned with rocks classed as Pottsville and lower Carbondale, the eastern margin of District III being placed just west of the outcrop of Springfield (No. 5) coal. In places this boundary can be accurately mapped, but elsewhere, due to the heavy cover of drift, it can only be approximated and changes will doubtless be made on the basis of future drilling.

CORRELATION

As stated in the preceding paragraphs, the correlation of the beds within the Pennsylvanian depends upon the presence and recognition of Colchester and Belleville coals. It is clear that in the absence of these key horizons or in the failure of recognition of them, there is ample opportunity for miscorrelation.

It seems well at this point to introduce some statements regarding the status of correlation in this part of the Illinois field so that the importance of critical data in stratigraphic work may be clearly indicated.

The Pottsville formation includes the basal beds of the Pennsylvanian up to the bottom of Colchester coal.¹ Inasmuch as this coal bed has only a limited distribution in District III there are comparatively large areas where the top of the Pottsville formation can not be recognized. Furthermore, since the area under discussion lies at the margin of the Illinois coal field, the beds exposed, whether of early or late Pennsylvanian age, are mainly sandstone and sandy shale with little or no coal, the whole group being composed of notably lenticular members without good horizon markers. It is clear, therefore, that in the absence of the key bed, Colchester coal, there may have been included within the beds classed as Pottsville an indefinite thickness of strata which belong to younger formations. In correlating a given coal which lies in this marginal area, it is equally clear that without the key stratum, identification must be made arbitrarily, and should be held subject to later stratigraphic studies. Because of the wide variation in the roof material over the coals of this district, they have been correlated mainly on the basis of thickness, the thickest coal of any section having been considered the main coal of that general region. In view of the lenticular form of all of these beds, it is clear that errors may have been made.

In considering the beds classed as Carbondale, precisely the same factors of error must be considered. Hence it is fair to recognize the possibility or probability that the clastic strata of this age closely resemble those of the preceding (Pottsville) time and have been con-

¹DeWolf, F. W., Year Book for 1909, Ill. State Geol. Survey Bull. 16, p. 179, 1910. (Although there has been some tendency to include the floor clay of the Colchester No. 2 coal with the Carbondale, the present practice of the Survey is to conform to the original definition and make the break at the precise base of the coal bed.)

fused with them. Similarly, some of the beds classed as Carbondale belong in all probability to the following stage, the McLeansboro.

It must be recognized, therefore, that any statement made in this report is based on the present accepted correlation, which may be in error to an unknown degree. So far as possible, repetition of this problematical error will be eliminated by the substitution of locality names of certain beds for the more generally used names and numbers. For example, the coal usually classed as the Pottsville (No. 1) coal of the northwestern part of the State will here be called the Rock Island coal. Similarly, the term Rushville coal will be used instead of the more common Springfield (No. 5) coal, thus avoiding the implication that this is identical with the main coal of the Springfield-Peoria field.

Recent work in the northwestern part of the State has suggested the probability that some of the thick sandstones in that area which have been classed as Pottsville should be placed in the McLeansboro formation².

To what extent the massive sandstones which characterize the basal Pennsylvanian along the west margin of the field may occupy the same or similar position in the stratigraphic column can be determined only on the basis of future detailed studies.

POTTSVILLE FORMATION

The beds classed as Pottsville are mainly sandstones and sandy shales, frequently conglomeratic in the lower part. The upper portion in places shows a massive phase which may be widespread. Thin, and in most places lenticular, beds of limestone appear (fig. 2), but rarely occur in a section sufficiently large to justify an opinion as to their stratigraphic position.

The coal beds are likewise lenticular, and though locally reaching a thickness of nearly 8 feet, the thicker parts are confined to small areas. In parts of the district, the workable coal lies in elongate basins roughly parallel with the margin of the field. In most parts of the district there is but one coal worked, although one or more thin coal beds are present. Locally these may be thick enough to warrant exploitation.

CARBONDALE FORMATION

Those beds lying above the Pottsville and below the McLeansboro formations are included in the Carbondale which has at its base the Colchester coal and at its top the Belleville coal.

² Savage, T. E., and Udden, J. A., Geology and mineral resources of the Edgington and Milan quadrangles: Ill. State Geol. Survey Bull. 38, p. 161, 1921.

The beds of the Carbondale are predominantly clastic, mainly shale, although including minor thicknesses of sandstone (fig. 3) and few thin limestones. In thickness, the series ranges from a few feet in the western part of the district to about 175 feet at the east where the protecting cap limestone at the base of the McLeansboro appears. This variation is probably due to two factors: 1) differences in



FIG. 2. Section of Pottsville beds including thinly bedded sandstone at base, overlain by shale locally carbonaceous, topped by nodular limestone which serves locally as a key stratum in Brown County.

original thickness, and (2) subsequent erosion of beds along the western margin.

The coal beds of this formation, although showing a somewhat irregular distribution, are much more regular in their development than are the coal beds of the Pottsville. Thus, although they are present over larger areas without break, they do not show the exceptional

STRATIGRAPHY

thickness which is exhibited locally by the Rock Island or Greenfield beds. The Colchester coal is usually about 24 to 30 inches thick and is noted for its uniformity over a given area. The Rushville coal is also rather uniform in thickness, ranging from 4 to $5\frac{1}{2}$ feet where worked.

The Golden Eagle coal, isolated from the rest of the district by subsequent erosion of the connecting strata, has commonly been included with the beds of the Carbondale, sometimes as Colchester (No. 2) coal and frequently as Rushville (No. 5) coal.



FIG. 3. Typical section of Carbondale strata in Adams County. Below the 15 feet of till lies 3 feet of sandstone which grades down in 40 feet to a non-gritty shale comprising the basal 20 feet.

MCLEANSBORO FORMATION

Although as defined originally the area included in District III did not include any beds classed as McLeansboro, later work by members of the Survey has served to show that in parts of the district there are strata which lie distinctly above what appears to be the Belleville coal, the top of the Carbondale formation. It is necessary, therefore, to indicate the area so classed and note briefly the character of the beds of this formation.

The McLeansboro formation comprises more evenly developed strata than characterize the Carbondale (fig. 4). Except at the west margin, sandstones are relatively few, shales are thick, but in places enclose marine limestones which, although thin, are persistent and wide-spread. The coal beds, on the other hand, are less common than in the lower formations, and with a few possible exceptions are of secondary commercial importance because of their thinness.

The area underlain by these beds is not yet clearly defined. They have been recognized, however, in western Rock Island, central Mercer, and northeastern Adams counties, and doubtfully in central Morgan and southern Calhoun counties.

Stratigraphically this formation is of importance since it includes certain marine strata which can be recognized readily. Among these are the cap limestone, and the red Rallsford shales over the Belleville coal, and in the east central part of the district the Lonsdale limestone. In the southern part of the district are one or more limestones



FIG. 4. Typical section of McLeansboro strata in Mercer County. Below 20 feet of drift, partly removed at right, lie 5 feet of shaly sandstone and 30 feet of clean shale with a thin carbonaceous zone at the base. Each bed shows little lateral variation.

which can be traced for considerable distances. The most important of these are the Piasa limestone, named from Piasa Creek on which it is most excellently exposed, and the Golden Eagle limestone, well known in Calhoun County. These beds are of considerable value in stratigraphic work, since they constitute horizon markers which can be positively identified over relatively large distances or areas.

STRUCTURE

RELATION TO GENERAL STRUCTURE OF ILLINOIS

Lying at the edge of the main Illinois coal basin, the Pennsylvanian beds of District III show a slight regional dip toward the central part of the major depression. This is barely perceptible locally but can be measured usually across a distance of several miles. There is no other general or major structure which affects any large portion of the district, and the regional inclination is of importance only in stratigraphic studies, since the amount of dip is too small to be a factor in mining problems.

MINOR STRUCTURES

Minor structures are abundant. These include small faults, low folds, and local warps of the strata which modify and conceal the major structure locally and are of considerable importance in mining. Plans for haulage ways, drainage lines and other general features of a mine layout can be made to take advantage of these natural conditions, which if disregarded, may be a source of much trouble, danger and expense.

Determination of structure depends upon the identification of some one or more key beds occurring in a region. Since there is no one bed or group of beds distributed generally over the area included in District III it is impossible, with present data, to outline the structure as a whole. In several separate areas, however, one or more key beds are identifiable, and the major features of local structures have previously been worked out in connection with detailed quadrangle surveys. These studies have been restricted to the middle portion of the district, from southern Warren County to northern Schuyler County.

In the main, these structures have been determined with reference to the Colchester coal, the position of which has been indicated by a series of contour maps published for each area separately³.

Structural studies on both Pennsylvanian and Mississippian strata, involving the relations of the two systems, have been made in Greene, Jersey, Madison and adjoining counties in connection with oil investigations made by the Survey. The results of this work, now being prepared for publication, are not available for this report, and the reader is referred to the forthcoming bulletin for details of structure in that portion of District III.

Details of the other structures, where related to the matter of coal resources, will be noted in the several county reports.

 $^{^{\}rm 3}\,{\rm Hinds},$ Henry, U. S. Geol. Survey Atlas, Colchester-Macomb folio (No. 208), 1919.

Savage, T. E., Geology and mineral resources of the Avon and Canton quadrangles: Ill. State Geol. Survey Bull. 38, p. 209, 1921.

Savage, T. E., and Nebel, M. L., Geology and mineral resources of the La-Harpe and Good Hope quadrangles: Ill. State Geol. Survey Bull. 43, p. 9, 1921.

CHEMICAL CHARACTER OF THE COAL OF DISTRICT III

Detailed reports⁴ on the chemical character of Illinois coals have been published in Bulletins 3 and 27A of this series, and in Bulletin 29 of the State Geological Survey so that a discussion of the quality of the coals in this district is not necessary. However, for convenience, tables giving analyses for individual mines (Table 2) and average analyses for mines and counties in District III (Table 3) are here given.

A very brief statement of the meaning of each of the several columns, which give the results of analyses in Tables 1 and 2, 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.

In the "Proximate Analysis" of coal no attempt is made to determine the chemical elements which make it up, but the constituents are resolved into four groups known as volatile matter, fixed carbon, ash, and moisture. The relative percentages of these are given in Table 2 as are also other features such as the heat value, amount of sulphur, and carbon dioxide.

A recalculation of the results of each analysis is given on a second line to show the relative percentages of the constituents on a "dry" basis. Thus by the elimination of the 11.38 per cent moisture by calculation in analysis No. 12469, the 38.66 per cent of volatile matter becomes 43.62 per cent in the "dry 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 when the coal is burned. Obviously, a coal of low moisture content is desirable.

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, 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 the heatproducing constituents. For domestic use a low-volatile coal is to be preferred because the ordinary domestic stoves and furnaces are capable

⁴ Parr, S. W., A chemical study of Illinois coals: Ill. Coal Mining Investigations Bull. 3, 1916. (Edition exhausted. Analyses reprinted in Ill. Mining Investigations Bull. 27A).

State Geological Survey Bull. 29, 1914. (Edition exhausted. Analyses reprinted in III. Coal Mining Investigations Bull. 27A).

Hawley, G. W., Analyses of Illinois coals: Ill. Coal Mining Investigations Bull. 27A, 1923.

TABLE 2.—Analyses of coal samples from mines in District III

y number	ıber				Proxin 1st: "A 2nd: "I	nate an s receive moistur)ry'' or 1	alysis o ed,'' wit e. moistur	f coal. h total e free.				
Laborator	Index nun	Date	County	Coal bed	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	CO2	B. t. u.	Unit coal
12469	105	3 -2 1	Fulton	1	11.38 Dry	$38.66 \\ 43.62$	$39.51 \\ 44.58$	$10.45 \\ 11.80$	$\frac{4.52}{5.10}$.87 .98	$\frac{11436}{12905}$	14979
12470	105	3–21	Fulton	1	11.42 Dry	$38.17 \\ 43.09$	$40.07 \\ 45.24$	$10.34 \\ 11.67$	$\frac{4.76}{5.37}$. 45 . 51	$\frac{11409}{12880}$	14934
12471	105	3-21	Fulton	1	10.84 Dry	$38.42 \\ 43.09$	$40.91 \\ 45.88$	9.83 11.03	$5.61 \\ 6.29$.54 .61	$\frac{11554}{12959}$	14939
5338	19	8-12	Mercer	1	13.23 Dry	40.29 46.43	$37.20 \\ 42.88$	9.28 10.69	$\frac{4.37}{5.04}$.41 .47	11104 12797	14641
5339	19	8-12	Mercer	1	15.24 Dry	$37.66 \\ 44.44$	$35.73 \\ 42.15$	$11.37 \\ 13.41$	$\frac{4.80}{5.66}$	$1.47 \\ 1.73$	$10353 \\ 12214$	
5340	19	8-12	Mercer	1	15.15 Dry	$39.06 \\ 44.44$	$\frac{38.48}{42.15}$	$7.31 \\ 14.41$	$3.30 \\ 5.66$.17 1.73	11252 12214	14478
5363	19	8-12	Mercer	1	14.97 Dry	$38.27 \\ 46.03$	$37.07 \\ 45.36$	$9.69 \\ 8.61$	$3.75 \\ 3.89$.33 .19	9637 13260	14760
5364	19	8-12	Mercer	t	14.46 Dry	$40.42 \\ 44.99$	35.33 43.61	9.79 11.40	$\frac{4.23}{4.95}$. 69 . 43	$10780\\12749$	14712
5365	19	8-12	Mercer	1	14.07 Dry	$39.95 \\ 47.24$	$\frac{34.01}{41.32}$	$\frac{11.97}{11.44}$	$\frac{4.55}{4.94}$.78 .59	$10525 \\ 12603$	14551
5359	18	8-12	Mercer	1	14.58 Dry	$39.49 \\ 46.49$	$\frac{36.82}{39.59}$	9.11 13.92	$5.60 \\ 5.29$.15 .91	$10894 \\ 12247$	14604
5360	18	8-12	Mercer	1	15.07 Dry	$38.14 \\ 46.23$	37.44 43.09	$9.35 \\ 10.68$	$4.85 \\ 6.56$.34 .18	$10790 \\ 12754$	14642
5361	18	8-12	Mercer	1	14.10 Dry	39.60 44.91	36.73 44.01	$9.57 \\ 11.02$	$3.92 \\ 5.71$.23 .38	$10956 \\ 12705$	14618
5371	17	8-12	Mercer	1	17.75 Dry	$39.50 \\ 48.03$	$34.61 \\ 42.08$	$8.14 \\ 9.89$	$5.53 \\ 6.72$.86 1.05	10435 12687	14373
5372	17	8-12	Mercer	1	17.50 Dry	$38.78 \\ 47.00$	33.66 40.80	$10.06 \\ 12.20$	$\frac{4.51}{5.46}$. 29 . 35	$10238 \\ 12409$	14372
2641	230	7-09	Calhoun	2	10.62 Dry	$38.13 \\ 42.67$	$39.65 \\ 44.36$	$11.60 \\ 12.97$	$\frac{4.96}{5.55}$		$11224 \\ 12557$	14806
5232	22	7-12	McDonough	2	19.35 Dry	$31.70 \\ 39.35$	$40.61 \\ 50.40$	$\frac{8.34}{10.35}$	$2.31 \\ 2.87$.37 .46	$10392 \\ 12898$	14605
5233	22	7-12	McDonough	2	16.46 Dry	$33.94 \\ 40.63$	$\frac{42.46}{50.83}$	$7.14 \\ 8.54$	$1.71 \\ 2.04$.11 .14	$11064 \\ 13246$	14660
5234	22	7-12	McDonough	2	16.39 Dry	$34.26 \\ 40.97$	$\frac{41.36}{49.47}$	$7.99 \\ 9.56$	$2.04 \\ 2.44$.33 .40	10977 13130	
9728	.213	11-16	McDonough	2	14.89 Dry	$35.48 \\ 41.68$	$40.75 \\ 47.88$	$\frac{8.88}{10.44}$	$3.78 \\ 4.43$		$10969 \\ 12887$	14678
9729	213	11-16	McDonough	2	16.83 Dry	$34.68 \\ 41.71$	$39.79 \\ 47.83$	8.70 10.46	$3.94 \\ 4.74$		10628 12778	14565
9709	214	11-16	Schuyler	2	12.34 Dry	$38.11 \\ 43.48$	42,29 48,24	$7.26 \\ 8.28$	$\frac{4.32}{4.92}$	· · · · · · · ·	11841 13507	15011
9708	214	11-16	Schuyler	2	12.73 Dry	$37.56 \\ 43.04$	41.88 47.99	7.83 8.97	4.77 5.46	 	11621 13316	14924

TABLE 3.—Average analyses and heat values for separate mines and for counties in District III

Index number Moisture Volatile matter		Fixed carbon	Ash	Sulphur	CO 2	B. t. u.	"Unit coal"	
105	11.21 Dry	$38.41 \\ 43.26$	$40.16 \\ 45.23$	$10.20 \\ 11.50$	$4.96 \\ 5.58$.62	11466 12914	14950
	I	DISTRICT	NO. 3—1	MERCEI	R CO., N	10. 1 CC	DAL	
17	17.63 Dry	$39.13 \\ 47.51$	$34.13 \\ 41.44$	9.11 11.05	$5.02 \\ 6.09$. 70 .85	10336 12548	14373
18	14.58 Dry	$39.07 \\ 45.74$	37.00 43.31	$9.35 \\ 10.95$	4.79 5.61	.21 .25	10880 12737	14640
19	14.52 Dry	$\begin{array}{c} 39.26\\ 45.93 \end{array}$	$36.32 \\ 42.49$	$9.90 \\ 11.58$	4.24 4.96	.68 .80	10809 12645	
Average	15.58 Dry	$39.17 \\ 46.40$	$35.80 \\ 42.41$	9.45 11.19	4.69 5.55	.53 .63	10673 12643	14546
	D	ISTRICT	NO. 3—M	DONOU	GH CO.,	NO. 2 C	COAL	·
22	17.40 Dry	$33.30 \\ 40.31$	$41.47 \\ 50.23$	7.82 9.48	$2.02 \\ 2.45$.27 .33	10811 13091	14663
213	15.86 Dry	$\begin{array}{c} 35.08\\ 41.69\end{array}$	$40.27 \\ 47.85$	$8.79 \\ 10.45$	$3.86 \\ 4.58$		10798 12832	14621
Average	16.63 Dry	$\begin{array}{c} 34.19 \\ 41.00 \end{array}$	40.37 49.04	8.31 9.96	$2.94 \\ 3.51$		10804 12961	14642
	í I	ISTRICT	NO. 3—S	CHUYLI	ER CO.,	NO. 2 C	DAL	
214	14.53 Dry	37.83 43.26	$42.08 \\ 48.11$	$7.54 \\ 8.62$	4.54 5.19		11731 13411	14967

DISTRICT NO. 3-FULTON CO., NO. 1 COAL

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 highvolatile coal can be used with equal efficiency.

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 produces about a third as much heat as does carbon.

The "B.t.u." column gives the calorific (heat) value of the coal in British thermal units per pound of coal. This value indicates the heating power of the coal and is therefore important as a means of comparison of different coals. In the calculation of this figure, account is taken of the ash and moisture present, as well as of 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.

PART II-COUNTY REPORTS

ADAMS COUNTY

GENERAL STATEMENT

Adams County lies in the extreme west margin of the Pennsylvanian basin, and has but a thin veneer of "Coal Measures" over the Mississippian strata (Pl. I B). The Pennsylvanian is found mainly in Ranges 5 and 6 W. although apparently disconnected patches are found farther west as at Mendon, T. 1 N., R. 8 W. The system is thin, the coal of irregular development, and no extensive operations have been reported.

PRODUCTION AND MINES

The reports of the Department of Mines and Minerals for the last few years have shown no mines operating in Adams County, either local or shipping. Little or no production is therefore to be listed for this county.

Area underlain by workable coal	sq. mi.
Average thickness	inches
Amount available originally838,720,00	00 tons
Production, year ending June 30, 1923	none
Average annual production, 1919-1923	20 tons
Total production recorded4	34 tons

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene beds are not as thick in the eastern portion of Adams County as they are farther north. Records of borings show thicknesses ranging from 10 to 85 feet. These materials include the usual loess at the top, which ranges from 5 to 10 feet in thickness, with yellow or blue drift clays beneath. The differences in thickness of the drift appear to be referable to the unevenness of the earlier rock surface. The thickness of the loess covering is, of course, greater to the west, reaching a maximum of 40 feet on the bluffs overlooking Mississippi River.

ADAMS COUNTY

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds do not outcrop prominently, although along certain of the streams exposures are fairly abundant. Even though some portions of Adams County have been drilled rather extensively in oil tests, the records kept for the Pennsylvanian portion of the section are unsatisfactory, and therefore little information is to be gained from most of the records of the borings. Such information as is available shows the thickness of the Pennsylvanian to range from a few feet to more than 140 feet. Worthen placed the maximum at 120 feet for the whole county. Difficulty of recognizing the base of the Pennsylvanian where it is in contact with some of the shales of the Upper Mississippian, makes it impossible to fix definitely the thickness of the "Coal Measures". The figures given above may therefore be increased by as much as 100 feet. The following generalized section is fairly uniform over the eastern part of the county:

Generalized Pennsylvanian section for eastern Adams County

Description of strata T		Thickness	
	Ft.	In.	
Limestone and underclay	4		
Shale, blue	55	• •	
Sandstone, shaly and calcareous	11		
Limestone, very cherty	3	• •	
Shale, blue, sandy at top	20		
Limestone (?) discontinuous	1		
Shale, black fissile, "slate"	2	••	
Coal, Colchester (No. 2)	2		
Underclay and shale	12	• •	
Limestone, nodular	1	6	
Shale; sandstone series with several discontinuous conglomer-			
atic zones	21		
Shale, blue	3		
Limestone, black	1		
Sandstone, platy	7		
Sandstone-shale series		• •	
Basal part white sandstone	8		

Within the section the more prominent beds include a limestone 25 to 50 feet above the top of Colchester (No. 2) coal, the coal itself, the nodular limestone 10 to 15 feet below and a black limestone 25 to 35 feet below the Colchester coal.

Worthen records the presence of three coal beds in the county of which the middle or Colchester bed is by far the most widespread. Examination of the area about sec. 17, T. 1 N., R. 6 W., in which Worthen's No. 3 was reported, has not revealed such coal, and it is possible that a change in the roof material over the Colchester coal in that vicinity led him to mistake the bed for one overlying the Colchester.

Coal No. 1, according to Worthen, included those patches of coal occurring along the west margin of the Pennsylvanian area, and which were unrelated to the main field. Differences in roof material, as well as in the character of the bed itself, led him to consider these as the outliers of a Pottsville coal. This may be their true relation, although it is possible that they may be either Colchester or a higher bed.

The Colchester coal is fairly uniform in its development within the area mapped in the eastern part of the county. It has been removed by erosion along major streams in the southeast part of the county, as along McGees Creek in the vicinity of Haselwood, and along the creek east of Richfield. The upland area is apparently uniformly underlain by this coal.

Structure

The structure of the Pennsylvanian beds can be determined only on the basis of the attitude of the Colchester coal, the attitude of which in turn depends on the identification of this bed throughout the area. It is believed that the section which includes the Colchester coal is readily identifiable, and that therefore the identification of this coal in outcrops and mines is probably correct. Its identification in well records is obviously less secure. On this basis, however, the altitude of the top of the Colchester coal ranges from about 600 to 680 feet. These altitudes vary within short distances, however, and if any general inclination is apparent, it is to the north and east at a very low angle. Earlier studies⁵ in T. 1 N., R. 5 W. (Clayton Twp.) have suggested a doming of the Pennsylvanian in the east central part, but sufficient data are not at hand to show the relation of this to other minor structures.

Colchester (No 2) Coal

The main area for Colchester coal is the eastern two ranges from the north county line to the vicinity of Richfield, except along McGees Creek where erosion has removed the Pennsylvanian strata. A typical section, including the coal, is as follows:

⁶Currier, L. W., Geology of northeastern Adams County: Ill. State Geol. Survey Bull. 43, p. 308, 1922,

ADAMS COUNTY

Typical Pennsylvanian section including Colchester coal in Adams County

Description of strata		Thickness	
	Ft.	In.	
Shale, light gray	1		
Shale, light gray calcareous, with abundant Chonetes	1		
Limestone, nodular, light gray fossiliferous		10	
Shale, light to medium gray, calcareous, Chonetes abundant	1	3	
Shale, medium to dark gray		3	
Shale, black fissile "slate"		1	
Coal, soft d'ull	1	4	
Sand, argillaceous, light gray	5		
Limestone, crystalline, Mississippian			

The roof of this coal is commonly of gray shale, although it is locally replaced by a black "slate", as in the above section. The floor material is generally unconsolidated, mainly clay, which is locally sandy.

It does not appear probable from the general relations of the Pennsylvanian beds that the coal of this region will ever become commercially important.

Mendon Coal

There is a small area in the vicinity of Mendon, T. 1 N., R. 8 W., where coal has been stripped to a limited extent. The correlation of this bed is not possible on present data, but the isolated position of the bed with reference to the rest of the Pennsylvanian of the county suggests that it is to be classed with the marginal beds, although it may belong to the upper rather than the lower part of the Pennsylvanian system. The coal shows a maximum of nearly 5 feet, but probably averages about 48 inches. The area underlain by this bed is thought to be extremely small, but because of the favorable thickness and cover it is considered as a factor in the resources of the county. A section of this coal is given:

Pennsylvanian section including Mendon coal in Adams County

Description of strata	Thickness	
	Ft.	In.
Coal, dull, weathered		8
Bone and sulphur		2
Coal, dull with bright bands, lenses of sulphur		12
Shale, parting, black locally sandy		2
Coal, dull, harder than above	••	28
Total		52

The roof is all drift where known, but is probably the usual shale or "slate" locally. The floor is a light gray clay in places, but is mainly sandstone. These features indicate that this bed was deposited near the margin of the area of coal formation, and bear out the suggestion that it is an original outlier of the main coal field.

BROWN COUNTY

GENERAL STATEMENT

Brown County lies near the west margin of the coal basin, and in its general geology closely resembles Schuyler County to the north that is, the beds of the Pennsylvanian are thick at the east margin of the county, but thinner in the west, appearing to overlap the Mississippian limestones over most of the county. They have been eliminated entirely along McGees Creek in the southern part of the county, and along Crooked Creek in the northern part (Pl. I B).

Production and Mines

Very little mining has been done in the county, most of it in the vicinity of Damon, Mt. Sterling, and Ripley. The report of the Department of Mines and Minerals for 1923 lists but one mine, producing a total of 150 tons. The report for 1920 gave six local mines, producing a total of over 3,000 tons.

Area underlain by workable coal182 sq	. mi.
Average thickness	iches
Amount available originally412,820,000	tons
Production, year ending June 30, 1923150	tons
Average annual production, 1919-19234,668	tons
Total production recorded26,489	tons

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene is not exceptionally thick over the county, as it averages about 30 or 40 feet. Locally, on account of irregularities in the bed rock surface, it reaches a maximum of 120 feet. These beds are mainly drift, boulder clay, with some sand and gravel, capped in most places by the unconsolidated loess. Along McGees and Crooked creeks and Illinois River, the alluvium deposited by these streams reaches considerable thickness. One well near Crooked Creek records 210 feet of alluvium above the bed rock. The loess also is locally 100 feet thick, but is much thinner except near the Illinois bluffs.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds found in the county belong in two formations, the Pottsville and the Carbondale. The Pottsville formation relatively thin, ranging from 6 to 50 feet in thickness, comprises soft gray or white fire clay, sandstone, and locally a thin limestone. Rarely a thin carbonaceous bed appears. Near LaGrange, the following Pottsville section appears⁶:

Section measured near center sec. 29, T. 1 S., R. 1 W.

Description of strata Thickness Ft. Tn. Shale and underclay of No. 2 coal..... 7 . . Limestone, white nodular (Key horizon No. 3)..... 5 . . Shale, gray 3 . . Shale, sandy 3 . . Clay shale, weathers out white..... 9 . . Coal 4 . . Sandstone, ferruginous 5 . . Shales, sandy and clay..... 9 . . Limestone (St. Louis)..... 12 6 Dolomite, sandy (Salem) (Key horizon No. 2) 206 4 74

The Carbondale has a maximum thickness of about 130 feet and consists of shales, sandstone, thin limestones, and locally Rushville coal and more uniformly Colchester coal at the base. A typical section of the Carbondale for the northern part of the county, as given by Nebel⁷ follows:

Generalized section of the Carbondale formation in the north half of

Brown County

Description of strata

	Ft.	In.
Shale	5	
Limestone, white nodular (Key horizon No. 8)	2	6
Shale, gray	11	
Limestone, gray, with Chonetes? and Spirifer cameratus (Key		
horizon No. 7)	1	
Shale, gray	13	
Limestone, white or light gray, heavy nodular (Key horizon No.		
6)	5	
Clay shale, soft, gray or blue	6	
Sandstone and sandy shale	10	
Shales, blue gray, sandy	59	

⁶ Nebel, M. L., Brown County: Ill. State Geol. Survey Bull. 40, p. 30, 1919. ⁷ Idem, p. 29.

Thickness

Generalized section of the Carbondale formation in the north half of Brown County—Concluded

Description of strata	Thickness	
	Ft.	In.
Limestone, shaly fossiliferous (Key horizon No. 5)	2	6
Clay shales, blue, sandy	20	6
Limestone, black, septarian	1	
Shales, black, bituminous, thin-bedded (black slate)	3	•
No. 2 coal (Key horizon No. 4)	2	
		<u> </u>
	141	6

Structure

The following quotation from an earlier report of the Survey presents all available information as to the structure of the Pennsylvanian strata in Brown County⁸:

DETAILED STRUCTURE

"The detailed structure was worked out by obtaining the elevation of seven key horizons. The most uniform and most reliable of all these horizons is No. 2 coal, and it was selected as the one most likely to show all details of structure. Its elevation above sea level was determined either by direct leveling or by computation from the elevations of the other key horizons, and a structure-contour map constructed by drawing lines through all points of equal elevation. The following structures were revealed:

"In general the coal dips to the east, but it has a rolling surface upon which are developed small domes, anticlines, terraces, and synclines. The maximum elevation attained is 653 feet in sec. 5, T. 3 S., R. 4 W. (Fairmount Twp.), just over the line in Pike County. The coal in the southwestern portion of Brown County is high, with a decline to the east of 123 feet to an elevation of 530 near Illinois River. In the northwestern portion of the county it is again high, rising to an elevation of 617 in sec. 29, T. 1 N., R. 4 W. (Pea Ridge Twp.), and decreasing to the east to an elevation of 516 in sec. 24, T. 1 N., R. 3 W. (Missouri Twp.). Outcrops are almost lacking in a broad belt across the central portion of the county so that it is impossible to predict the structure in that area.

"Covering most of T. 2 S., R. 3 W. (Elkhorn Twp.), and parts of adjoining townships is a broad terrace upon which lie three small domes. The terrace has an elevation of about 580 feet above sea level. A small dome covers most of sec. 1, T. 2 S., R. 4 W. (Buckhorn Twp.). At the apex of the dome in the NE. ¼ sec. 6, T. 2 S., R. 3 W. (Elkhorn Twp.), the coal has an elevation of 607 feet and is about 30 feet higher than to the north and east. To the south and west there is only a slight decline.

"In sec. 7, 8, 9, 17, and 18, T. 2 S., R. 3 W. (Elkhorn Twp.) is an irregular flat dome upon which the coal lies at an elevation of 600 feet or 30 feet higher than in the area to the north and east.

⁸ Nebel, M. L., Brown County: Ill. State Geol. Survey Bull. 40, p. 44-46, 1919.

BROWN COUNTY

"A broad terrace at an elevation of 580 feet covers most of the southern half of T. 2 S., R. 3 W. (Elkhorn Twp.), with a slight doming in secs. 13, 24, and 25. The apex lies at 596 feet in section 13. To the east the rocks dip off rapidly, so that the apex of the dome rises about 50 feet. To the west there is first a gentle dip, then the rocks rise into a sharp anticline.

"Extending almost due north in secs. 16, 17, 20, 21, 32, and 33, T. 2 S., R. 4 W. (Buckhorn Twp.), is a sharp anticlinal nose on which the coal lies 50 to 60 feet higher than to the north, east, and west. The shape of this structure on the south has not been determined, since field work extended only a short distance south of the county line. The highest known point is in the NW. ¼ sec. 5, T. 3 S., R. 4 W. (Fairmount Twp.), Pike County, where the coal lies 653 feet above sea level. To the west the coal dips steeply into a narrow syncline, while to the east it slopes gently toward the broad terrace in T. 2 S., R. 3 W. (Elkhorn Twp.). It is possible that additional data in Pike County will modify this structure, and that the coal may rise even higher to the south.

"In T. 1 S., R. 2 W. (Cooperstown Twp.), is an area of uplift, but outcrops are very few in this township, and it is impossible to outline the structure accurately. The data available suggest a broad dome with its apex in sections 27, 28, 32, 33, and 34, in which the coal lies 20 to 30 feet higher than in the area to the west, and 50 to 60 feet higher than in the area to the east. It slopes off gently to the north and south.

"In T. 1 N., R. 4 W. (Pea Ridge Twp.), is a dome with its apex lying in sections 20, 21, 28, and 29, at an elevation of 617 feet. It is 30 feet higher than to the east, south, and west. To the northeast it flattens out into a broad terrace, covering sections 2, 3, 9, 10, 15, and 16 at an elevation of 590 to 600 feet. In sections 13 and 14 of the same township is a slight dome arising about 20 feet above the surrounding territory, and sloping off into a low, narrow anticline to the northeast in secs. 5, 6, 7, and 8, T. 1 N., R. 3 W. (Missouri Twp.).

"A narrow strip across the northeast corner of the county, covering parts of Missouri and Ripley townships, was studied in 1914 by Morse and Rich.¹ The structural relations suggested by them have been slightly modified by new data, obtained in the course of the present work, but no important changes need be made. A dome exists in secs. 1, 2, 11, and 12, T. 1 N., R. 3 W. (Missouri Twp.), as indicated by their work, with a large syncline to the southeast. The broad Ripley dome in T. 1 N., R. 2 W. (Woodstock, Schuyler County, and Ripley, Brown County), is best interpreted as a terrace, since the new data indicates that the contour lines do not close around the south end.

"A small synclinal basin lies in secs. 8, 9, 16, and 17, T. 1 S., R. 3 W. (Mt. Sterling Twp.), completes the list of structures brought out by the contour map."

¹Morse, Wm. C., and Kay, Fred H., The area south of the Colmar oil field: Ill. State Geol. Survey Bull. 31, pp. 8-36, 1915.

COAL RESOURCES OF DISTRICT III

Colchester (No. 2) Coal

The Colchester (No. 2) coal is present over a large area lying between the valleys of Crooked Creek and McGees Creek. Here it is uniformly about 2 feet thick, without partings and of good quality, as elsewhere in this part of the State. The roof is black shale except in the northern part of the county where from one to eight feet of gray shale come in between the black shale and the coal. The floor is gray clay, sandy in places, about three feet thick.

In the extreme eastern part of the county, near LaGrange, T. 2 S., R. 2 W., is a small area which is presumably underlain by Colchester coal of usual thickness. The coal and accompanying strata essentially duplicate those in the larger field to the west.

Between these two fields, an area comprising nearly one-third of the county, no workable coal has been reported.

MOUNT STERLING COAL

In the immediate vicinity of Mt. Sterling, sec. 8, T. 1 S., R. 3 W., a coal ranging from two to three feet in thickness was mined for a time. This lies above the Colchester coal, possibly at the same horizon as the Rushville coal of Schuyler County, and is therefore here called the Rushville coal.

This coal is recorded in but a few places and does not appear to be of importance in an estimate of the resources of the county. While it underlies an area that may be as large as three or four square miles, it is apparently too irregular in its thickness to be of any value for mining.

BUREAU COUNTY

GENERAL STATEMENT

Only the western part of Bureau County is included in District III (Pl. IA). This area lies at the extreme north edge of the Illinois coal basin, the margin of the "Coal Measures" passing through T. 17 N., in ranges 6 and 7 E. The thickness and character of the Pennsylvanian beds suggest that they once extended farther north but have been partly eroded. The precise boundary of the rocks of this system is not known, but the workable coal extends little if any north of T. 16 N.
BUREAU COUNTY

Production and Mines

While at no time an important item in the total production of the county, there has always been a small tonnage won from this district for local use. The abandoned mines near Sheffield were among the first ones opened in the county, but at present the operations are in the next township west. The 1923 report of the Department of Mines and Minerals lists 5 mines from this part of the county.

STRATIGRAPHY

PLEISTOCENE SYSTEM

Except along stream valleys, all bed rock is concealed by the surficial deposits. These comprise the usual glacial and recent materials, unconsolidated, and very irregular in extent. They range in thickness from less than 10 feet to more than 100 feet. West of Sheffield, in T. 16 N., R. 7 E., the loose material is thinner than to the south, but east of Sheffield the cover is thickest. The records across the line in Henry County showing more than 200 feet of drift suggest deep erosion of the Pennsylvanian beds. This may extend in to the area about Neponset, T. 15 N., R. 6 E., where there are no records of borings.

PENNSYLVANIAN SYSTEM

Outcrops of the Pennsylvanian rocks are rare and the lack of adequate drill records makes impossible more than generalized statements of the character of these beds. Typical sections are exposed along the creek east of Sheffield. Here the uppermost beds are sandstone, about 15 feet thick, underlain by about as much shale. Below these are two calcareous beds, the upper a massive argillaceous bed, the lower a limestone ranging from 1 to 2 feet thick. Still lower is a shale zone about 3 feet thick, in places sheeted and hard, but elsewhere soft. Under this variable cover is a coal of fairly uniform development, about 4 feet thick and having a light gray, sandy underclay.

The recorded logs for this area show similar successions of beds, mostly sandy shale or sandstone, with little coal and an occasional bed of limestone. As is to be expected in an area so near the margin of the Pennsylvanian coal basin, the rocks show considerable variation from place to place. The coal itself ranges from a few inches to five feet, but carries a shale parting near the middle in most places. Other clay partings occur locally near the bottom of the bed. In places the roof is black shale or soapstone, elsewhere sandstone, and less commonly the cap limestone comes down to the clod over the coal. The following log is typical of the beds in this region:

Description of strate	Thi	ckness	Depth	
Description of sciata	Ft.	In.	Ft.	In.
Soil and clay	12		12	
Sand	3		15	
Sandstone, soft	3		18	
Clay shale	7		25	
Shale, light	11	4	36	4
Hard rock		8	37	
Slate	1	• • •	38	• •
Coal Sheffield (No. 6)	4	5	42	5
Light shale-lime nodules	31	3	73	8
Light sandy shale nodules	19		92	8
Shale, gray	· 27		119	8
Sandstone, shale	6		125	8
Shale, dark and gray	35	• •	160	8
Shale, gray	46	• •	206	8
Shale, light	4		210	8
Shale, gray	4	6	215	2
Shale, light	2	10	218	• ••
Fossil limestone		8	218	8
Slate	2	• •	220	8
Shale, dark	5	6	226	2
Slate	2	8	228	10
Shale, light	6		234	10
Slate		10	235	8
Shale and sand, light	11	6	247	2

Typical log of Pennsylvanian strata in Bureau County

Few beds in the section can be recognized definitely. The series of five beds above the coal in the log belong clearly to the sequence which always accompanies this coal in Bureau and adjoining counties. The "hard rock" is the limestone which uniformly carries fossils, among which is usually the fusulina that has long been considered an index fossil for the Sheffield coal.

Other coals appear in the area in places, but are less frequently recorded than in the Sheffield area. At a depth of more than 150 feet there is in places a 3-foot bed which has been correlated with the "third vein" of the La Salle area. A 2-foot bed of coal has also been noted in some parts of this region lying 25 to 40 feet above the Sheffield coal.

Structure

So far as the data at hand indicate, the Pennsylvanian beds of this part of Bureau County are essentially flat-lying. Local arching of a few feet is noted in all mines, but no general deformation is recognizable. In most mines, also, are small fractures and slips of the rocks enclosing the coal, too small to be considered important structural features.

Sheffield Coal

The most important coal of this portion of Bureau County is the 4-foot bed which is found at shallow depths near Sheffield. It was deposited irregularly over the south two-thirds of T. 16 N., in ranges 6 and 7 E., so that while locally it is of workable thickness, there are considerable areas in which it is too thin to be of value. There are no data on this coal for T. 15 N., but from its presence in the adjacent portion of Henry County it seems probable that it will be found here also. On this assumption, this part of the county should be included within the area mapped as containing workable coal belonging to this seam.

The coal ranges in thickness from a few inches to a maximum of 5 feet. In most mines it reaches maximum thickness, but the average is about 53 inches.

The Sheffield coal is somewhat variable in quality, but is in general a better coal than others in this region. It is hard, mostly bright, with sub-conchoidal fracture. It is plainly laminated, with mother of coal partings. It contains some calcite and gypsum as well as pyrite as impurities. The pyrite is much more common in the zones of fracture which are common in parts of this bed. Elsewhere it is of little consequence. A shale parting from ¼ inch to 2 inches thick commonly separates the coal into two benches. This is not everywhere present, but is commonly considered diagnostic of this bed.

A cap limestone is usually present over the coal, but separated from it by a few inches to several feet of shale. The shale is light gray to black and may be soft and loose or may be sheeted, hard and "frozen" to the coal. In the latter case it has to be drawn with the coal. Locally the shale top is gritty enough to be classed as sandstone, but this phase commonly grades to the true shale in short distances. In places, however, as near Sheffield, the beds normally over the coal have been eroded, and replaced by a later sandstone. Locally such sandstones "cut out" the coal. The floor is hard underclay, light in color, and containing at or near its base calcareous matter either as nodules or as a distinct bed of lenticular shape.

The following notes from one of the mines in this region show typical conditions for the Sheffield coal:

Shaft: 51 feet deep; surficial material 9 feet.

Roof: Limestone, with slate up to 54 inches beneath.

Coal: Maximum thickness 62, minimum 48, average 58 inches.

Floor: Shale, light gray, dry; does not heave.

Notes: The coal lies in an east-west trending basin; it is affected by a number of "horsebacks", which occur in a zone near the shaft. Pyrite is common in Bureau County and near the horsebacks, but the coal is unusually clean elsewhere.

Other Coal Beds

Over part of the area, as near Buda, T. 16 N., R. 7 E., a coal averaging 24 inches in thickness is reported from 25 to 40 feet over the Sheffield coal. It appears to have an extremely irregular disposition and to be of inferior grade. It is therefore not considered in the estimate of coal resources for the county. Another bed, lying between 100 and 200 feet below the Sheffield coal, is recorded near Sheffield. This is probably the coal mined near Tiskilwa and recorded in a log from Annewan in Henry County. It is tentatively correlated with the "Third Vein" of LaSalle County. No data at hand indicate this as an important bed and it is not considered in the estimate of the county's resources.

CALHOUN COUNTY

General Statement

Calhoun County lies in the extreme southwest corner of District III, and is separated from the main coal field by both Illinois River and a structural deformation which brings the Mississippian rocks to the surface on the northeast (Pl. I B). As a result, only the extreme southern part of the county is underlain by "Coal Measures", and a very limited area is involved.

Production and Mines

But one or two mines have ever been operated in the county. In recent years, no mines have reported production but between 1885 and 1912 from 2000 to 6000 tons were produced annually, mainly in con-

nection with clay mined for paving brick or sewer pipe in the vicinity of Golden Eagle.

Area underlain by workable coal8 sq.	mi.
Average thickness	ches
Amount available originally17,900,000 t	ons
Production, year ending June 30, 1923n	one
Average annual production, 1919-1923n	ione
Total production recorded96,087 f	tons

STRATIGRAPHY

PLEISTOCENE SYSTEM

The drift in the area underlain by Pennsylvanian rocks is largely loess which caps the bluffs along both the Illinois and the Mississippi. The till below the loess is relatively thin.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds outcrop in gullies of T. 13 S., ranges 1 and 2 W. The boundary of the Pennsylvanian areas can not be accurately mapped, and it is placed at the 520-foot level arbitrarily upon the elevation of the base at Golden Eagle, as well as upon the assumption of horizontal attitude. The section for the county, as given by Worthen⁹, is as follows:

Typical section of Pennsylvanian strata in Calhoun County

Description of strata	Thic	kness
	Ft.	In.
Shale, brown	6	
Limestone, gray, concretionary	5	
Shale, sandy brown and concealed interval	65	
Coal		4
Clay shale and iron ore	2	6
Coal	2	2
Fire clay	3	
Clay shale, grading down to black	12	
Sandstone and sandy shale	25	
Mississippian limestone		

In this section, the prominent beds are the upper concretionary limestone which contains fusulina and the 2-foot coal near the base. According to Worthen, the black shale below this coal probably corresponds with a lower coal bed, but no such coal has been found within the county.

9 Worthen, A. H., Geol. Survey of Illinois, Vol. IV, p. 16, 1870.

Structure

No information is available regarding the structure of the coal beds, either for the county as a whole or for the workings of the mine at Golden Eagle. On the basis of the general geology of the region, it is assumed that the Pennsylvanian beds are essentially flat, although variations from this attitude are to be expected.

GOLDEN EAGLE COAL

So far as known, coal has been found only in the following four places in the county: the NW. $\frac{1}{4}$ of sec. 10, the NE. $\frac{1}{4}$ of sec. 24, the NW. $\frac{1}{4}$ of sec. 36, T. 13 S., R. 2 W., and in the part of sec. 1, T. 14 S., R. 2 W., in which the Golden Eagle mine was located. The coal is from 24 to 30 inches thick, appears to be relatively free from sulphur, and in general the equal of the average western Illinois coal. There is about $2\frac{1}{2}$ feet of clay shale for roof, the upper part ferruginous. The 4-inch coal overlying this shale, which was classed by Worthen as a distinct bed, does not appear to be found elsewhere in the county, and perhaps should be considered a local development. Below the coal is fire clay two or three feet thick, which grades downward to black bituminous shale. The thinness of the bed makes it expensive to mine and it has therefore not been worked for the past ten years or more.

CASS COUNTY

GENERAL STATEMENT

Cass County lies along the east margin of the area included in District III, and shows a general section resembling that of eastern Schuyler County to the north (Pl. I B). The "Coal Measures" are relatively thick and include in the thicker portion beds which overlie Rock Island and Colchester coals.

Production and Mines

Production from this area has been somewhat irregular, but at no time of more than local importance. In 1922, four mines producing less than than 7,000 tons were reported, and in 1923, six mines produced about 9,000 tons. These are in the vicinity of Chandlerville, in the northeastern part of the county, Ashland in the extreme southeastern part, and in the bluffs east of Beardstown in the western part of the county.

Area underlain by workable coal	. mi.
Average thickness	ches
Amount available originally	tons
Production year ending June 30, 1923	tons
Average annual production, 1919-1923	tons
Total production recorded182,609	tons

Stratigraphy

PLEISTOCENE SYSTEM

The surficial deposits in Cass County are known to be rather heavy, as most well logs show about 100 feet of unconsolidated material over bed rock. A maximum of nearly 200 feet was reported from a well near Virginia, T. 17 N., R. 10 W. Details of the character of the deposits are lacking, however, and only a general statement is possible. Below a cover of fine loessial clay, from 5 to 20 feet thick, lie varying thicknesses of boulder clay, sand, and gravel. In places these have been found to contain much water. The floodplains of the Illinois and of the Sangamon are underlain by recent alluvium to considerable depths.

PENNSYLVANIAN SYSTEM

All of the county is underlain by "Coal Measures", except a narrow strip near Illinois River and along Sangamon River in the vicinity of Chandlerville. In these areas Mississippian rocks are exposed. The Pennsylvanian ranges from 10 feet to more than 250 feet in thickness, and shows the usual series of impure sandstone and shale with several thin limestone and coal beds. A shaft log from near Bluff Springs, T. 17 N., R. 11 W., shows the following section:

Log of shaft near Bluff Springs, T. 17 N., R. 11 W.

Description of strata	Thickness <i>Ft</i> .	$\begin{array}{c} ext{Depth} \\ ext{Ft.} \end{array}$
Soil (loess)	. 15	15
Sandstone, brownish, with plant impressions	. 13	28
Limestone ("blue rock")	. 2	30
Clay shale ("soapstone")	. 12	42
Coal	. 3	45
Fire clay, very hard	. 4	49

The coal here listed is probably the same as that mined at a depth of about 200 feet at Virginia, where a boring for coal shows the following section:

	 F't			
	1. 0.	In.	Ft.	In.
Pleistocene and Recent systems	115		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, Colchester (No. 2)	3	6	204	3
Fire clay (base of Carbondale)	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	16	4	258	3
Coal No. 1		3	258	6
Sandstone	2	9	261	3
Coal		2	261	5
Sandstone and shale	3	9	265	2
Clay shale	4		269	2
Sandstone	7	5	276	7
Bock hard siliceous	2		278	7
Clay shale	2	6	281	1
Bock hard siliceous	3	6	284	7
Shale hard green	2	10	287	5

Record of coal boring near Virginia

It is not improbable that approximately the lowest 10 feet in the above section belongs with the Mississippian system.

The geology of the "Coal Measures" of Cass County has been adequately discussed in an Illinois Mining Investigations bulletin¹⁰' from which the following paragraphs are quoted:

"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

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¹⁰ Cady, G. H., Coal resources of District IV: Ill. Coal Mining Investigations Bull. 26, p. 62, 1921.

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 LaSalle "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 feet. It is probably this same bed which at one time was mined at Ashland at a depth of 205 feet. As the identity of this coal is not determined, and as it may be younger than No. 2 coal, 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 correlation of the coal mined at Bluff Springs and Virginia is based on comparisons made by Worthen, 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 is a bed of limestone 2 to 5 feet thick, known locally as the 'sump rock'.

"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....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.

"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 $3\frac{1}{2}$ feet in thickness, and elsewhere possesses great regularity in thickness and in physical characteristics though very little is known of 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.....

"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."¹¹

¹¹ Idem, p. 64.

FULTON COUNTY

General Statement

Fulton County lies near the center of District III along the east margin, and includes within its boundary a considerable area of Mc-Leansboro and Upper Carbondale beds (Pl. I A). It occupies a position near the margin of the thicker part of the Illinois coal basin, and is essentially a continuation of the beds of the Peoria-Springfield area. The relations to the main field are essentially the same as in Knox County, and here, as in the report of Knox County, some discussion of the eastern part of the county in which the Colchester and lower coals are not of commercial importance is included. The area included for District III is practically restricted to eight townships in the northwest part of the county.

Production and Mines

There are about as many mines in Fulton County as in any county of the State, but the total production is not great because of the great predominance of country banks. The report of the Department of Mines and Minerals for 1923 records 26 shipping mines with a total production of approximately 2,000,000 tons. In addition, there are recorded 194 local mines with a total production of slightly more than 250,000 tons. Of the 220 mines, but one of the shipping mines and 45 of the local mines belong in District III.

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene of the county varies in thickness from 10 to about 155 feet, with an average of about 40 feet. The materials are similar to those of Knox County to the north. Glacial clay, in places containing many boulders, makes up most of the deposit. On the uplands, however, it is overlain by a yellow clay or silt, with a maximum thickness of 20 feet, and in the lowlands by recent alluvium. A small amount of sand and less gravel appears in the Pleistocene system.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds outcrop in all parts of the county, but the best exposures are in the valley of Spoon River and its branches. Spoon River exposures were combined into a type section by Worthen in his early work in Illinois and a series of seven coal beds were described and numbered. With one exception, these beds are still recognized, Worthen's No. 4 now being considered identical with his No. 5.

A large amount of drilling has been done in the county, but mainly in the eastern part where the Springfield and Belleville coals are commercially important. Much less is known of the lower beds with which this report is primarily concerned. The records from the eastern side of the county show a total thickness of between 300 and 400 feet for the Pennsylvanian, but the logs from the west margin show the system to be much thinner. One record near Marietta, T. 6 N., R. 1 E., shows 14 feet of limestone overlying about 70 feet of blue shale. These overlie Mississippian limestone, to which system some of the shale perhaps should be referred.

The Pennsylvanian section in western Fulton County shows considerable sandstone. Shale and sandy shale predominate, with limestone and coal in very subordinate thicknesses. The beds important stratigraphically are Seville (No. 1) coal and its limestone cap, and Colchester (No. 2) coal which usually can be recognized without difficulty. The relations and character of these beds are indicated in the following paragraphs taken from an earlier Survey report.¹²

"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 $4\frac{1}{2}$ 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 part-

¹²Cady, G. H., Coal resources of District IV: Ill. Mining Investigations Bull. 26, p. 80-81, 1921.

ings. Where it is worked in the western part of the county at Ellisville, it is $3 \text{ to } 5\frac{1}{2}$ 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 disappear 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.

"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.

Description of strata	Thickness		De	pth
	Ft.	In.	Ft.	In.
Pleistocene and Recent systems-				
Clay	18		18	•••
Pennsylvanian system—				
Carbondale formation-		1	· · · ·	
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	4
		1		

Record of drilling between Fiatt and Cuba

FULTON COUNTY

Description of strata	Description of strata Thickness		Depth	
	Ft.	In.	Ft.	In.
Pottsville formation—				
Shale, sandy, light	18	8	164	• • •
Coal	1	••	165	
Shale, light, sandy	12	••	177	
Shale, dark	1	••	178	
Coal		4	178	. 4
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	Ì	219	
Shale, dark, hard	6	7	225	7
Coal (No. 1)	4	4	229	11
Shale, light, sandy	6	1	236	

Record of drilling between Fiatt and Cuba-Concluded

"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

In general, throughout Fulton as in the other counties of the district, the Pennsylvanian rocks show very little deviation from a horizontal attitude. They show a slight regional dip eastward with minor upwarps west of Avon, T. 8 N., R. 1 E., and northwest of Fairview, T. 8 N., R. 3 E.

It is probable that in any area exploratory work will reveal minor variations of structure which will be of especial importance in actual mining operations. Minor irregularities in structure will be noted in the discussion of certain coal mines.

Colchester Coal

From the standpoint of available tonnage, it is probable that the Colchester coal is the most important bed in that part of Fulton County which lies in District III. It has been reported from near Lewistown, Table Grove and Astoria and appears to underlie the west half of the county except where removed by erosion. Data now available do not permit mapping boundaries of this coal south of Seville, but throughout this area it has been exploited in country banks rather generally. Only a small fraction of the original tonnage has been touched, however, and when coals thinner than are now mined become important, this will become a valuable resource. It ranges from 20 to 30 inches in thickness, and is noted for its remarkable uniformity. No persistent partings accompany this bed, which is of better quality than the higher coals, and carries only a small amount of pyrite. The roof is quite uniformly gray shale 10 to 15 feet thick, called "soapstone" by the miners. In places, as in the Vermont area, the shale is sandy so that the roof in one part of the mine may be shale and in others sandstone. Over this stratum are a few feet of black fissile shale. The floor clay is generally soft, gray and plastic. Only the upper two feet are commonly penetrated, and the lower beds are not known.

Ellisville Coal

The only other coal of importance in western Fulton County is that now worked at Ellisville Station, on Spoon River. This is the No. 1 bed of Worthen's type section for this part of the State, and has generally been correlated with the Rock Island coal, which it closely resembles. This bed appears to have a very irregular distribution in the county so that its importance as a coal reserve is problematical. It is known rather generally north of Table Grove, in T. 4 N., R. 1 E., as at Marietta, Avon, Babylon, and Ellisville, but has rarely been identified south of this area. East of the limit of District III it has been reported commonly in logs, but here too it shows no regular deposition. Although fairly persistent, its thickness is so variable as to render exploitation questionable, and it commonly has partings of shale which render it worthless for mining.

It reaches a maximum of 6 feet in thickness and over considerable areas maintains an average of about 4 feet. If the entire region where it is known to be present is considered, however, it is much thinner than that and only extensive drilling will serve to outline areas of workable coal.

The Ellisville coal is of relatively high grade. It has no persistent partings and what pyrite it contains is commonly in bands or lenses which can readily be separated from the coal as it is mined.

Where normally developed, this coal has a cap-rock of limestone. In places a lower bench of this limestone comes down after the coal is removed. Elsewhere as much as 5 feet of shale comes in between the limestone and the coal. These occurrences are troublesome and expensive in mining, but where the cap is close to the coal it makes an excellent roof. The floor clay is carbonaceous for the top ten inches and softens up along roadways, but does not heave enough to give any trouble. Below this the bed is gray sandy shale which rarely softens.

Mine Notes

The following notes taken by a member of the Survey, are introduced to show the details of the occurrence and character of the Ellisville coal:

Ellisville coal at Spoon River Colliery Company mine¹³

Entrance: shaft, 40 feet to coal.

Thickness of rock over coal: about 25 feet.

Roof: Limestone cap-rock with clod or shale below it in places. Black shale occurs in lenses and is generally found in the swags. This shale is black, carbonaceous, with some lime near the margin of the lenses. It is more solid toward the center, with less lime, and may be more than 5 feet thick. The cap limestone, with the overlying calcareous shale known as the blue rock, is in places as much as 21 feet thick.

Coal: Maximum 72 inches, minimum 36 inches, average 48 inches. No benches; much harder than Matherville or Sherrard; only slightly banded, becoming more massive near the bottom. Sulphur and sulphurous clay in lenses. Considerable mother coal in partings. Where thin, the coal contains more sulphur.

¹³ White, K. D., Mine notes in files of State Geological Survey.

Floor: Dark sandstone and shale, does not heave. The coal is interrupted by faults of small dimensions, these make steep grades in places, but are not of consequence otherwise. Figure 5 shows the usual type of dislocation.



FIG. 5. Sketch showing fault in Ellisville coal.

Other Coal Beds

Although not of commercial importance, other coal beds are commonly noted in drill logs from the western part of Fulton County. These are usually thin and discontinuous and can rarely be traced with certainty more than half a mile. The following extract from a report on the Avon Quadrangle is of interest in this connection:¹⁴

"In a number of places in the Avon quadrangle a coal bed 1 to $2\frac{1}{2}$ feet thick is present only a few feet below the Rock Island bed, and is usually overlain by sandstone. This coal has been mined by drifts in a few places, as in sec. 31, T. 9 N., R. 1 E., sec. 13, T. 8 N., R. 1 W., and sec. 18, T. 8 N., R. 1 E. At the latter locality the bed is about 14 inches thick and resembles cannel coal. Many years ago it was extensively worked for the distillation of coal oil, in which process 10 retorts were at one time in operation. Thirty gallons of oil are said to have been produced from one ton of coal. At that time the clay underlying the coal was also mined and manufactured into fire brick. A coal bed belonging to this horizon is also well exposed in the banks of Cedar Creek in secs. 23 and 26, T. 9 N., R. 1 W."

¹⁴Savage, T. E., Geology and mineral resources of the Avon and Canton quadrangles: Ill. State Geol. Survey Bull 38, p. 252, 1922.

GREENE COUNTY

GENERAL STATEMENT

Greene County lies in the southwest margin of the coal basin, and shows a more complete section of the "Coal Measures" than any of the counties south of Fulton (Pl. IB). It includes a portion of the McLeansboro, much of the Carbondale, and some of the Pottsville formations.

PRODUCTION AND MINES

Mining has at no time been very active in this county, but from a relatively early date, local banks have been worked in Colchester (No. 2) coal in the vicinity of Roodhouse, Whitehall, and Carrollton. The Greenfield bed has been exploited less continuously, but at present is producing about 70 per cent of the coal reported from the county. In 1922 the report of the Department of Mines and Minerals recorded five mines producing a total of 3,000 tons, while in 1923 the three mines listed a total of over 8,000 tons. Earlier records show as many as nine local banks with a total production of less than 10,000 tons.

Area underlain by workable coal204 sq	. mi.
Average thickness	lches
Amount available originally461,000,000	tons
Production, year ending June 30, 1923	tons
Average annual production, 1919-192324,171	tons
Total production recorded	tons

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene deposits are from 100 feet to 120 feet thick, showing the usual gray drift with yellow loess on top, the latter being relatively thin in the area underlain by the Pennsylvanian beds.

PENNSYLVANIAN SYSTEM

The "Coal Measures" underlie only the eastern half of the county, the boundary line showing marked irregularity because of the combination of the thinness of the Pennsylvanian section and the topographic relief along the major streams. Thus, there is a westward projection in the high land near Drake, in T. 12 N., R. 12 W., while the valleys of Apple Creek and Macoupin Creek cause marked reentrants of from 5 to 15 miles. A few square miles in the extreme southeastern part of the county are probably underlain by Pennsylvanian beds.

From a feather edge at the west, the Pennsylvanian thickens to more than 150 feet at the east. The rocks commonly outcrop near the margin of the Pennsylvanian area, but are mainly concealed elsewhere. A typical section for the county is given by Worthen,¹⁵ as follows:

Typical section of Pennsylvanian strata in Greene County

Description of strata	Thickness
	Feet
Compact brown limestone	2-4
Bituminous shale	1
Coal No. 6	6
Shaly clay and nodular limestone	3 - 4
Shale	15 - 20
Bituminous shale	2 3
Coal No. 5	2 - 3
Arenaceous shales and sandstone	25 - 30
Bituminous shale, passing to coal No. 3?	2
Sandstone and shale	40 - 50
Coal—Tulison's and Nettle's coal No. 1	2 - 3
Nodular steel-gray limestone, sometimes replaced with fire clay,	,
as at Tulison's	4 - 6
Shale and sandstone, passing locally into conglomerate	15 - 20
Total	153

From east to west, the upper beds recorded in drill logs appear to be older, the recognized McLeansboro beds extending only two or three miles into the county. The important beds in the section are the limestone cap-rock over the Belleville (No. 6) coal which is reported to outcrop in sec. 36, T. 10 N., R. 10 W., the nodular limestone which outcrops in sec. 27, T. 10 N., R. 11 W., and the 2-foot coal which outcrops in secs. 24 and 25, T. 12 N., R. 10 W. and in sec. 12, T. 10 N., R. 12 W. The relations between the coals in the various parts of the county are not well understood, since the rock section appears to vary considerably from place to place. The following sections are selected to show the character of the strata in various parts of the county. The section at Roodhouse, T. 12 N., R. 12 W. is as follows:

¹⁵ Worthen, A. H., Geol. Survey of Ill., Vol. III, p. 124, 1868.

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GREENE CO	U	Ν	Т	Y,
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Description of strata	Thickness	Depth
	Ft.	Ft.
Pleistocene system	73	73
Pennsylvanian system		
Soapstone	14	87
Coal, elevation 563 feet	2	89
Clay	5	94
"Cap-rock"—brecciated limestone	16	110
Shale	19	129
Slate and coal	3	132
Fire clay	. 3	135
Soapstone	. 2	137
Mississippian system		

Section of Pennsylvanian strata near Roodhouse

A boring from sec. 15, T. 10 N., R. 11 W., six miles east of Carrollton records the following section:

Description of strata	Thic	kness	Depth		
	$F\dot{t}.$	In.	Ft.	In.	
Pleistocene system	40		40		
Pennsylvanian system					
Shale, red	4		44		
Shale, black with 1-inch coal	1		45	•	
Limestone	2		47		
Shale, blue, with sand strata	108		155		
Coal		8	155	8	
Shale, blue	4		159	8	
Shale, white	6		165	8	
Shale, red	12		177	8	
Shale, green	2		179	8	
Shale, blue	30		209	8	
Mississippian system					
Rock, white	10		219	8	

Section of Pennsylvanian strata near Carrollton

A section near the boundary of the Pennsylvanian north of Macoupin Creek is as follows:

Thicl	kness	Depth		
Ft.	In.	Ft.	In.	
3	6	3	6	
2		5	6	
15		20	6	
	6	21		
2		23		
1		24		
$15\pm$		$39\pm$		
	Thic: Ft. 3 15 2 1 15 \pm	Ft. $In.$ 3 6 2 15 6 2 15 15 15 15 15 1 15	ThicknessDep $Ft.$ $In.$ $Ft.$ 36325152062122312415± $39\pm$	

eSction of Pennsylvanian strata north of Macoupin Creek in Greene County

The base of the Pennsylvanian does not appear to be as irregular as farther north, although moderate relief is in evidence in all exposures.

Structure

The Pennsylvanian beds show a regional eastward dip of low degree. Local warping, or original inequalities, appear in all the mines. Some minor fractures of one or two feet in magnitude appear in most openings. It is not clear whether these fractures and the slickensides which affect the clay associated with the coal are the result of differential slipping coincident with consolidation, or whether they are related to later movement. Detailed structural studies, as yet uncompleted in this and adjacent areas, will be the basis of a later Survey report.

Colchester (No. 2) Coal

The oldest coal mined in Greene County is that in sec. 24, T. 12 N., R. 10 W., and along Wolf Run, east of Whitehall. Essentially the same sequence of strata appears in all workings, and one from Wolf Run may be taken as typical:

Section of Pennsylvanian strata in Wolf Run east of Whitehall

Description of strata				
	Ft.	In.		
Shale, gray	15			
Shale, black		$8\frac{1}{2}$		
Sulphur		$1\frac{1}{2}$		
Coal		$4\frac{1}{2}$		
Sulphur		$\frac{3}{8}$		
Coal	1			
Sulphur		$\frac{1}{2}$		
Coal		3		

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GREENE COUNTY

Section	n oj	' Per	insy	lvan	ian	st	rata	in	V	Volj	fΓ	lun	ea	st	of	И	Th	ite	eh	ali	<i>l</i>	Conc	luded
De	escr	iptio	n of	stra	ıta																	Thicl	kness
																						Ft.	In.
Charco	al	and	sulj	phur	•••				• •					• •	•••			• •				••	1/2
Coal .												•••			•••			• •					41/2
Fire c	lay,	soft																				12	

The coal probably underlies nearly all the area mapped as Pennsylvanian, so that with an average thickness of 24 inches a considerable tonnage of reserve coal is available when conditions permit mining thin beds.

GREENFIELD COAL

Along the eastern margin of the county there is an irregular distribution of a considerably thicker coal which lies well up in the Pennsylvanian section and may be the representative of the Belleville (No. 6) bed of Macoupin County. Some development of this coal area has been made near Greenfield, T. 10 N., R. 10 W. It has been mined also east of Rockbridge, to a lesser extent southwest of Athensville, T. 12 N., R. 10 W., and in the earlier days southeast of Roodhouse, T. 12 N., R. 11 W. The section showing its maximum development in the mine of the Greenfield Coal Company is as follows:

Section of Pennsylvanian strata in the mine of the Greenfield Coal Company

Description of strata	Thickness Inches
Soapstone roof	
Top coal, thickness not measured	
Coal	. 13
Shale and pyrite band	· ¼
Coal	. 5
Pyrite lens	. 1
Coal	. 18
Pyrite lens	. 1/8
Coal	. 6½
Pyrite lens	. 3/8
Coal	. 331/2
Dark gray floor clay	

The thicker coal is not known to underlie as much as one square mile in any case, so that while locally of importance, this bed can not be considered of consequence in an estimate of the resources of the county.

HANCOCK COUNTY

GENERAL STATEMENT

Hancock County lies in the extreme west margin of the Illinois coal field, and except for certain small outliers, the Pennsylvanian beds are found only along the east margin, and they are thin in most places (Pl. I A).

PRODUCTION AND MINES

There are no shipping mines operating in the county, and the 1923 report of the Department of Mines and Minerals lists seven local mines, all in the vicinity of Augusta, which produced a total of 9,313 tons during the fiscal year.

Area underlain by workable coal7 sq. mi	
Average thickness	5
Amount available originally	5
Production, year ending June 30, 1923	3
Average annual production, 1919-192327,015 tons	5
Total production recorded	5

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene deposits are prominent over the whole county, and their thickness makes the placing of the boundary of the Pennsylvanian beds difficult. The Pleistocene varies from 20 to 75 feet in thickness, the upland having an average of 20 to 60 feet. The beds are similar to those described for adjoining counties, having loessial clay on top averaging nearly 10 feet in thickness, with hardpan or gravelly clay at the base, containing occasional lenses of sand and gravel.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds are thin, comprising sandstone and shale, with few and thin coals and some conglomerate. The outcrops of the Pennsylvanian are fairly abundant along the stream channels in the entire easternmost tier of townships in Hancock County. For the most part, the exposed sections are less than 10 feet in thickness, but locally 30 feet or more appear. In all except the southeast part of the county the outcrops are mainly sandstone with minor amounts of shale. A few inches of coal "blossom" appears in places. The maximum thickness of the Pennsylvanian is a little less than 100 feet. So great a thickness appears only in the extreme southeast part of the county where considerable thicknesses of Carbondale beds appear over Colchester (No. 2) coal. In this part of the county the upper part of the sections includes some limestone. This is perhaps the only distinctive bed in the Pennsylvanian section, but because of its limited extent, it is of no value for stratigraphic purposes. There is no other prominent bed except Colchester (No. 2) coal. Two coal beds appear in the southeast part of the county, but the lower bed is much less widespread than the upper. The interval between the two ranges from 2 feet to more than 8 feet. The following logs give a general conception of the Pennsylvanian in Hancock County:

Description of strata	Thic	kness	Depth		
	Ft.	In.	Ft.	In.	
Pleistocene system					
Black soil	3	10	3	10	
Yellow clay	10		13	10	
White sand	3		16	10	
Blue clay	15		31	10	
Boulders	4		35	10	
Pennsylvanian system					
Slate		10	36	8	
Soapstone	14		50	8	
Coal	3		53	8	
Fire clay	12		65	8	
Sandstone	10		75	8	
Fire clay	6	6	82	2	

Log of boring near Augusta, T. 3 N., R. 15 W.

Another log records 55 feet of Pleistocene with 34 feet of shale and sand below. The following shaft logs indicate the succession in the extreme eastern part of the county:

Shaft lo	og of	the	Augusta	Coal	Company
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Description of strata	Thickness	Depth
	Feet	Feet
Shale, light gray	. 33	33
Coal	, 3	36
Clay, light gray	. 7	43
Coal "cannel"	$2\frac{1}{2}$	$45\frac{1}{2}$
Clay		

In. 	Ft. 10 36	In.
 	10	
	36	
	50	
	45	
	51	
	83	
	86	
6	88	6
2	90	8
	93	8
	$\begin{array}{c} & & \\ & & 6 \\ & 2 \\ & \ddots \end{array}$	86 88 2 90 93

Shaft log of the Ebben Mine, sec. 26, T. 3 N., R. 5 W.

The Pennsylvanian beds lie in overlap relations to the Mississippian limestone series below. This lower surface is somewhat uneven, but the records do not show the marked relief which appears in adjoining counties. More detailed information will doubtless reveal the presence of greater irregularity than now appears.

Structure

The Pennsylvanian beds, while maintaining a general flat attitude, probably have a slight eastward dip. Minor warping is marked where mining operations have made it possible to follow given beds for any distance. Thus, in the Williams Creek area, the coal shows a general southwest and west dip, in places this being compensated by equivalent eastward and northeastward dips. These show inclinations as high as seven degrees for 100 yards. Whether these variations in altitude are original and represent irregularities in the basin of deposition, or whether they are warps induced by subsequent folding, is not clear from present data. The fact that the coal commonly becomes thinner in places where it is higher favors the idea that these basins are original and not structural.

COLCHESTER COAL

The only coal field in the county important at present is in the extreme southeastern corner in T. 3 N., R. 5 W. where Colchester (No. 2) coal from 24 to 36 inches thick underlies an area estimated at about seven square miles. It has no persistent parting, although the upper part is usually harder and brighter than the lower. A typical section is as follows:

HANCOCK COUNTY

Typical section of Colchester coal in southeastern Hancock County

Description of strata	Thick	ness
	Ft.	In.
Gray shale roof		
Pyrite		$1\frac{1}{2}$
Coal		$4\frac{3}{4}$
Pyrite		$\frac{1}{2}$
Coal		$7\frac{3}{4}$
Pyrite	••	1/4
Coal	•••	$16\frac{1}{2}$
Underclay	4	

The lower part shows more distinct banding of bright and dull coal, and a larger per cent of charcoal. The roof of this coal is gray shale uniformly in this county, although a few miles to the east in Schuyler County the shale is replaced by sandstone. The floor material is as usual for Colchester (No. 2) coal, a light gray plastic clay. No other coal is worked in this county, except in those places where the lower bed, as at the Ebben mine, is separated from the main bed by only two or three feet of shale. This lower bed is commonly called the "cannel coal" from its subconchoidal fracture and its massive appearance. While resembling the cannel coal, it possibly does not have the chemical or organic composition which is essential for a true cannel.

Other Coal Beds

West of the main boundary of the coal field in Hancock County, as mapped in Rs. 5 and 6 W., are one or more isolated patches of coal which have been worked or reported. These may be connected with the main field but more likely constitute outliers both of the coal and of the Pennsylvanian beds as a whole. Such a one appears in sec. 34, T. 3 N., R. 6 W. Coal was similarly reported along Crooked Creek in T. 5 N., R. 6 W. This coal was 12 inches thick, and presumably lies below the regular Colchester coal, although it may be the thin western edge of that bed. Old coal workings are reported from sec. 13, T. 4 N., R. 8 W., and a 14-inch coal was reported from sec. 4, T. 5 N., R. 8 W., and sec. 32, T. 6 N., R. 8 W. At Nauvoo a thin coal was found immediately below the drift, and was stripped at an early date by the Mormon settlers.

It thus appears that over most of the county there is a possibility of finding thin patches of Pennsylvanian rocks with or without coal. While coal in this general area may reach a thickness sufficient to make it possible to mine, it will never be found sufficiently widespread to make more than local mining attractive. When the Mississippian surface is known in greater detail, probably it will be found that the majority of the Pennsylvanian rock patches constitute outliers separated from the main coal field by distances ranging from 1 to 20 miles.

HENDERSON COUNTY

GENERAL STATEMENT

Henderson County lies on the western margin of the Illinois coal field so that only the southeastern portion of the county is underlain by Pennsylvanian strata (Pl. IA). Within this area the workable coal is confined to the SE. $\frac{1}{2}$ of T. 8 N., R. 4 W.

No shipping mines have ever been operated in the county, and no local banks have been commercially operated for many years, although in the past some coal has been dug in sec. 26, T. 9 N., R. 4 W.

Area un	derlain by	workable coal	22 sq. mi.
Average	thickness		29 inches
Amount	available	originally	,000 tons

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene is reported 16 to 80 feet thick, being thicker in the southeastern part of the coal area where it effectively conceals the bed rock. The deposit comprises yellow and blue clay with subordinate sand and gravel.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds are thin; the maximum thickness reported is in sec. 25, T. 9 N., R. 4 W., where it is less than 40 feet. The only known outcrops of Pennsylvanian beds are in the northwest part of T. 8 N., R. 4 W. (Raritan Township) and along the small creek in the NE. ¼ sec. 26, T. 9 N., R. 4 W. These reveal gray-white sandstone underlain by thin coal in places, elsewhere by shale or more shaly sandstone. Drilling shows the sandstone to be as much as 30 feet thick and to make up most of the Pennsylvanian section. The uppermost sandstone is probably continuous over the Pennsylvanian area, probably overlapping the lower coal-bearing beds on the west and hence underlain there by the Mississippian beds. Two coals appear in the area, and if the reported logs can be relied upon, there is still another carbonaceous zone which includes coal in places. The uppermost coal lies more than 700 feet above seal level. The next lower is at about 680 feet, while the questionable zone is at about 650 feet.

HENRY COUNTY

The uppermost is the best known, and probably the most valuable. It has been identified as the Colchester (No. 2) coal, and appears to have its best development in T. 8 N., R. 4 W., where it is reported about 30 inches thick. It has also been mined in T. 9 N., R. 4 W. in a small way. The roof is sandstone, locally conglomeratic, and is somewhat fractured so that workings must be carefully timbered. The floor is gray plastic underclay several feet thick. The other coals are known only from drill logs, and have similar roof and floor. They vary in thickness from 6 to 36 inches.

HENRY COUNTY

GENERAL STATEMENT

Henry County lies near the northern edge of the Pennsylvanian area and hence includes a portion of its boundary in the northern townships (Pl. I A). Because of the excessive thickness of the drift, the exact position of this boundary can not be determined. It lies approximately parallel to and a little south of Green River in the eastern part of the county, bending north to Rock River a little east of Geneseo, and following the Rock to the western edge of the county. Thus the southern three-fourths of the county is underlain by "Coal Measures" and within this area mining has been done in most of the marginal townships leaving a group of six in the interior, Tps. 15 and 16 N., Rs. 2, 3, and 4 E., which are scarcely prospected.

Production and Mines

Local mines are operated in most parts of the county, although but one shipping mine is now running. There are several mines in the vicinity of Kewanee, some near Geneseo and Briar Bluff and a recently opened mine near Warner. To the south is the new Shuler mine, located at Alpha on the Chicago, Burlington and Quincy Railroad.

The 1923 report of the Department of Mines and Minerals lists 17 local mines, having a total tonnage of 58,074 for the fiscal year.

Area underlain by workable coal	. mi.
Average thickness43 in	iches
Amount available originally1,247,530,000	tons
Production, year ending June 30, 192358,074	tons
Average annual production, 1919-1923	tons
Total production recorded4,754,791	tons

STRATIGRAPHY

PLEISTOCENE SYSTEM

The surface covering of Henry County ranges from a few feet to more than 125 feet in thickness. It is relatively thin along the northern margin of the coal itself, although thicker at the north margin of the coal-bearing beds. Differences in thickness amounting to more



FIG. 6. Loess slope gullied by rainwash. Remnant shows tendency of this material to stand in vertical walls when capped by sod. Henry County.

than 100 feet are known in the same township, near Annawan, where a deep post-Pennsylvanian valley is suggested by drill records. The surficial materials comprise the usual glacial till with interbedded sand and gravel locally covered with varying thickness of loess. Slopes covered with this light clay are easily gullied by rain wash, so that otherwise valuable farm land is rendered unsuitable even for grazing purposes. Figure 6 shows the character of this erosion, and illustrates well the tendency of the loess to stand with vertical walls. Because of this heavy cover of drift and alluvium, the bed rocks of the area are but rarely exposed.

PENNSYLVANIAN SYSTEM

Outcrops of the Pennsylvanian beds are confined to the valley of Rock River above Cleveland, to Mineral Creek east of Briar Bluff and its main tributaries from the south, and to the vicinity of Galva. Even these exposures are limited, and reveal but a few feet of beds at any point. The best outcrops are in the neighborhood of Briar Bluff where the Pennsylvanian system is thin and the basal beds exposed lie but a few feet over the Devonian limestone. Here the following section has been described:

Section of Pennsylvanian strata exposed near Briar Bluff, Henry County

Description of strata		
	Ft.	In.
Sandstone, light to medium gray, platy, carbonaceous partings, base uneven	16	
Limestone, argillaceous, dark gray, upper part massive, lower		
less clayey	2	• •
Clod, well jointed, dark	••	9
Coal, with shale parting	4	• •
Concealed	10	
Sandstone, light gray, thin-bedded, grades in basal 10 inches to		
black shale	4	
Shale, black to dark gray, several bands of clay ironstone con-		
cretions, base concealed	22	•••

Very few logs record the beds below the upper coal of the county so that there is little information as to the thickness and character of the Pennsylvanian. A well at Kewanee, which records what appear to be Pennsylvanian beds at 200 feet, has no record for the next lower 196 feet so that there is a possibility that the system is 324 feet thick there. Another record at Kewanee shows 286 feet of strata above the Devonian limestone. A log from near Galva records what appear to be Pennsylvanian beds for 332 feet. In the vicinity of Alpha, a total of 365 feet of strata overlies the first thick limestone. To the north, along Rock and Green rivers, the "Coal Measures" thin to a feather edge. Here the uppermost beds are apparently identical with those which lie near the top of the section in the southern portion of the county. This relationship strongly suggests that the beds making up the lower part of the thick Pennsylvanian section in the southern part of Henry County do not extend to the north edge of the coal field and are distinctly older than the beds outcropping there.

Comparison of data from all parts of the county indicates that the Pennsylvanian system includes a large amount of shale, which is in part sandy, sandstone being much more prominent in the upper part of the section than in the lower.

Few beds in the entire section are identifiable over any large part of the county. Identification is almost impossible from drill logs, and over much of the county there are no mines or outcrops. The 4foot coal mined at Galva and Kewanee with its cap limestone is recognizable over the southeastern part of the county. Similarly, the Rock Island coal and its cap-rock are known to underlie a large part of the area west and north of Cambridge. Below this coal there is commonly found a thick bed of dark gray to black shale. Aside from these, no beds are known to have a wide distribution in the county.

Coal beds are found in all parts of the county. They are not restricted to any one part of the Pennsylvanian system, but come in at irregular intervals, in the upper or lower part. At the north where the total section is thin, there are rarely more than two coals found, and of these in many places only the lower is thick enough to work. Farther south, both at the east and west, several beds are found, as in the following log:

Description of strata	Thickness		${\tt Depth}$	
· · · · · · · · · · · · · · · · · · ·	Ft.	In.	Ft.	In.
Upper clays and sand	50		50	
"Slate", gray	3		53	
Sand rock, white	4		57	
"Slate", black, gritty	2	••	59	
Coal	2	9	61	9
Fire clay, white		9	62	6
Coal		10	63	4
Fire clay, light blue	3	11	67	3
Rock, hard, gritty	$\underline{4}$		71	3
Sand shale, blue	<u>4</u> .		75	3
Sandstone, bluish	7		82	. 3
Shale, blue	14		96	3
Shale, gray	39		135	3
"Slate", black	4	1	139	4
Coal		11	140	3
Fire clay, blue	4	•••	144	3

Log of boring in southern Henry County

Description of strata	Thickness		Depth	
	Ft.	In.	Ft.	In.
Sand shale, light	6		150	3
"Slate", black	1		151	3
Shale, blue	3		154	3
Rock, white, gritty, (like limestone)	3	••	157	3
Shale, blue	4		161	3
"Slate", gray	2		163	3
Shale, blue	4		167	3
Shale, light, gritty	22		189	3
"Slate", gray	31	••	220	3
"Slate", dark	22	6	242	9
Blue rock, dark	3	4	246	1
Coal		4	246	5
Fire clay, white	5	10	252	3
Sandstone, light	8		260	3
Shale, blue	13		273	3
Shale, brown	2		275	3
Shale, light blue	15		290	3
Medium dark shale	5		295	3
Shale, light	7		302	3
Shale, dark	1		303	3
Sand rock, white	2		305	3
Coal	2	7	307	10
Fire clay, light	8	5	316	3
"Slate", dark	7	•••	323	3
Rock, white gritty	5	••	328	3
"Slate", black	5		333	3
Coal	1		334	3
Fire clay, light	3		337	3
Fire clay, white	10		347	3
Rock, hard flinty	1	••	348	3

Log of boring in southern Henry County-Concluded

The relations between the coal beds in the several parts of the county are not known, but it appears that the lower coals thin and pinch out northward as the pre-Pennsylvanian surface rises. Lack of records of deep drilling makes it impossible to even suggest the character of the pre-Pennsylvanian surface.

Structure

The basin in which these beds were deposited apparently had a gentle slope to the south and this presumably gave the marginal strata a tendency toward a southerly regional dip. Aside from this, there is slight evidence of any general deviation from the horizontal. Local variations from the horizontal are common. Thus, in the Briar Bluff area, the Rock Island coal shows 22 feet of relief in half a mile, and near Sunny Hill shows 88 feet. It maintains the same general elevation, however, over more than five townships. Similarly, near Kewanee the Sheffield coal ranges from 685 to 748 feet above sea level, and shows but little more relief in the whole district between Sheffield and Galva.

Sheffield Coal

The main coal field is in the southeastern part of the county the Kewanee-Galva area. The Sheffield coal which formerly was mined in a number of places near Galva is now mined rather extensively north of Kewanee. This bed has not been positively identified in other parts of the county although one of the beds of the Alpha section will probably be correlated with it. In the mines the bed is about four feet thick, but since the workings are restricted to the thicker coal, it is probable that outside the area in which the coal is mined it averages less than three feet. Future exploration may, however, show a number of small basins similar in extent and character to those about Kewanee and Galva in which this coal is sufficiently thick to be commercially important. In estimating the resources, the entire area is assumed to contain coal 42 inches thick.

The coal bed commonly has a shale parting of two inches or less, which separates the bed into two benches. This parting is not readily separated from the coal and causes considerable loss; in some mines this band, together with all pyrite lenses, is gobbed so that an especially clean coal is produced. The upper bench is commonly separated by two or more charcoal partings which are discontinuous and which do not split the coal into definite benches.

The roof is quite satisfactory in most mines. It is black fissile shale, the "slate" of the miners, and has a limestone from 4 to 72 inches above it. This limestone is the usual cap-rock of the Belleville (No. 6) coal of the Illinois section, and ranges from 18 to 24 inches in thickness.

The floor of the coal is a gray clay, ranging from 18 to 48 inches in thickness. It is usually so dry and hard as to give little trouble from heaving. Locally it contains carbonaceous matter in which excellent plant fossils have been found.

In most mines of the district, clay slips or "horsebacks" are common. No part of the area seems to be free from them, although they may be encountered only in one part of a given mine. These slips are similar to the well known dislocations of the No. 5 coal of the Spring-

HENRY COUNTY

field-Peoria district. Each slip involves a zone varying from less than 6 inches to several feet in thickness. The contact of the clay and the coal is very irregular, the fingers of clay extending into the coal for about 6 inches on either side of the main body. Ordinarily there is no thickening of the coal at these slips, but instances of this have been recorded.

The coal bed is affected by the usual irregularities in roof and floor, rolls in either or in both, nearly cutting out the coal for a few yards.

ROCK ISLAND COAL

An extension of the main body of Rock Island coal is found in the extreme northwest part of Henry County, in two small areas. The larger includes part of T. 17 N., R. 1 E. and the north part of T. 16 N., R. 1 E.; the smaller lies in the vicinity of Cleveland in T. 18 N., R. 2 E. This coal reaches more than 60 inches in thickness where mined, but is thought to average less than 48 inches for the area.

The coal is identical with that mined to the west in the Coal Valley area. It is not a hard coal, although the upper bench is harder than the lower where it shows a shale or other persistent parting. Elsewhere, it is apparently uniform in character from top to bottom. It breaks with an irregular fracture but shows no regular jointing.

Roof conditions are generally satisfactory. The coal is covered by a black fissile shale or "slate", which in some places comes down with the coal, but is ordinarily a safe top. Above the "slate" there is commonly a thin limestone. This is absent in places, probably through non-deposition. The floor is the usual underclay, light in color, hard, tough, and firm. In most places it makes an excellent working floor, although in places there is a tendency for the coal to "freeze" to the floor. Some of the older mines of the State were sunk in this coal and in the Cleveland area this coal is essentially worked out. In the Warner field there is still a considerable tonnage in the ground.

Alpha Coal

In the vicinity of Alpha, recent exploration has resulted in the development of a new field for Henry County. This probably includes an area considerably larger than that blocked out for the present operations. On the basis of available data, this field is mapped to include part or all of Tps. 14 and 15 N. of Rs. 1 and 2 E.

The coal that is worked lies at a depth of about 200 feet and over part of the field at least it has an average thickness of nearly five feet. Two other coals overlie this thicker bed. Present information suggests a correlation of the lowest coal with the main bed of the Rock Island section at the north.

COAL RESOURCES OF DISTRICT 111

Other Coal Beds

Very little mining is done outside of the areas so far outlined. Stretching east and west of Geneseo for several miles is an elongate field of unknown boundary in which a coal has been mined locally for many years. At the west end is the old Mineral Creek field underlain by a 3-foot coal and locally by an upper and thinner bed. At the east a similar bed was mined at shallow depth near Atkinson. Near Geneseo a 44-inch bed outcrops in the creek and was formerly worked by shaft. For purposes of estimating the probable reserves of the county, these three small fields are combined. It appears probable that in the unmapped area to the south, there is enough coal to more than make up for the lack which may exist in the area mapped as coal land.

Two other small patches in Henry County are known to contain some coal, one near Cambridge and one near Bishop Hill. One of the earliest mines of this part of the State was located in the Bishop Hill region. These areas are of unknown extent, but possibly are not connected with any of the other fields in the county. The coal at Cambridge was reported by Shaw¹⁶ to be about 3 feet thick at the shaft and to thicken toward the south. Neither of these is included in the estimated coal land and tonnage of this county.

Additional coal beds are recorded in drill logs. These are more numerous in the southern part of the county where the Pennsylvanian system is thicker than farther north. In the vicinity of Warner and Lynn, two additional coal beds are recorded. Two are also found in the Alpha area, while near Galva, five coals besides the Sheffield bed are listed. Although in most cases the additional coal beds are too thin to be of importance, they have been found in workable thickness, and it is probable that a small tonnage might be recovered from them. Like the minor coal beds of Mercer County, however, they were apparently deposited in basins of small dimensions, and are probably characteristically thin and bony.

JERSEY COUNTY

GENERAL STATEMENT

Jersey County includes a portion of the southwest margin of the Illinois field, and only the eastern half of the county is underlain by rocks of "Coal Measures" age (Pl. IB). Of this area, probably less than half is included in District III.

¹⁶ Shaw, James, Geol. Surv. of Ill. Vol. V, p. 195, 1870.

Production and Mines

The only mines in the Pottsville or Carbondale coals are in the vicinity of Delhi, where Colchester (No. 2) coal is mined in a few local banks. In 1923, no production was reported from mines in that portion of Jersey County included in District III, although a small tonnage was mined about 1890.

Stratigraphy

PLEISTOCENE SYSTEM

The cover of Pleistocene is fairly uniform over the upland, concealing all preglacial irregularities, and giving a rather smooth upland surface. This has been so incised by streams as to produce surface relief amounting to more than 150 feet. The surficial materials include a few feet of loess with the usual bouldery till below. Limestone boulders from the underlying Pennsylvanian rocks predominate in the till.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds are not well exposed in the western part of the area underlain by this series. Along Piasa Creek a fairly complete section is obtained in Tps. 7 and 8 N., R. 10 W. On the basis of these and similar outcrops, the western margin of the area underlain by McLeansboro beds is indicated on the map along the line slightly west of Kemper, Fidelity, and Brighton. In the area assigned to District III the Pennsylvanian beds overlie the St. Louis limestone of Mississippian age, and show a maximum thickness of less than 100 feet. Very little information is available for any of the area, except near Delhi, T. 7 N., R. 10 W., where a few borings and one or two small openings on the coal have been made. A typical section for this area is as follows:

Typical Pennsylvanian section near Delhi

Description of strata			
	Ft.	In.	
Surface	10		
Shale, gray "soapstone"	20		
Shale, black, fissile	1		
Coal	2	6	
Underclay, gray plastic	3	6	

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Structure

The Pennsylvanian beds appear to have a general easterly dip, which is more marked near the west margin of the coal field because of the post-Pennsylvanian deformation which brings the Mississippian strata to the surface in the neighborhood of Jerseyville. No data are available relating to the details of the structure, which will be presented in a forthcoming report on the geology of Jersey County.

Delhi Coal

North of Delhi is an area of about ten square miles, which is apparently underlain by a thin coal, locally called Colchester (No. 2). In outcrops or in mine workings the coal is about 26 inches thick, occurs without partings, and locally carries much sulphur in the form of pyrite. The roof is black fissile shale, the floor, soft plastic clay several feet thick, underlain in some places by a nodular and brecciated limestone.

Elsewhere, there is probably a patchy development of one or more coal beds which belong in the lower Carbondale or Pottsville series. Such beds have been noted in places, but are apparently never of sufficient thickness and extent to be of value.

KNOX COUNTY

General Statement

Knox County lies near the west margin of the Illinois coal field and has representatives of all three divisions of the Pennsylvanian system (Pl. I A). It includes a part of the margin of the McLeansboro formation which covers the eastern two-thirds of the county. Only the western tier of townships is included in the area known as District III. For purposes of comparison, however, there is included in this report a brief discussion of all the coal in the county so far as information regarding it is at hand.

Production and Mines

There are no shipping mines at present being operated in Knox County, and the number of local mines varies considerably from year to year. In 1923, a total of 39 mines producing a total of 51,528 tons was reported by the State Department of Mines and Minerals. These mines are located in the western and north-central parts of the county. The largest operations at present are at Soperville.

Area une	derlain by	workable coal	7 sq	. mi.
Average	thickness		36 ir	lches
Amount	available	originally1,727,000	,000	tons
STRATIGRAPHY

PLEISTOCENE SYSTEM

Knox County is almost entirely covered with a deposit of glacial material which ranges from about 10 to 85 feet in thickness. The thickness is variable in all parts of the county, and in places considerable unevenness in the underlying rock surface has been concealed by corresponding uneven deposition of the glacial materials. These deposits comprise the usual sands, gravels and boulder clays, in beds of irregular extent. Yellow and blue clays are commonly noted in logs from the western part of the county. The yellow clay is a loess-like deposit perhaps largely of wind-blown material.

PENNSYLVANIAN SYSTEM

The whole county is underlain by strata of the "Coal Measures". The exposures of these strata are not uncommon, but the sections visible are so limited vertically and horizontally that little can be learned from them as to the character of the system as a whole. So far as the western part of the county is concerned, outcrops are found near Soperville, east of Wataga, near the plant of the Purington Brick Company east of Galesburg, and to the south along Cedar Creek west of St. Augustine.

Relatively little drilling has been recorded in Knox County, and the available data comes from one or two localities so that there is little information for most of the county. In rare instances, the drill has penetrated beds below the Pennsylvanian and from these records it is clear that the Pennsylvanian beds are thicker here than to the north or west. As much as 300 feet of strata are reported from near Knoxville, and nearly 350 feet from a boring in T. 12 N., R. 1 E. In the latter record, it is not clear that all of these beds belong in the Pennsylvanian. The system is possibly somewhat thicker in the east than in the west, but the difference is not apparent from available records.

As elsewhere in the district, the beds of the "Coal Measures" are largely shale, in places very sandy. True sandstones are not common but are found at any horizon in the section. Limestones are rare, and practically confined to the upper part of the series. As many as five or six beds of coal have been reported in some of the borings, but most of these are thin and of little or no value. The following log from the western part of the county is typical for the region, and serves to emphasize the marked vertical variation exhibited by these rocks:

COAL RESOURCES OF DISTRICT III

Description of strata	Thic	Thickness		Depth	
	Ft.	In.	Ft.	In.	
Clay, sandy			20		
Shale, gray	- 33		53		
"Slate", dark	2	1	55	1	
Coal	1	2	56	3	
Shale, gray	2	7	58	10	
Sand rock, light, very hard	3	2	62		
Shale, light	2	2	64	2	
Sand rock, light, moderately hard	1	4	65	6	
Shale. light	15	3	80	9	
Boulder rock, light, very hard	2	2	82	11	
Shale gray	8	1	91		
Shale, brown sand	29		120		
Sand rock, gray, moderately hard	15	4	135	4	
Shale dark	7	11	143	3	
Lime rock blue very hard	2		145	. 3	
Shale dark	7	9	153		
"Slate" dark	1	11	154	11	
Coal	1	7	156	6	
Impure coal	-	2	156	8	
Coal	••	4	157		
Fire clay	2		159		
Sand rock white very hard	8	10	167	10	
Sand chale light	4	10	172	8	
Sand chalo grav	7	8	180	4	
Sand shale light	5	8	186		
Coal soft	1		187	••	
Sand shale light	2		189	2	
Lime shale	4	4	100	ß	
Sand rock light yory hard	-r 9	10	197	.0	
Sand shale light moderately hard	5 1	10	198	8	
Sand rock light yory hard	1	- T 9	202	10	
Sand chole light yery hard	7	6	202	10	
Shale grey	، م	7	210 919	11	
Goal	1	9	21.0 91.4	1	
Coal chale gray	1	11	214	1	
Sand male, gray	5	11	220	 6	
Chale dark	••	0	220	0	
Shale, dark	1	0	222	2	
Cap rock, extremely hard	1	1	220	0	
Impure coal	<u></u>	4	440 996		
Sand rock, gray, very nard		10	220	9	
Sand rock, light, very hard	3	3	229	8	
Sand shale, light	'' 10	4	237		
Sand shale, gray	10	3	247	3	

Record of boring in western Knox County showing typical Pennsylvanian strata

KNOX COUNTY

Description of strata	Thic	kness	Depth	
	Ft.	In.	Ft	In.
Coal		11	248	2
Shale, gray	3	6	251	8
Shale, light gray	4		255	8
Sand shale, gray	8	1	263	9
Coal		3	264	
Fire clay	1	4	265	4
Sand shale, gray	4	1	269	5
Coal		2	269	.7
Sand shale, light		10	270	5
Sand rock, light, very hard	2	8	273	1
Slate, dark	10	6	283	7
Sand rock, light, very hard	1	6	285	1
Shale, dark	36		321	1
"Slate", dark, very hard	15	10	336	11
Sand rock, light, very hard	2	6	339	5

Record of boring in western Knox County showing typical Pennsylvanian strata—Concluded

In the early Survey report,¹⁷ the boundary of the Belleville (No. 6) coal area was extended from Galva in Henry County southwest through Oneida, thence south to the vicinity of Maquon and south into Fulton County. Considerable similarity between the rocks in eastern Henry and eastern Knox counties would therefore be expected. Essentially the same section as noted for the Kewanee field, including the fusulina limestone, some shale, and a 4-foot coal with charcoal and shale partings is found near Etherly, Victoria, and Wataga, and hence the Etherly coal is correlated with the Sheffield coal.

As in Henry County, the drill records in Knox County which go below the Etherly coal show several lower coal beds. These have commonly been labeled Nos. 5, 4, 2, and 1, on the assumption of proper correlation for the topmost bed. In places, however, a coal is recorded 15 to 20 feet above what is called the Etherly bed. The beds below the Etherly bed are not reported with sufficient regularity to indicate any definite interval at which coal may be found. It is believed that they represent the irregular deposits of Pottsville and Carbondale time made near the margin of the coal-forming area.

Structure

Essentially the same structural relations as those reported for Henry County are found in Knox County. On the basis of correla-

¹⁷ Green, H. A., Geol. Survey of Illinois: Vol. IV, p. 314, 1870.

tion outlined above, the Etherly or Sheffield coal is somewhat lower in eastern Knox County than in southeastern Henry County and continues to dip to the west. This, however, is relieved by local variations which are less marked than in the Henry County area. This attitude of the Etherly coal probably fairly reflects the structure of the lower beds of the system. So far as the coal is concerned the regional structure is of no consequence. The local deviations from this structure, in places involving only about one square mile, are somewhat more important. In no case, however, is the coal found to lie in the steep sided basins which characterize the Mercer and Warren County fields. It is probable that further exploratory work will reveal some such local warping, but the general character of the deposits indicates that uniform conditions obtain over wider areas than in the counties to the west.

Minor dislocations of the coal bed, clay slips and rolls are found in this area as elsewhere. These will be noted in connection with the description of the several coal beds.

SOPERVILLE COAL

At the present time, about half of the coal of the county comes from the Soperville field north of Galesburg. The position of this bed in the Illinois general section of "Coal Measures" has not been finally determined. It appears to lie too high to be correlated with the Colchester or No. 2 bed, and perhaps too low to be classed with the Springfield (No. 5) coal. The latter correlation has been made tentatively, although earlier reports classed this bed with the Rock Island coal. Detailed stratigraphic studies in the area will be needed to complete the correlation.

The Soperville bed is not known to extend widely over the county. So far as known, it is restricted to parts of Tps. 12 and 13 N. of R. 1 E. in this county and probably extends west into northeastern Warren and southeastern Mercer counties.

The bed has an average thickness of about 48 inches, reaching a maximum of 72 inches in one of the mines. Locally, it is practically cut out beneath surface materials so that it is unworkable. The bed is normally in three benches, with a charcoal and dirt parting below the top bench and a shale-pyrite parting above the lowest one. The top bench is relatively brittle, and has abundant calcite facings throughout. The middle bench is less dull, more laminated and harder than the top. The bottom bench is the hardest coal, and is somewhat more dull than the others. Locally the top few inches is nearly a cannel coal, showing few laminations and a distinct conchoidal fracture. The roof is shale, mainly black and locally fissile. It ranges up to 18 feet in thickness, but gives trouble and must be supported by the top coal in places. The shale contains large calcareous and pyritic concretions which commonly fall when the coal is removed. There is no widespread limestone cap-rock such as overlies the Etherly coal. The floor is rather hard, slightly flinty clay at the top with softer clay below. This is light gray in color, and more than six feet thick.

The coal bed is interrupted by "horsebacks" and "clay-slips" and by small faults of little displacement. The flaring V-shaped slips are the most troublesome in mining, as they increase the hazard and cost, besides reducing the area of workable coal perceptibly. The character of this type of fault is illustrated by figure 7.



FIG. 7. Diagram of fault in Soperville coal in Knox County.

ETHERLY OR SHEFFIELD COAL

In the Etherly area, which includes the eastern two-thirds of Knox County, the same general succession of beds described for the Kewanee field is present. The early reports show the Sheffield bed to underlie eastern Knox County as far as a line connecting Oneida, Wataga, and Maquon. Since this area lies outside of District III and has been described in some detail in an earlier bulletin¹⁸ it will not be considered further here.

Abingdon Coal

A small amount of coal is spasmodically mined from the Abingdon field. The extent of this coal is not well known, but recent drilling indicates that it extends northward to within three miles of Galesburg and eastward somewhat beyond Spoon River. It is normally about two feet thick, without partings, and of fair quality. It is bright

¹⁸Cady, G. H., Coal resources of District IV: Ill. Mining Investigations Bull. 26, p. 106, 1921.

and hard and commonly contains lenses and balls of pyrite. The roof is shale, black and fissile, and overlain by another shale, non-gritty, gray in color, known as "soapstone". The section here is similar to that of the Colchester coal.

Other Coal Beds

Practically throughout the county, drill records show more than one bed of coal. A log from the extreme northeast corner of the county shows six unidentified beds, only one of which is of workable thickness. The record from western Knox County shows eight beds of coal; three beds are reported from the Etherly field. Most of these beds appear to be of irregular development and may be of workable thickness in one place but pinch out to a few inches within short distances.

In the St. Augustine area the Rock Island bed, lying a few feet below the Colchester bed, is thick enough to be worked in a small way. It seems to underlie only the southwest part of the county, in Tps. 9 and 10 N. of R. 1 E. It shows the same characteristics here as are noted in the adjoining part of Warren County. It is about 30 inches thick, with or without a shale parting, and is of fair quality. The shale roof with limestone capping makes it easy to work. The light gray clay floor gives no trouble by heaving.

MADISON COUNTY

General Statement

Madison County is at the extreme south end of District III, and in its general relations duplicates Jersey County to the north (Pl. I B). As indicated on the map, the area assigned to District III is a northwest-southeast strip about 4 miles wide extending west as far as East Alton, and Godfrey, and bounded on the east by the outcrop of younger strata which include Rushville (No. 5), Belleville (No. 6), and higher coals.

Production and Mines

At the present time, production from the lower coals in Madison County is from four or five country banks in the vicinity of Upper Alton producing less than 10,000 tons annually. These mines were formerly of more importance, as they produced more than 100,000 tons each year. The later discovery of thicker coal to the east has caused the decline in production from this field.

Area	underlain	by	workable	coal	sq. 1	mi.
Avera	ge thickr	iess			inch	hes
Amou	nt availa	ble	originally		00 tc	\mathbf{ns}

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MADISON COUNTY

Stratigraphy

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds are rarely exposed in outcrop, and are known mainly from the coal openings and one or two borings. In the vicinity of Upper Alton, the limited data reveal coal overlain by shale, and in places underlain by clay with limestone. Following is a typical log from farther east in the county, recording the McLeansboro beds but showing the character of the Lower Pennsylvanian beds as well:

Log of boring in Madison County showing the succession of Pennsylvanian strata

Description of strata	Thickness	Depth
	Feet	Feet
Clay, sand and gravel	156	156
Shale, (with thin coal)	4	160
Clay shale, with soft lime nodules	7	167
Clay shale	3	170
Lime shale	12 .	182
Shale, mixed	3	185
Clay shale	3	188
Limestone, fossiliferous	3	191
Clay shale	1	192
Shale, black	1	193
Clay shale	9	202
Clay shale, with soft lime chunks and thin coal	2	204
Shale	2	206
Limestone	10	216
Shale, soft (base of McLeansboro formation)	4	220
Coal	5	225
Clay shale	6	231
Limestone	2	233
Clay shale	15	248
Lime shale	3	251
Lime shale, sandy	49	300
Shale, blue	13	313
Coal	1	314
Shale, sandy	22	336
Shale, blue	16	352
Limestone	2	354
Slate	. 2	356
Coal	3	359
Shale, blue	3	362
Shale (base of Pennsylvanian system)	13	375
Shale and limestone of Mississippian system	275 +	650 +

A mine in sec. 6, T. 5 N., R. 9 W. shows the following section:

Section of coal in mine located in sec. 6, T. 5 N., R. 9 W.

Description of strata	Thickness
	Inches
Roof shales with some sandstones	
Coal	24
Coal, bony	3
Shale band "blue band"	5
Underclay	

Most of the coal of the main bench is dull and distinctly laminated with bright bands up to half an inch thick. The so-called "blue band" is locally as much as 8 inches thick, and is rarely less than 4 inches. Where this band is thick, the overlying band of bony coal is also thicker than the average. What is probably the same coal as this shows no shale band where it is mined half a mile to the north in a 20-foot shaft. About 4 miles to the east in sec. 14, a 24-inch bed was found at 165 feet, with sandy shale and sandstone overlying. The bed is full of bony layers, making it very hard to work; it carries an unusual amount of pyrite balls, lenses and stringers, and shows much calcium carbonate in facings.

From the few data available, it appears that the Colchester coal is developed over the north-central part of T. 5 N., R. 9 W., and in the southwest part of T. 6 N., R. 9 W., but that there is no marked uniformity in its deposition. It appears to have been deposited at the margin of the coal basin in more or less isolated patches, and under conditions which locally permitted the introduction of considerable amounts of mud, resulting in a carbonaceous bed about two feet thick which is workable in places.

North of Godfrey to the county line there is nothing to indicate the presence of any workable coal. At East Alton, the Tile and Sewer Pipe Plant has used the Colchester coal to a limited extent. The section exposed along the creek behind the plant is as follows:

Section exposed along creek behind the Tile and Sewer Pipe plant at East Alton

Description of strata	Thickne	ess
	Ft.	In.
Shale, sandy, buff colored, in thick beds	10	
Shale, black fissile	2	
Coal	2	6
Clay, gray, dark at top, lighter below	2	6
Limestone, somewhat bouldery but continuous, with fusulinas	1	6
Shale, light gray above, darker below	10 +	

The limestone of this section is apparently a distinct type. It is of medium gray color, slightly pinkish when fresh, weathering to buff. Fossils in this limestone are in the matrix rather than in fragments, and comprise crinoid rings, some small brachiopods and a small fusulina resembling *Girtyina ventricosa*. This has been considered the Colchester coal section, with the zone of the Cheltenham clay in the base underlying the "brecciated lime."

No other coal has been recognized in this area, and it is believed that even the Colchester coal is not sufficiently regular to be of consequence as a resource.

Structure

From present data, the Pennsylvanian strata appear to be involved in no major deformation. The results of detailed structural studies now in progress in this and adjoining areas will be presented in a forthcoming report on Madison County.

MASON COUNTY

INTRODUCTION

Although no coal has ever been mined in Mason County, it is known to be partly underlain by at least one bed of coal (Pl. IB). The following quotation from another publication of the Survey gives all available information on the coal and inferences as to its correlation:¹⁹

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."

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

¹⁰ Cady, G. H., Coal resources of District IV: Ill. Mining Investigations Bull. 26, p. 148, 1921.

^aLeverett, Frank, The Illinois glacial lobe: U. S. Geol. Survey Mon. 38, p. 688, 1899.

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."

McDONOUGH COUNTY

General Statement

McDonough County lies in the west margin of the Illinois coal field, and the geology of the "Coal Measures" is similar to that in the southern part of Warren County, and the western part of Fulton County (Pl. I A). It lies about 25 miles west of the recognized area of Belleville (No. 6) coal in eastern Fulton County. The Pennsylvanian rocks here are relatively flat-lying and extend to only shallow depths.

Production and Mines

The mine list for 1923 shows local mines operating in that year, but no shipping mines. The production was entirely from the Colchester (No. 2) coal.

Area underlain by workable coal	. mi.
Average thickness	ches
Amount available originally	tons
Production, year ending June 30, 192325,964	tons
Average annual production, 1919-192392,233	tons
Total production recorded2,204,138	tons

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene beds are for the most part level-topped, but lie on an uneven surface of bed rock. The surficial covering is loessial clay 5 to 10 feet thick, with clay, sand and small amounts of gravel below, making up a total of between 30 and 200 feet. This great range is due to the presence of buried valleys cut in the bed rock before the advent of the ice.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds are from 40 to 230 feet thick, and are known both from outcrops along the east fork of Crooked Creek along Camp and Grindstone creeks, and from drill logs and mining operations. A typical section compiled from these sources in T. 4 N., R. 3 W., is given as follows:

MC DONOUGH COUNTY

Typical Pennsylvanian section compiled from records of outcrops, borings, and mines in T. 4 N., R. 3 W.

Description of strata	Thicl	kness
	Ft.	In.
Sandstone, buff to gray, thin bedded	39	
Shale, argillaceous, with ferruginous nodules	10	
Coal (Colchester)	2	6
Clay and concealed beds	15	
Shale, blue to white at top, drab below	9	
Clay, sandy, bluish white	5	
Sandstone, white, quartzose, thin-bedded, weathering to light buff	5	
Interval, chiefly blue-black shale	20	
Sandstone, white, quartzose, weathers to dark drab, contains		
partings of blue-black shale	4	
Shale, in part very calcareous and filled with carbonized stems.	3	
Concealed, overlying Mississippian formations	i Thickness thin bedded	• •
Total	118	6

The Pennsylvanian includes parts of the Pottsville and Carbondale formations. The Pottsville, 125 feet thick, comprises thin sandstones and shale, with one to three thin coals and one limestone. The limestone is an important stratigraphic marker in this region and is described in the Colchester-Macomb folio²⁰ as follows:

"The limestone is bluish gray, fine grained and very brecciated or nodular, so that it weathers with a characteristically uneven surface. It has no regular bedding or cleavage. In its brecciation, texture, and general aspect it somewhat resembles the St. Louis limestone, but can be discriminated from it by the nature of contiguous beds. In places it contains many crystals of marcasite or pyrite, which on weathering give it a reddish tinge...... In some outcrops it is a continuous ledge rarely as much as 5 feet thick; in still others it is represented only by rows of 'boulders' in clay, or by inconspicuous calcareous shale, and in still others it is altogether wanting."

McDonough County appears to be uniformly underlain by beds of the Pottsville formation, which show considerable lithologic variation from place to place. The Carbondale formation, which has a maximum thickness of 90 feet, comprises sandstones, shales, one coal, and one limestone. Irregular patches of the Carbondale are found extending northward from Colchester and Good Hope, and in the southern part near Industry. The two important members of this formation are the coal bed known as the Colchester or No. 2 coal, which lies at the base of the formation, and the Vergennes sandstone which appears at the top of the formation over an erosion unconformity of marked irregularity. This sandstone was called the Ver-

 $^{^{20}\,\}rm Hinds,$ Henry, U. S. Geological Survey Geol. Atlas, Colchester-Macomb Folio (No. 208) p. 6, 1919.

gennes by Hinds²¹ because of its resemblance to a sandstone of similar position, so named by Shaw in the Murphysboro quadrangle.

The coals of the Pottsville show an irregular deposition which is apparently original. Where but one prominent coal appears it is usually called No. 1. It is not to be understood, however, that the No. 1 of one locality is positively known to be the stratigraphic equivalent of the No. 1 of other localities. The main coal of the Pottsville lies between 30 and 40 feet below the Colchester coal. The Colchester (No. 2) coal is relatively widespread, and presumably appears in fairly uniform thickness (20 to 30 inches) over the northern part of the county and in isolated patches in the southern part, as indicated by the line of outcrop on the map (Pl. I A). Above the coal is blue shale which reaches a maximum thickness of 55 feet. The beds are much more sandy at the top where the greater thicknesses are exposed. Below the Vergennes sandstone in places there appears a thin limestone which is quite fossiliferous. This lies from 25 to 30 feet over the Colchester coal.

Most of the logs record only shallow drillings, a large number reaching only the Colchester coal. Typical of the deeper logs is that from the farm of W. H. Young in sec. 9, T. 7 N., R. 2 W. (Walnut Grove Twp.):

Description of strata	Thic	kness	Depth	
	Ft.	In.	Ft.	In.
Pleistocene system				
Soil	10		10	
Sand	2	6	12	6
Pennsylvanian system				
Soapstone	4		16	6
"Slate" and rock	3	6	20	
Soapstone	18	3	38	3
Coal Colchester (No. 2)	2		40	3
Fire clay, very white	6	3	46	6
Clay, hard, or rock	7		53	6
Soapstone, hard	5		58	6
Rock	4	6	63	
Soapstone, hard	13	-	76	
Clay, hard	1	6	77	6
"Slate"	1	6	79	
Fire clay	5	••	84	

Record of well drilled on W. H. Young farm, sec. 9, T. 7 N., R. 2 W.

²¹ Hinds, Henry, U. S. Geological Survey Geol. Atlas, Colchester-Macomb Folio (No. 208) p. 6, 1919.

Description of strata	Thicl	rness	Depth	
	Ft.	In.	Ft.	In.
"Slate", hard	14	••	98	• •
Soapstone	5		103	•
"Slate"	7		110	
Shale rock	4	6	114	(
"Slate" and rock	4	6	119	•
Fire clay	2	6	121	(
Rock, hard	3	3	124	Ę
Fire clay	1	6	126	(
Rock, very hard (could not drill				
through it)	8	6	134	ę

Record of well drilled on W. H. Young farm, sec. 9, T. 7 N., R. 2 W. —Concluded

Although the "hard soapstone" of this section is probably a sandy shale, the absence of true sandstone is notable. The Pennsylvanian beds lie in marked unconformity on the Mississippian formations. The relief of this old rock surface is probably in excess of 100 feet.

Structure

The Pennsylvanian beds are essentially flat-lying, the Colchester coal ranging from about 640 feet to nearly 700 feet above sea level. So far as available data from mining operations indicate, the Pennsylvanian in this county is free from minor structure such as slips, small faults, and rolls which commonly interrupt the continuity of the coal elsewhere.

Colchester Coal

The main coal of the county is the Colchester (No. 2) commonly mined by drifts or shallow shafts, and which, because of its thinness (about 24 inches) is not mined on a commercial basis except in connection with some of the clay plants. The coal is of good quality, however, and shows no persistent partings or impurities. In places it carries a few lenses and small nodules of iron pyrites ("sulphur"), films of mother coal, calcite, and gypsum, and streaks of bone an inch or less thick. It is jet black, with some bands of dull luster, has a hackly fracture and shows no well developed cleat or horizontal cleavage. The bed is thus exceptionally clean and is relatively undisturbed by horsebacks, clay slips, or rolls. The most important coal area is about Colchester, and the next most important is in the southcentral part of the county where but little mining has been done up to the present time. The roof of the coal is in all cases a blue-gray shale, somewhat massive and in places quite sandy, which serves well for mining purposes. Below the coal is an underclay a little more than 2 feet thick, which in most places is soft and plastic and makes an ideal medium for undercutting the coal.

Other Coal Beds

No other coal beds are mined except for private uses in those localities where the Colchester coal is absent, and one of the Pottsville coals is developed in thickness sufficient to make small mining practical. These are not considered of sufficient value to be included in an estimate of the resources of the county.

MERCER COUNTY

GENERAL STATEMENT

Mercer County lies in the northwestern part of the State, having approximately the same relation to the Illinois coal field as Rock Island County (Pl. I A). The "Coal Measures" in the northeastern part of the county are continuous with those of Rock Island on the north and Henry on the east. Farther west the Pennsylvanian beds are thin, and near Seaton, in the southwestern part of the county, they have been eroded and Mississippian beds lie at the surface.

Production and Mines

Mining is somewhat more active in Mercer than in Rock Island County, the 1923 report of the Department of Mines and Minerals listing 15 local but no shipping mines. This is a larger number than has been reported for some years, and reflects the recent coal shortage.

Area underlain by workable coal127 sq.	mi.
Average thickness	\mathbf{ches}
Amount available originally	tons
Production, year ending June 30, 1923	tons
Average annual production, 1919-1923	tons
Total production recorded13,689,352	tons

STRATIGRAPHY

PLEISTOCENE SYSTEM

Outcrops of the coal-bearing rocks are rare, for the county as a whole is deeply mantled with glacial drift. These surficial deposits range in thickness from a few feet in stream valleys to more than 200 feet beneath some of the upland.

PENNSYLVANIAN SYSTEM

Practically all data regarding the extent and character of the Pennsylvanian rocks are gained from mines and drill logs. The latter are mainly from east of Aledo and are closely spaced in the Matherville area, but widely scattered elsewhere. The Pennsylvanian ranges in thickness from less than 75 feet to as much as 150 feet. Few logs are at hand in which the precise base of the system can be determined, but present data indicate maximum thickness of Pennsylvanian at the east margin of the county. At the west, near the boundary of the "Coal Measures" the thickness is probably considerably less than 75 feet, but there are no logs showing this westward thinning.

So far as appears in the well logs, the Pennsylvanian section is predominantly shale, most of the sandstone appearing in the upper part. The following log is typical of the barren beds in Mercer County, but cannot be considered as a generalized section:

Thic	kness	Depth	
Ft.	In.	Ft.	In.
23		23	
19		42	
7		49	
16		65	••
2		67	
3		70	
1		71	
8		79	
5		84	
10		94	
2		96	
3		99	
17		116	
7		123	
14		137	
	3	137	3
4	9	142	
36	• • •	178	
3		181	
3		184	·
10		194	
. 2	·	196	
	Thic Ft. 23 19 7 16 2 3 1 8 5 10 2 3 17 7 14 4 36 3 10 2 2 19 2 19 19 2 19 2 19 2 19 2 19 2 2 10 2 2 2 10 2 2 2 2 2 2 	Thickness $Ft.$ $In.$ 23 19 7 16 2 3 10 2 3 10 7 14 3 3 3 10 2	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$

Log of boring showing typical Pennsylvanian succession of the barren beds in Mercer County

Description of strata	Thick	tness	Depth		
Mississippion system	Ft.	In.	Ft.	In.	
Mississippian system			000		
Shale, light	24	••	220	• •	
Shale, blue	6		226	••	
Shale, light	5		231		
Lime shale	58		289		
Shale, brown	2		291		
Lime shale	5	• •	296	•••	

Log of boring showing typical Pennsylvanian succession of the barren beds in Mercer County—Concluded

Of the above section, the first four beds are surficial, the next lower members to a depth of 196 feet are probably Pennsylvanian, and the rest of the section should perhaps be referred to the Mississippian.

A section typical of the coal-bearing part of the system is added below for comparison:

Description of strata	Thic	kness	Depth		
	Ft.	In.	Ft.	In.	
Pleistocene and Recent systems					
Soil and clay	9		9		
Pennsylvanian system					
Pottsville formation					
Sandstone and shale	3		12		
Limestone, blue, shaly	9		21		
Coal	3	6	24	6	
Underclay and shale	57		81	6	
Sandstone	30		111	6	
Coal	2	6	114		
Underclay and shale	12		126		
Devonian system					
Limestone	52		178	••	

Log of test boring in the town of Cable

But one stratum reported in this log is recognizable over much of the county. This is the blue, argillaceous limestone overlying the thicker coal. This and the coal itself are probably correctly identified at Sherrard, Matherville, in the area north of Millersburg, and southward nearly to Burgess. The limestone carries fossils, locally abundant, among which is the small protozoan Fusulina, which has not been found in this county except at this horizon. The Rock Island coal is the only one of commercial value and it has an irregular distribution. Another coal which has been worked to a limited extent lies from 15 to 30 feet below the main bed. This is even less uniform in character and distribution than the main coal. Throughout much of the area in which the Rock Island coal can be profitably worked, drill logs record the presence of a thin coal lying 10 to 25 feet over the main bed.

Little is known of the character of the pre-Pennsylvanian surface. It seems probable that it closely resembles that of Rock Island County in showing considerable relief. Study of the available logs indicates that in the southern part, at least, the "Coal Measures" are underlain by Mississippian rather than Devonian beds.



 $F_{1G.8}$. Diagram showing relation of thickness of the Rock Island coal to its altitude. Except in No. 3, which may be structurally high, the thicker coal lies in the hollows.

т.	15 N	., R.	2 1	N.				T. 1	5 N	., R. 2	V	v.				
	1.	SE.	1∕4.	SE.	¼	sec.	27.		5.	SE. 1/2	1	SE.	1⁄4	sec.	22.	
	2 .	SE.	¼	SE.	¼	sec.	27.		6.	NE. ½	4	SE.	¼	sec.	22.	
	3.	NE.	¼	SE.	¼	sec.	27.		7.	NW.	₩	SW	7. 1	$4 \mathrm{sec}$	e. 2	3.
	4.	SE.	¼	NE.	¼	sec.	27.		8.	SW. 1	4	NW	7. 1	4 sec	e. 2	3.

Structure

The Pennsylvanian beds are flat-lying over the county as a whole, although they are affected by minor flexures which give rise to sharp local folds. The one recognizable bed in the series, the fossiliferous limestone, shows a remarkably flat attitude except for these minor deformations. This bed lies at an elevation of 670 feet north of Millersburg and is only five feet lower near Cable, 15 miles to the east. In the intervening area, local warping has produced many times this amount of relief, in one instance 90 feet being measured in less than a mile. In general, the coal is thicker in the low places and thinner where it lies at a greater elevation. This is illustrated by figure 8, in which the top elevation of the coal and the thickness of the bed at each point are indicated. These relations are exhibited in all three of the districts in which mining has permitted detailed observation. While the data available from the Sherrard mine are not full enough to make the point clear, there is some indication that the coal there worked lies in a trough with relatively steep sides.

At Cable the situation is better known. The coal lies in a basinshaped depression, the center of which is just north of the village. In the mines north and northwest of Cable, the coal lies at an elevation of about 602 feet above sea level. Less than a mile southwest the elevation is 650 feet and the coal scarcely half as thick.

Similarly at Matherville, most of the thick coal lies in a troughlike depression. In Alden No. 7 mine, the coal surface was about 590 feet above sea level at the shaft, but varied from this throughout the workings. Less than a mile southwest, the coal outcrops at an elevation of 650 feet, and the coal is thin.

The fact that the coal is almost uniformly thicker in the hollows than on the "hills" of the mines suggests that the variation in altitude is at least in part original in the coal, reflecting the irregularities of the surface on which the bed was deposited. On the other hand, the fact that in some of the depressions the cap limestone shows essentially the same amount of relief suggests that the unevenness is in part due to deformation of the strata after the deposition of the whole series.

ROCK ISLAND COAL

The most important coal of the county is the Rock Island bed. While fairly widespread in the eastern portion of the county this bed shows a very uneven deposition and coal of workable thickness has a distinctly patchy distribution. The known areas of thicker coal lie in Tps. 14 and 15 N. of Rs. 1, 2, 3, and 4 W. It is probable that small areas of equally thick coal lie in the vicinity of the areas mapped. Present information does not warrant an attempt to include them in the estimates of total coal area and tonnage for the county.

Within the mapped areas the coal probably has an average thickness of 40 inches or more. The coal ranges from 24 to 60 inches in thickness where it is worked. Outside of the mapped areas, and particularly in the western part of the county, the coal is uniformly thinner.

In places this coal bed appears to be split by a band of shale. Such an occurrence is reported by Green^{22} from the southeast quarter of section 1, T. 14 N., R. 3 W., where the coal showed an 8-inch

²² Green, H. A., Geol. Surv. of 111., Vol. IV, p. 305, 1870.

parting in the middle. While this parting was reported from only a few mines, and was generally quite thin, a short distance east of this locality it was 20 inches thick and to the west it was reported as much as 4 feet.

The following notes on the character of the coal are taken from a report on the Milan quadrangle²³:

"In the mines where the coal bed has been worked, the thickness varies from 2½ to nearly 5 feet. It is a black, and rather soft coal, having a dark-brown streak. Where it is normally developed it is in a single bed which contains a parting with some impurities a short distance below the middle part. The details of this coal and associated strata at different localities where the bed could be well studied are shown below:

Section of coal in mine No. 3 of Coal Valley Mining Company at Matherville

Section of coal bed in mine No. 7 of the Alden Coal Company at Matherville

	Thickr	1ess
	Ft.	In.
Limestone, dark	7+	••
Shale, dark	3	2
(upper bench	1	4
Coal { middle bench	••	10
lower bench, with a little marcasite near the top	2	6
Shale, with marcasite and imprints of Stigmaria	1	
Underclay	3	6

Section of the coal in the mine of Dougherty Bros., near Boden

	Thicknes		
	Ft.	In.	
Limestone, dark	14	••	
Shale, black, fissile	2	• •	
Coal	2	10	
Shale, or bony coal, brown, containing marcasite	••	2	
Underclay, gray	2+	••	

²³ Savage, T. E., and Udden, J. A., Geology and mineral resources of the Edgington and Milan quadrangles: Ill. State Geol. Survey Bull. 38, p. 195, 1921.

Thickness

The following data are taken from mine notes made by various members of the Survey:

Coal Valley Mining Company No. 2 mine at Sherrard

Entrance: shaft, about 210 feet to coal, Rock Island bed.

Thickness of rock over coal: 75 feet.

Roof: limestone in general, but with intervening slate up to 10 feet in places.

- Coal: maximum 54 inches, minimum 36 inches, average 42 inches. Occurs in two benches, the top being harder and brighter. In places the bottom has numerous bony bands.
- Floor: underclay at least five feet thick; in places the clay is separated from the coal by a bony layer, a thin sandstone, or a hard carbonaceous shale known as "false bottom." When wet, the clay interferes with mining by heaving. In places it goes to the roof.

Throughout most of the mines the coal is affected by slips, small faults, and by rolls. These are of little consequence in mining operations. A typical fault is shown in figure 9.



FIG. 9. Sketch of fault in Sherrard mine, Mercer County.

Coal Valley Mining Company No. 3 mine at Matherville

Entrance: shaft about 65 feet to coal; Rock Island bed.

Thickness of rock over coal: 34 feet.

Roof: limestone with intervening "slate" up to 8 feet.

Coal: maximum 60 inches, minimum 44 inches, average 54 inches. Two benches, the upper harder and in places brighter than the lower. Partings of sulphur not abundant; more sulphur in plates along joints and crevices. In places the bed shows a very large amount of "mother coal" filled with impressions of plants and showing a charred woody structure. This material occurs in layers and lenses which are locally cemented into hard masses by sulphur.

90

Floor: underclay, probably several feet thick, light gray, sandy; shows plant impressions. Below the clay is a sandstone which has been penetrated as much as 20 feet. This bed is in contact with the coal in places. (Note: It may be questioned whether this sandstone is not identical with one reported from the No. 2 Mine at Sherrard, which was reported there to overlie the clay.)

Variations in the thickness and position of the coal are common.

Alden Coal Company No. 7 mine at Matherville.

Entrance: shaft about 90 feet to coal, Rock Island bed. Thickness of rock over coal: not measured.

Roof: limestone with as much as three feet of black slate over coal locally. Coal: maximum 57 inches, minimum 45 inches, average 54 inches. Uniformly in two benches, separated by a smut band. Considerable calcite throughout the coal. Sulphur in thin veinlets in the bed.

OTHER COAL BEDS

In the southeastern part of Mercer County is an area of a few square miles underlain by a coal lying above the Colchester (No. 2) coal. This is an extension of the Soperville field in Knox and Warren counties and it is not well known in Mercer County. The coal probably averages about 40 inches in thickness and has about the same character and associated beds as in the adjoining region. Details for Mercer County are lacking and the reader is referred to the discussion of this bed in Knox County for such data as are available.

Small areas of thin coal are known to lie in T. 13 N., R. 2 W., in T. 14 N., R. 1 W., and possibly in the extreme western portion of the county, T. 15 N., R. 5 W. Most of these beds are less than 18 inches in thickness and are not considered of commercial importance.

MORGAN COUNTY

GENERAL STATEMENT

Morgan County lies near the middle of the east border of District III, and beds of early Pennsylvanian age come to the surface in the western part of the county near Neelys (Pl. IB). It bears much the same relation to the main Illinois field as do those counties farther north like McDonough and Warren, which have a border of Mississippian rocks on the west, and of late Pennsylvanian rocks on the east.

Production and Mines

In 1922 the report of the Department of Mines and Minerals listed but three mines producing a total of less than 1,000 tons. The report for 1923 shows but one operating mine producing 400 tons.

Area underlain by workable coal	mi.
Average thickness	ches
Amount available originally1,340,500,000 f	tons
Production, year ending June 30, 1923400 t	tons
Average annual production, 1919-19232,810 t	tons
Total production recorded	tons

Stratigraphy

PLEISTOCENE SYSTEM

The covering of Pleistocene over the bed rock is relatively thick, averaging about 40 feet. Boulder clay with considerable thickness of sand and gravel is reported in drill logs. A surficial loessial clay covers much of the county, and is particularly thick in the western part near the Illinois.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds are relatively thin in the western part of the county, but eastward from the vicinity of Jacksonville reach thicknesses in excess of 150 feet. There are practically no outcrops in the western part of the county, and what information is available comes from the coal and oil tests which have been made. The details of the columnar section are by no means well known, and as a result, correlations within the county are difficult, and between Morgan and adjoining counties impossible. A typical log follows:

Log of boring at Jacksonville

Description of strata	Thickness	Depth
	Feet	Feet
Soil and drift	. 94	94
Shale, bluish gray	. 58	152
Coal	. 3	155
Fire clay	. 3	158
Shale, mixed, yellow and blue	. 62	220
Limestone, Mississippian		

It is not improbable that some of the shale overlying the Mississippian limestone really belongs with the Mississippian formation, re-

MORGAN COUNTY

ducing the thickness of the Pennsylvanian by that much. The log of a shaft from a mine in section 9 of T. 14 N., R. 10 W. is as follows:

Log of shaft from mine in sec. 9, T. 14 N., R. 10 W.

Description of strata	Thickness		
	Ft.	In.	
Soil and drift	$29\pm$		
Limestone	5	••	
Shale, gray, "soapstone"	16		
Shale, black, fissile ("slate")	3		
Coal, with one or two partings	3	4	
Clay, base not exposed	2	•••	

In the western part of the county, in the vicinity of Neelys, the following section is exposed in the stream south of the Wabash Railroad:

Section of Pennsylvanian strata exposed near Neelys

Description of strata	Thickness
-	Feet
Surface	2
Coal, much weathered, with a 2-inch clay band one foot above the	
base	4
Clay, light to medium gray, slightly gritty, base unexposed	3
This coal is reported to lie 40 feet above the coal which was	formerly
mined here.	

Structure

Very little is known of the structure of the Pennsylvanian beds in Morgan County. This is partly due to the lack of data as to the altitude of any given bed in the section over the county, but also due to the impossibility of correlating the coal beds in the different parts of the county. Thus the relation between the Jacksonville and Neelys coals is not known, and the general structure for the two areas can not be determined.

From the limited data in the western part of the county, the Pennsylvanian beds appear to be flat-lying except for the usual local variations common to "patchy" fields. For the Jacksonville area somewhat more careful studies have been made in connection with oil studies and the following paragraph is taken from a recent report on that field.²⁴

"A detailed contouring of the Pennsylvanian structure or folding based on the correlation of a certain coal which has been reported rather frequently in logs of wells in the vicinity of this particular area has been attempted. Contours are drawn on this coal, but they can be considered as

²⁴ Collingwood, D. M., Oil and gas development in the vicinity of Jacksonville: Ill. State Geol. Survey Bull. 44, p. 20, 1923,

tentative only. Not only were the logs scarce and imperfectly kept, but some wells were not close enough together to enable exact correlation, and as it was not possible to run levels to all of these holes in the limited time available, in some cases the elevations had to be estimated from comparison with railroad levels."

JACKSONVILLE COAL

One of the two areas in which mining has been carried on in western Morgan County lies about five miles south of Jacksonville. Little is known of the area underlain by this coal, but it probably extends as far south as Woodson and the scattered drill records indicate that it may extend beyond the south limit of the county. It is possibly of commercial thickness to within 2 miles of Jacksonville, but may not be important beyond that point. From records apparently reliable this bed ranges from 36 to 72 inches in thickness. An average thickness is probably about 42 inches. The roof is black "slate" beneath limestone cap-rock, and gives little trouble in mining. The floor is fire clay about 8 feet thick.

NEELYS COAL

Coal has been found and mined at several places in Tps. 15 and 16 N., R. 12 W. While precise correlation between the several occurrences has not been made, most of the beds have been tentatively classed as belonging to the zone of the Colchester coal. The coal at Neelys was one of the earliest to be worked, and hence the name is in common use. This bed is not definitely known to underlie any extensive area in the county, but may fairly be assumed to be present throughout the county east of Neelys.

It has an average thickness of about 24 inches, ranging from 20 to 54 inches where worked. It is reported to be of good quality, although commonly carrying considerable sulphur in the form of iron pyrites. The gray shale and black fissile shale roof commonly over this coal is absent at Neelys, where glacial drift comes down to the coal, necessitating considerable loss of coal as some had to be left up for roof. The floor is of gray clay, commonly showing remains of plant fossils.

CONFUSION IN CORRELATION

In the early reports on the coal of this county some of the beds were referred to the Rock Island (No. 1) of the Fulton County section, others to the Colchester (No. 2), and still others to No. 3. From available data it is not clear that these correlations are justified, nor indeed that all three coals are present. Two coals are present at

PIKE COUNTY

Neelys, one below drainage, known as the Neelys coal, and another, also four feet thick, lying about 40 feet above it. The latter has a shale parting below the middle and is not recognized elsewhere in the county.

Two coals were reported from the southwest part of T. 16 N., R. 2 W., but it is possible that a difference in elevation of two coal beds worked gave the impression of a difference in stratigraphic position.

PIKE COUNTY

General Statement

Pike County lies on the southwest margin of the coal basin and has an even thinner cover of "Coal Measures" than Adams and Brown counties to the north (Pl. I B). The area is dissected by streams in the same way, giving a very irregular areal pattern with numerous isolated patches outside the main Pennsylvanian field. This entire field is separated by the Illinois from the coal area of Cass, Morgan, and Macoupin counties.

PRODUCTION AND MINES

Pike County does not appear in the list of producers published by the Department of Mines and Minerals. There has been from time to time, particularly in the early days, some exploitation of such beds as appear in the county. The opening of transportation across Illinois River made the thicker coal in those counties to the east accessible, and very little mining has been done since.

STRATIGRAPHY

PLEISTOCENE SYSTEM

The Pleistocene is of the same character as appears in adjoining counties, although it is not especially thick in that portion of Pike County underlain by coal-bearing rocks. A top covering of loess from 5 to 10 feet is usually present. This deposit reaches thicknesses of nearly 70 feet in the bluffs at Chambersburg. The underlying drift, comprising the usual boulder clay with small amounts of sand and gravel, averages probably less than 30 feet thick.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds outcrop on the west margin of the coal field in the vicinity of Hadley and along the east margin from Maysville to the northern boundary of the county. Very few logs are available which indicate the character of the Pennsylvanian beds, although there has been considerable deep drilling showing the lower strata. The Pennsylvanian beds probably do not exceed 60 feet in thickness, and the greater thicknesses are in the northern part of the county. Toward the south, the coal-bearing beds thin to a feather edge.

Several outliers in the vicinity of Pittsfield have produced small amounts of coal. The coal is mainly the Colchester bed and above it, in many places separated by a few feet of gray shale, is a black fissile shale which appears to accompany this bed throughout this part of the Illinois basin. One other stratum of importance is a dark gray shale, highly calcareous, which contains great numbers of small brachiopod shells, among which *Marginifera muricatus* and *Chonetes mesolobus* are predominant. A typical section for the northern part of the county is as follows:

Typical Pennsylvanian section for northern Pike County

Description of strata	Thick	ness
	Ft.	In.
Drift	18	• •
Shale, light gray to blue, very sandy near the top	45	
Shale, medium to dark gray, with large argillaceous limestone		
nodules in a zone near the middle "Chonetes bed"	6	
Shale, black fissile and coal, soft, highly weathered	1	2
Clay, medium gray, slightly gritty	2	
Clay, white to light gray, abundant gypsum crystals, base unex-		
posed	3	

A typical section for the vicinity of Maysville includes:

Typical Pennsylvanian section near Maysville

Description of strata	Thic	kness
	Ft.	In
Drift	30	
Shale, medium to dark gray "Chonetes bed"	3	
Shale, dark gray, flaky, weathers blue		5
Shale, black fissile		. 10
Coal, highly weathered	1	7
Clay, white to gray, gypsum crystals	16	
Sandstone, white, thin bedded	2	
Shale, base unexposed	1	
Interval	8	
Limestone, cherty Mississippian		

PIKE COUNTY

The section for one of the outliers near Pittsfield includes :

Pennsylvanian section near Pittsfield

Description of strata	Thicl	aness
	Ft.	In.
Loess and drift	98	
"Slate", black	4	
Coal	1	
Clay, gray		. 4
Flint rock and limestone. Mississippian		

It is apparent from the inspection of these sections that the thicker "Coal Measures" in the north include Upper Pennsylvanian beds which do not appear at the south end of the field.

In the northern part of the county, the Pennsylvanian beds lie on the Salem limestone, but elsewhere on the Burlington limestone showing an unconformity on the Mississippian beds which was brought about by an uplift of those strata, followed by erosion of the upper portion of it in pre-Pennsylvanian times. The surface below the Pennsylvanian does not have as great relief as appears farther north.

Structure

Very little information regarding the structure of these beds is available, although a low northeasterly dip brings the Colchester (No. 2) coal from 650 feet above sea level on the east margin to about 720 or 740 feet on the west. Minor warping of these beds has not been worked out in sufficient detail for presentation, but it is believed to be unimportant in mining.

COLCHESTER COAL

Most of Tps. 3 and 4 S., R. 4 W., as well as additional areas on the east and west as mapped, are underlain by the Colchester (No. 2) coal. Some of the small outliers also contain coal. No bed, other than the Colchester, has ever been found, and even it is of such thickness as to make extraction expensive, except by the method of stripping where the overburden is light. In such situation, the lack of cover may have resulted in some weathering of the coal, thereby appreciably lessening its value. The coal is rarely more than 20 inches thick, averaging less than 18 inches.

In sec. 10, T. 4 S., R. 5 W., is a very limited area of coal which reaches a maximum of 6 feet. The character of the bed, together with its roof and floor suggest it is Colchester coal which here is filling a depression in the Mississippian limestone, and hence reaches an

unusual thickness. Throughout the Pike County field, the roof is gray shale, with an overlying black fissile shale or "slate", the gray shale ranging from half an inch to several feet in thickness. The floor is unconsolidated gray clay, which is locally sandy.

ROCK ISLAND COUNTY

GENERAL STATEMENT

Rock Island County lies at the northwest margin of the Illinois coal basin; consequently the beds of the Pennsylvanian or "Coal Measures" underlying most of the county give place in the northern portion to rocks of Devonian and Silurian age (Pl. IA). These latter are exposed in places along both Mississippi and Rock rivers and their tributaries in that part of the county lying northeast of Andalusia and Milan, in Tps. 17, 18, 19, and 20 N., Rs. 1 and 2 E. and Rs. 1, 2, and 3 W.

PRODUCTION AND MINES

No shipping mines are now operated in the county. The small production recorded comes from a few country banks. The report of the State Mine Inspector for the fiscal year 1923 gave nine local mines having a total production of 63,035 tons.

Area underlain by workable coal63 sq	mi.
Average thickness	iches
Amount available originally171,760,000	tons
Production, year ending June 30, 192363,035	tons
Average annual production, 1919-1923	tons
Total production recorded	tons

Stratigraphy

PLEISTOCENE SYSTEM

The beds of the "Coal Measures" outcrop along stream channels in places, but for the most part are concealed beneath surficial materials which here have a maximum thickness of over 200 feet. These consist of clay, sand and gravel of glacial origin, together with loess, terrace deposits, river alluvium, and dune sands.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds lie unconformably on Devonian or Silurian strata. The exposures near Rock Island show the basal Pennsylvanian beds to be sandstone and conglomerate with lesser amounts of shale. Near Black Hawk's Watch Tower across Rock River from Milan are several exposures showing Pennsylvanian beds rising over protuberant Devonian limestone (fig. 10). The pre-Pennsylvanian surface was rather uneven, and resulted in irregular and patchy deposition of early Pennsylvanian strata. Worthen²⁵ found 60 to 70 feet difference in elevation in a coal bed in less than a mile near Hampton, and assumed the irregularity to be conformable with the surface of the underlying limestone.

Drilling has been concentrated on relatively small areas, so that there is little or no data available as to geologic conditions over most of the county. From the outcrops, from the various openings



FIG.10. Pennsylvanian shaly sandstone over protuberant Devonian limestone. Near Black Hawk's Watch Tower, Rock Island County.

on the coal and from a study of drilling records at hand, the main features of the Pennsylvanian beds can be learned.

The extreme northeastern margin of these strata lies between Port Byron and Rapids City. From south of Hampton to East Moline no Pennsylvanian beds are known, but from East Moline south and west to the bluffs opposite Muscatine, Iowa, the county is nearly all underlain by rocks of the "Coal Measures". The strata are not identical in character from place to place and have few fossils which serve to identify them, yet by means of the lithologic character, fossils, and structural relations, their stratigraphic relations can be approximately determined.

The Pennsylvanian beds are thin at the northeast, ranging from a feather edge near Port Byron to nearly 100 feet southeast of Hamp-

²⁵ Worthen, A. H., and Shaw, James, Geol. Surv. of Ill. Vol. V, p. 220, 1873.

ton. Greater thicknesses are met to the south and west reaching a maximum of about 250 feet in Buffalo Prairie Township (T. 16 N., R. 4 W.).

In the northeast part of the county, the Pennsylvanian rocks are mainly sandstone. Over the coal in the mines east of Hampton is a thin argillaceous limestone, some shale, and an upper sandstone with flint beds, with an underclay and some shale between the coal and the



FIG. 11. Abandoned drift in Rock Island coal showing overlying beds and 10 feet of fossiliferous shale below, sec. 9, T. 19 N., R. 1 E., Rock Island County.

pre-Pennsylvanian limestones. The coal bed itself occupies only two small basins, one near Rapids City and one two miles from Hampton. Drilling shows the latter to lie beneath parts of secs. 15, 16, and 22 of T. 18 N., R. 1 E. The northern basin is probably of even smaller size.

The Pennsylvanian beds in the Carbon Cliff area (fig. 11) are in part like those at the northeast, but include other beds which appear to lie below the coal section. These latter include the dark carbonaceous shale now being worked at the Tri-City Brick Company's pit.

In the Coal Valley area the same beds appear in outcrop and mines as at Carbon Cliff, with some 60 feet of beds below the coal worked there.

To the west, near Andalusia, the Pennsylvanian rocks are exposed in valleys tributary to the Mississippi. Here the following section was reported by $Savage^{26}$:

Exposure of Pennsylvanian strata near Andalusia

Description of strata	Thick	Thickness	
	Ft.	In.	
McLeansboro formation			
Sandstone, thin bedded, gray to yellow, micaceous	12		
Shale, gray, sandy, in layers 1 to 6 inches thick, with bands			
of sandstone and thin clay-ironstone concretions	25		
Coal (locally present)		6	
Shale, gray	4		
Limestone, concretionary, argillaceous (locally absent)	1 to 4	• • •	
Carbondale formation			
Coal, (Herrin, No. 6 bed?): locally present	4 to 11	••••	
Pottsville formation			
Sandstone, thin-bedded	4	6	
Coal (locally present)	1	$1\frac{1}{2}$	
Shale, gray to dark, with many small concretions of clay-			
ironstone	13		
Coal (locally present)	½ to 1½		
Sandstone, gray, micaceous, in thin layers, with a thicker			
layer at the top	3	6	
Shale, gray to black, the middle part with large concretions			
and bands of dark nodular limestone, the surfaces of			
which are covered with "cone-in-cone" structures, and in			
places nodules covered with pisolite	21	• • •	
Sandstone, hard, quartzitic, in two layers	1	6	
Coal, in some places	½ to 2	•••	
Shale, gray to dark	23	• • •	

To the south, in Buffalo Prairie Township (T. 16 N., R. 4 W.), a greater thickness of Pennsylvanian beds appears. No recognizable horizon is noted in logs from this area but the relative elevation of the Rock Island coal and the beds recorded suggest that the Pennsylvanian here may extend as much as 150 feet below the zone of that coal. In the extreme western part of the county the upper part of the Penn-

²⁶ Savage, T. E., and Udden, J. A., Geology and mineral resources of the Edgington and Milan quadrangles: Ill. State Geol. Survey Bull. 38, p. 149, 1922.

sylvanian section consists of sandy beds, locally 60 feet thick.²⁷ These appear to belong to the upper part of the Pennsylvanian system.



FIG. 12. Graphic logs from eastern and western parts of Rock Island County.A. Eastern part. B. Western part.

Two formations of the county merit special notice because of their stratigraphic importance. These are the limestone, which locally is

²⁷ Savage, T. E. and Udden, J. A., Geology and mineral resources of the Edgington and Milan quadrangles: Ill. State Geol. Survey Bull. 38, p. 152, 1922.

the cap-rock of the Rock Island coal, and the massive sandstone near the top of the section exposed near Muscatine, Iowa.

The coals of the county are distributed irregularly, are of variable thickness, and appear at different horizons in the Pennsylvanian section. Typical logs from the eastern and western parts of the county are presented for comparison (fig. 12). The lack of adequate records for the eastern part has necessitated the substitution of a log from just south of the county line in Mercer County.

The most important coal of the county is the Rock Island coal which has been worked at Coal Valley, Carbon Cliff, and Hampton. Other coals appear above or below this coal, but they seem to have a still more limited development. In no case has any thicker coal been discovered, nor one with wider or more uniform development. Thin coals have been reported from near the base of the "Coal Measures" but these apparently have no commercial value.

Structure

The base of the Pennsylvanian beds in Rock Island County has an altitude ranging from about 600 feet near Milan to about 475 feet near Buffalo Prairie. The upper surface of the Pennsylvanian beds ranges from about 560 to over 730 feet. Since no single stratum or group of strata have been recognized throughout the county, it is not possible to determine the structure of the beds as a whole. Comparison of the elevations of the two formations above noted leads to the inference that at least the upper Pennsylvanian beds lie essentially flat, and there is no suggestion in the records at hand that this attitude is not maintained by the lower beds as well. This general horizontality is locally modified, especially where beds of coal appear. In such places, as at Coal Valley, the whole series of beds above the coal lie in relatively narrow basins, or troughs, and have dips of approximately 30 feet to the mile. This low inclination, however, appears to represent the original inequality of the coal swamp and not to indicate any structural deformation.

ROCK ISLAND COAL

The Rock Island coal is recognized in small isolated basins of a few square miles in extent in T. 18 N., R. 1 E., in T. 17 N., R. 1 E., in T. 16 N., R. 1 W., and doubtfully in T. 16 N., R. 2 W. and in T. 16 N., R. 4 W. The coal ranges from three inches to six feet in thickness and is rarely uniform within a single mine. There is also considerable variation in character. In some places it shows no partings; in others two or more bands of pyrite or shale separate the bed into several

COAL RESOURCES OF DISTRICT III

benches. As a general rule the top coal is harder and commonly brighter than the lower. Where three benches are developed, the middle is usually the dullest and the bottom bench commonly contains the most pyrite in balls and lenses. The roof is dark shale, locally sheeted and slaty; commonly there is a cap-rock of dark argillaceous limestone. This is a fossiliferous stratum and carries the fusulina hitherto recognized as the index fossil of the limestone overlying the Belleville (No. 6) coal. This limestone is usually less than three feet in thickness, and is overlain by a relatively massive, slightly calcareous shale of dark bluish-gray color, commonly called the "blue rock" by the miner. The distinction between these two beds is more marked on weathered surfaces than in the freshly-cut sections. The "blue rock", however, contains relatively few fossils. The floor is in most places medium to light gray clay, soft, and without laminations.

Other Coal Beds

Other beds are recorded in many parts of the county. Locally, as in Drury Township (T. 16 N., R. 5 W.), they are nearly three feet thick and are worked as country banks. These have in no case been fully prospected, but appear to have an even less extensive development than the Rock Island coal and are considered of little commercial importance. Probably some of these beds lie stratigraphically above the horizon of the Rock Island coal, and some of them undoubtedly lie beneath that coal bed. The matter of stratigraphic relations can not be cleared up until some means of identification of the lower beds in the Pennsylvanian section are found.

SCHUYLER COUNTY

General Statement

Schuyler County lies just inside of the west margin of the Illinois coal field and as a consequence shows relatively thin Pennsylvanian beds between the drift and the Mississippian limestone formation below. Because of the shallowness of the "Coal Measures", erosion by streams, especially Crooked Creek on the west and Sugar Creek and Illinois River on the east, has removed these beds from relatively wide areas, as shown on the map (Pl. IB).

Production and Mines

The report of the Department of Mines and Minerals for 1923 records a total of 36 local mines in the county, producing a total of 25,636 tons. Of this tonnage 65 per cent came from the Rushville

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SCHUYLER COUNTY

bed and the remainder came from the Colchester (No. 2) coal. The mines are so scattered over the county that practically every township is represented in the list. Many strip pits are operated in the summer months, but during the winter the other properties are actively worked.

Area underlain by workable coal	sq.	mi.
Average thickness	inc	hes
Amount available originally538,100,00	0 t	\cos
Production, year ending June 30, 1923	6 t	ons
Average annual production, 1919-1923	9 t	cons
Total production recorded	7 t	cons

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene deposits are of the usual type, but are relatively thin on the average. Various wells record from 7 to a maximum of 210 feet, but in the area underlain by "Coal Measures" the Pleistocene is probably little more than 50 feet thick.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds outcrop in most parts of the county, but are nowhere common. The more prominent outcrops are along the Little Missouri and other tributaries of Crooked Creek in the west, along Sugar Creek in the vicinity of Ray and Pleasant View, and along Coal Creek near Frederick. Very few logs showing the character and thickness of the Pennsylvanian beds have been reported from the county.

The accumulated data show the Pennsylvanian to range from a feather edge near the boundary of the beds to more than 200 feet in the Rushville area. The base of the series is not readily recognized because of the presence of similar beds in the upper part of the Mississippian formation. Therefore the total thickness may be increased by as much as 100 feet where this thickness of clastic beds is recorded on top of the main limestone of Mississippian age. Such additions to the known thickness appear in the logs from secs. 13, 15, 27, and 32 of T. 3 N., R. 2 W. (Littleton Twp.), and in sec. 3 of T. 2 N., R. 2 W. Above these basal beds which are doubtfully Pennsylvanian, lie the beds which are commonly exposed in the county. These are presented graphically as a generalized columnar section (fig. 13).

The lower four members in the section comprise the Pottsville portion above which lies the Carbondale with the Colchester (No. 2) coal with its underclay at its base. The lowest eight members, including the sandstone over the Colchester coal are found rather generally

1	Thickness $Feet$		
	2	(I)	Limestone.
	15		Shale.
	5	(H)	Limestone, dense, gray, fossiliferous. Shale, black, fissile.
****	5	(G)	Coal, (Rushville bed).
	10		Under clay.
	2	(F)	Limestone, nodular, fossiliferous.
	20		Shale, fine.
	50	(E)	Sandstone, massive, grading upward. Base uneven
	10	(D)	Limestone, fossiliferous, flinty.
	4		Shale, black, fissile, with pyritic concretions
	5	•	Sandstone.
	10	1	Shale, locally sandy.
	2	(C)	Coal, (Worthen's No. 2).
	10		Under clay.
	2	(B)	Limestone, brecciated.
	15		Sandstone and sandy shale.
	1	(A)	Coal, locally developed.
	15		Sandstone, locally conglomeratic.
	184	Total.	
F1G. 13.		Gener	alized columnar section for

Schuyler County.
over the county. In the limited highland area north of Rushville and Pleasant View is an irregular patch where the Pennsylvanian beds are considerably thicker, and in which are found the upper eleven beds of the section.

PROMINENT BEDS

There are several prominent beds in the section by means of which it may be possible to make statewide correlation of the series in Schuyler County. These are listed below with the appropriate index letter referring to the generalized section (fig. 13):

- I. The blue to buff, fine-grained limestone lying about 150 feet above the No. 2 coal.
- H. A gray fossiliferous limestone lying 130 feet above No. 2 coal.
- G. A 5-foot coal (Rushville) lying 125 feet above the No. 2 coal.
- F. A gray nodular limestone 2 or 3 feet thick, 110 feet above the No. 2 coal.
- E. A massive sandstone from 20 to 70 feet thick, lying 30 feet above No. 2 coal.
- D. Dark blue limestone, cherty in upper part, argillaceous below, 10 feet thick, lying 20 feet above No. 2 coal.
- C. Colchester (No. 2) coal.
- B. Brecciated limestone 2 feet thick lying 10 feet below top of the Colchester coal.
- A. No. 1 coal of Worthen, usually less than 1 foot thick, but locally developed in 2 benches with 18 inches of gray shale between. This bed lies 20 feet below the top of No. 2 coal.

Three coals are recognized in Schuyler County of which but two are worked, one in the limited area north of Pleasant View and the other in all parts of the county. These have been correlated as Rock Island or No. 1 bed at the base; Colchester or No. 2 bed about 25 feet over Rock Island coal; and Rushville or No. 5 bed about 125 feet over the Colchester coal.

As is usual in the strata of the Pennsylvanian system, there is considerable variation in the character and thickness in relatively short distances. Thus the following typical log of the upper portion of the section, taken from the shaft of the Root mine in sec. 23, T. 2 N., R. 1 W., shows some marked differences when compared with the generalized log in figure 13:

COAL RESOURCES OF DISTRICT III

Description of strata	Thickness		${\tt Depth}$	
	Ft.	In.	Ft.	In.
Drift	8		8	
Limestone, gray	8		16	
Shale, gray	4		20	
Limestone, sandy	4		24	
Shale, light gray	23	6	47	6
Limestone, "cap rock"	•••	8	48	2
Shale, black, fissile	2	6	50^{-1}	8
Coal, without partings	5	5	56	1
Clay, light gray		3	56	4
Coal, bony	1	6	57	10
Clay, light gray	4		61	10

Record of the upper portion of the shaft of the Root mine, sec. 23, T. 2 N., R. 1 W.

While few logs are available which serve to indicate the character of the pre-Pennsylvanian surface, the general relations of the "Coal Measures" to the earlier strata clearly suggest that the former lies as a thin veneer over the uneven surface of the latter.

Structure

The Pennsylvanian beds, though essentially flat-lying, show a slight eastward dip, which may be original, although more probably is related to the upwarping of the Mississippian beds in the Colmar region. Selected data show a difference in altitude of the Colchester coal amounting to 62 feet in 20 miles. The limited workings in the coal do not reveal any minor structures of consequence.

The following statement from an earlier report of the Survey gives the structural relation of the beds in this county and in the adjoining area to the north²⁸:

GENERAL STATEMENT

"Elevations upon either or both coal No. 2 and the basal contact of the St. Louis limestone were secured wherever possible at intervals of one mile or less. These elevations were recorded upon a study map which revealed the following general structure of the two beds.

"In general, coal No. 2 dips to the south of east—from the highest elevation of 630 feet, in secs. 25 and 26, T. 3 N., R. 5 W. (Augusta), Hancock County, to the lowest elevation of about 500 feet along Illinois River in the vicinity of Browning and Frederick, Schuyler County. Upon this larger structure in places there are some minor features which take the forms of

²⁸ Morse, W. C., and Kay, F. H., Area south of the Colmar oil field: Ill. State Geol. Survey Bull. 31 p. 29, 1915.

small domes, anticlines, terraces, and synclines. The general dip, however, persists over large areas, and the coal bed lies nearly flat in a belt 4 to 6 miles wide stretching from Littleton to a point beyond Mabel and probably in a similar belt stretching southeast from Littleton through Rushville to Pleasant View, although elevations in this latter belt are very meagre because of the lack of coal outcrops.

"Like coal No. 2, the St. Louis limestone in the region under discussion, has a general dip to the south of east. It dips from the highest elevation of 580 or 590 feet in the vicinity of Huntsville and the northwest part of Schuyler County to the lowest elevation of about 450 feet along Illinois River between Browning and Frederick. Furthermore, the total amount of dip of these two horizons is about the same, being 130 feet for coal No. 2 and 140 feet for the St. Louis limestone. Upon this general structure of the St. Louis limestone there are also minor structural features similar to those shown by coal No. 2.

"Because of the general parallelism between coal No. 2 and the St. Louis limestone, and especially because in areas where exposures of the one are absent, outcrops of the other are commonly present, it has been regarded advantageous to combine the data regarding the two beds in a single map on which the altitude of the beds has been shown by means of contour lines. Where coal No. 2 is present the contours represent elevations run to that bed; where it has been eroded, its former elevation was determined by running elevations to the base of the St. Louis limestone and adding to this figure the average thickness of beds between the base of the St. Louis and coal No. 2. This thickness is 40 feet at the southeast part of the area and increases regularly toward the northwest. At the northwest corner of Schuyler County the interval is 75 feet, as determined by Mr. Hinds in his work in the Colchester and Macomb quadrangles.

FOLDS SHOWN BY COAL NO. 2 AND ST. LOUIS LIMESTONE

"A minor dome has been found in the coal to the east of Littleton, its apex being in secs. 12 and 13, T. 3 N., R. 2 W. (Littleton). The bed in the immediate vicinity rises from about 550 feet on the southeast and from a little less than 580 feet on the north to its maximum elevation of about 600 feet. Both the St. Louis limestone and coal No. 2 between secs. 8 and 21, T. 2 N., R. 2 W. (Buena Vista), lie at elevations 10 to 20 feet higher than they do in the immediate vicinity to the north, east, and south, as indicated on the map (Plate I). It must be noted, however, that the rise of the beds is a *very* slight one.

"Coal No. 2 in secs. 14 and 9, T. 1 N., R. 2 W. (Woodstock), and the St. Louis limestone in sec. 33, T. 1 N., R. 2 W. (at Ripley), reach elevations 20 to 30 feet higher than they do in the adjoining territory. Between these points elevations of the beds are not available for the reason that they are not exposed at the surface. The area of elevated strata is probably about as that represented on the map (Pl. I) within the limits of the 540-foot contour line. It is also a *minor* feature with unknown limits.

"In sec. 7, T. 1 N., R. 2 W. (Woodstock), and in secs 10, 11, and 13, T. 1 N., R. 3 W. (Missouri)—that is, at Scott Mill—the St. Louis limestone reaches an elevation 50 or 60 feet higher than it does to the south. Although elevations are not obtainable to the north, the limits of the elevated beds are

COAL RESOURCES OF DISTRICT III

probably correctly shown by the 570-foot contour line. Coal No. 2 lies at a higher elevation along what seems to be a small anticline whose axis runs southwest from sec. 5, T. 1 N., R. 3 W. (Missouri), through sec. 13, T. 1 N., R. 4 W. (Pea Ridge); but here also the rise is only a few feet. The coal bed also rises rather rapidly westward from 520 feet to 580 feet in sec. 4, T. 1 S., R. 3 W. (Mt. Sterling); but unfortunately lack of exposures and of field study makes it impossible to state now whether this bed continues to rise in this direction or culminates here in its highest observed point.

"In the area under discussion the greatest elevation which coal No. 2 attains is near the county line slightly north of west of Huntsville where the bed is more than 630 feet above sea level. The exact nature of this structure is not clear, because the bed is concealed to the west. It seems probable that it is an elongated dome, although it may be a terrace from which the bed rises to the north or to the west, or in both directions. The structure is more pronouncedly revealed by the contours on the base of the St. Louis limestone which reaches its maximum height slightly to the northeast of that of coal No. 2, or along a curved line extending from secs. 34 and 35 northwest to sec. 17, T 3 N., R. 4 W. (Birmingham). From the east the St. Louis rises rather rapidly from 530 or 540 feet to 580 or 590 feet along this belt of elevated beds. Unfortunately there are no outcrops to the west which would show the altitude of the limestone farther in this direction, but the suggestions are that the bed dips to the west, beyond the belt of elevated strata, thus forming an elongated dome. If on the contrary the limestone rises to the west then the structure is a terrace rather than an elongated dome. At any rate, there is a sudden arrest of the rapidly rising limestone along this belt of elevated strata and there is a terrace on the steeper portion of the dipping limestone two miles east of Huntsville as shown on Plate I. The Huntsville uplift is represented graphically on the map by contours based on both the limestone and coal elevations."

Colchester Coal

As shown on Plate I B, there are two main areas in which the Colchester (No. 2) coal is mined, the smaller lying south of Huntsville mainly in T. 2 N., R. 4 W., and the larger centering about Rushville and occupying most of Tps. 1, 2, and 3 N., of Rs. 1 and 2 W. The deep incision by streams produces an extremely irregular pattern on the areal map. Over these two areas the Colchester coal ranges from 18 to 36 inches in thickness. The coal is relatively clean, having no persistent partings of foreign material. The top coal is usually somewhat harder than the lower part. The roof is uniformly shale from 5 to 20 feet thick, the upper part usually sandy. In places the sand content is so great that the whole bed is essentially a sandstone. The floor is gray underclay which in many places is sandy, though it serves well as an undercutting bed in most workings.

This coal is worked for local trade entirely, and most of the operations are on a very small scale, with limited mining equipment. Figure 14 showing a drift in sec. 36, T. 3 N., R. 1 W., represents the typical outside equipment for mines working the Colchester coal.



FIG. 14. Outside equipment of drift on Colchester coal, Gory's mine, Schuyler County.

RUSHVILLE COAL

The Rushville coal underlies only a small portion of the county, but has produced a large percentage of the coal mined. It underlies the area of highland north of Rushville and Pleasant View, but is not recognized outside of this field. It ranges from 60 to 72 inches in thickness and is quite uniform in any one mine. Like the Colchester coal it shows no partings or benches and is therefore relatively clean as mined. It is a soft coal of easy and irregular fracture, of dull luster with but few bands of glance coal in the bed. Pyrite and calcite appear throughout the coal in facings and pyrite lenses are not rare. Clay slips affect the bed in some mines, but these are of limited size and are not a great hindrance in mining.

The roof is regularly black "slate" from 2 to 3 feet thick which maintains an even contact with the coal. The cap lime 2 to 3 feet thick overlying this combines with the "slate" to make an excellent mining roof. In places these beds have been eroded and glacial drift makes the roof. This condition appears in some strip pits. The floor is light gray sandy clay which shows little variation and serves well as a mining bottom as it rarely gives trouble by heaving.

Other Coal Beds

In the vicinity of Frederick two coal beds appear which are not readily referred to the foregoing stratigraphic section. Only the uppermost of these is mined, as the lower is not known to be more than 15 inches thick. The upper coal now being worked in Spiller's mine in section 4, T. 1 N., R. 1 E., is about 34 inches thick, without benches or persistent partings. It shows pyrite and shale lenses with facings of calcite and pyrite throughout. The 18-foot shale comprising the roof is here overlain by 8 feet of limestone, overlain by 60 feet of sandstone. This resembles the succession over the Colchester coal east of Pleasant View.

There is also a lower coal outcropping in the vicinity of Pleasant View which is correlated as Worthen's No. 1. It is so split by shale partings as to be of no value where sufficiently thick for mining.

SCOTT COUNTY

GENERAL STATEMENT

The "Coal Measures" of Scott County are quite similar to those of Morgan County to the north and of Greene County to the south, with the exception that the only beds appearing within the county boundary belong in the lower, rather than the upper part of the Pennsylvanian section (Pl. I B).

PRODUCTION AND MINES

Coal mining is of little consequence, except in the vicinity of Winchester, Exeter, and northeast of Alsey. At Alsey an extensive clay mine makes use of the overlying coal for a part of its supply. Nine mines producing a total of 5,120 tons were reported by the Department of Mines and Minerals in 1923. This was approximately one-third less than in 1922.

Area underlain by workable coal124 sq	. mi.
Average thickness24 in	iches
Amount available originally280,000,000	tons
Production, year ending June 30, 19235,120	tons
Average annual production, 1919-192318,004	tons
Total production recorded	tons

Stratigraphy

PLEISTOCENE SYSTEM

The loess which caps the uplands of most of the county is thicker close to the Illinois, where it reaches a maximum of over 40 feet. The underlying Pleistocene deposits closely resemble those of adjacent counties. Boulder clay, sand and gravel make up the bulk of the deposits, ranging from 20 to 95 feet in thickness. In places, as northeast of Alsey, these beds lie immediately above the coal, which thus can be readily extracted by stripping. In the main, however, the Pleistocene deposits cause little difficulty in coal mining.

PENNSYLVANIAN SYSTEM

The "Coal Measures" underlie only the eastern half of the county, the Mississippian limestone outcropping in the creeks along the line of the bluffs, between Winchester and Alsey. Doubtless much greater irregularity exists in this line than appears on the map, which is based on a reconnaissance survey. As a result of this relation to the Mississippian beds, the "Coal Measures" thin to a feather edge at the west, while at the east margin they are nearly 175 feet thick. Outcrops are found along the creeks in the vicinity of Exeter, along Big Sandy about 2 miles east of Winchester and in sec. 14, T. 13 N., R. 12 W., northeast of Alsey. Farther west, the Mississippian rocks outcrop prominently along the creeks. Worthen²⁹ gives the following section as representative for the county:

Representative Pennsylvanian section for Scott County

Description of strata	Thickness	Depth
	Ft.	Ft.
Sandstone and shale	. 30 `	30
Limestone	. 2	32
Bituminous shale (Coal No. 2?)	. 3	35
Sandstone and shale	. 35	70
Bituminous shale	. 5	75

29 Worthen, A. H., Geol. Surv. of Ill. Vol. III, p. 136, 1868.

COAL RESOURCES OF DISTRICT III

Representative Pennsylvanian section for Scott County-Concluded

Description of strata	Thickness	Depth
	Ft.	Ft
Coal (Exeter No. 1)	3	78
Clay shale, dark blue	3	81
Limestone, dark blue, dense	4	85
Shale, or "potter's" clay	12	97
Sandstone, shaly and conglomeratic with iron ore and	L	
locally thin coal	12	109
Limestone, Mississippian		

The following section from the vicinity of Alsey is representative of the Pennsylvanian in the southern part of the county:

Description of strata	Thickness		Depth	
	Ft.	In.	Ft.	In.
Sandstone	15		15	
Shale, sandy	1	6	16	6
Sandstone		10	17	4
Shale, medium gray	1		18	4
Shale, black fissile	3		21	4
Shale, light gray	•••	3	21	7
Coal	2	2	23	9
Clay, sandy	••	8	24	5
Interval concealed (probably shale).	3		27	5
Limestone, brecciated, nodular	4	••	31	5
Clay, light to dark gray (Cheltenham).	6	••	37	5
Coal, lenticular, with 1 in. shale below		7	38	
Limestone, (Mississippian)				-

Typical Pennsylvanian section for southern part of Scott County

The similarity in the two sections above is marked, but the identification of the Exeter bed, made by Worthen, is probably incorrect. The presence of the bituminous shale or "slate" over the 36-inch coal, and of the dense nodular limestone 4 or 5 feet below the coal rather definitely fixes this as the Colchester or No. 2 coal of southwestern Illinois. This coal presumably underlies the eastern half of the county, whereas the thinner coal below is but locally developed and does not constitute an appreciable part of the coal of the county.

It does not appear that the base of the "Coal Measures" of this county is marked by great relief, but the lower portions may be the site of deposition of a basal coal corresponding to the No. 1 coal of Worthen's type section. The relation of the Exeter coal to that of the Neelys coal in the extreme western part of Morgan County is

WARREN COUNTY

not clear. According to Worthen, the upper bed at Neelys lies 25 or 30 feet above the Exeter coal. It is there 48 inches thick, but does not appear to have any extensive development.

Structure

The beds lie essentially flat over the eastern part of the county, showing only a moderate dip which does not carry the coal below workable depths within the county limits.

Exeter Coal

Coal has been mined only in the vicinity of Exeter, Winchester, and Alsey, yet the Exeter bed appears to underlie the whole eastern half of the county. Available data do not show whether it is the same bed throughout the field, but the general character of the roof and floor and of the coal itself suggests this.

The bed has an average thickness of 30 inches and is not known to depart greatly from this amount in any mine. The roof is soapstone with black fissile shale above and gray shale over the "slate". The floor is gray clay about 2 feet thick underlain by a 3-foot bed of nodular, brecciated limestone, known as the "sump rock."

COAL BEDS BELOW THE EXETER BED

In several places in the county thin carbonaceous beds lie at or near the base of the Pennsylvanian strata. These locally may reach a thickness of about two feet, but because of their lenticular shape and generally bony character have not been attractive to prospectors, and therefore cannot be said to be a factor in the coal resources of the county.

WARREN COUNTY

GENERAL STATEMENT

Warren County lies at the western margin of the Illinois coal field and includes a small portion of the boundary of the Pennsylvanian beds (Pl. I A). This boundary is mapped approximately, but numerous well-logs located near the edge of the Pennsylvanian area indicate a very marked irregularity for this line. As drawn, it lies west of any of the known coal beds and approximates the margin of the main area of the "Coal Measures" disregarding the numerous small outliers of sandstone and shale. The western two-thirds of T. 12 N., R. 3 W., and the northern half of T. 11 N., R. 3 W., are underlain by Mississippian beds only. Elsewhere the Pennsylvanian rocks underlie the drift in considerable thickness.

PRODUCTION AND MINES

For many years past there have been no shipping mines in Warren County, although a considerable amount of coal has been obtained from year to year from the country banks. The annual production has varied greatly but at no time has it been important. In 1923 there were recorded nine local mines with a total production of but little more than 10,000 tons. These mines are scattered over the county from north to south with a majority in the southern two tiers of townships.

Area underlain by workable coal	mi.
Average thickness	hes
Amount available originally	ons
Production, year ending June 30, 192310,312 to	ons
Average annual production, 1919-1923	ons
Total production recorded	ns

Stratigraphy

PLEISTOCENE SYSTEM

The Pleistocene covering of the bed rock in Warren County is extremely uneven. This is in part due to the surface relief but is mainly accounted for by the irregularity of the bed rock surface itself. The greatest thickness recorded is 233 feet, in sec. 5, T. 11 N., R. 3 W. The drift includes considerable amounts of blue clay with some sand and gravel. In places buried soil and fragments of wood indicate the presence of more than one drift sheet.

PENNSYLVANIAN SYSTEM

The Pennsylvanian beds show thicknesses up to about 200 feet. These beds are largely sandy shale and shale with subordinate amounts of sandstone and little or no limestone. Because of the large amount of drift the outcrops of bed rock are few. In the northern part of the county they are found in the SE. ¼ of T. 12 N., R. 2 W. and in the NW. ¼ of T. 11 N., R. 2 W., about four miles north of Monmouth. In the southern part of the county, where the stream dissection has proceeded further, are numerous outcrops along creeks in T. 8 N., R. 2 W., and T. 8 N., R. 1 W., as well as in T. 9 N., R. 1 W. Further information on the Pennsylvanian beds is obtained from drill logs which are fairly well scattered over the county, although somewhat concentrated in the southern third.

A very large number of shallow borings have been made but these rarely reveal the bed rock below the drift. On the other hand a large number of deeper borings ended at the horizon of the Colchester coal so that relatively few logs show the thickness and character of the whole Pennsylvanian section in this county.

The general character of the Pennsylvanian beds is indicated by the following logs:

Description of strata	${f Thickness} Ft.$	$\begin{array}{c} ext{Depth} \\ ext{Ft.} \end{array}$
Clay, yellow	. 18	18
Clod, blue	. 2	20
Coal, Colchester	. 1	21
Slate, dark	. 29	50
Limestone, gray	. 8	58
Clod	. 2	60
Coal, Rock Island	. 3	63
Slate, black	. 12	75
Limestone, Burlington	. 125	200

Log of ooring in 1.0 m, n.1 m	Log	of	boring	in	T.	8	Ν.,	R.	1	W
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Description of strata	Thic	kness	Depth	
	Ft.	In.	Ft.	In.
Soil	1		1	••
Clay, yellow	17		18	••
Sand, yellow	10		28	
Shale, blue	16		44	••
Limestone, white	2		46	
Shale, black	18		64	
Sandstone (water)	6		70	
Rock, black	6		76	••
Sandstone	4	·	80	
Limestone	10		90	
Coal (Rock Island)	3	8	93	8

Log of boring in T. 10 N., R. 1 W.

Two beds in the Pennsylvanian section have been used as horizon markers with fair success although identification of either in drill logs is open to question. One is the Colchester coal which appears to be recognizable in the southern part of the county, and the other is the fusulina limestone overlying a coal which is tentatively correlated with the Rock Island bed. The limestone is positively identified in sec. 15, T. 11 N., R. 2 W.; in secs. 14 and 24, T. 12 N., R. 2 W.; sec. 4, T. 9 N., R. 3 W.; sec. 9, T. 9 N., R. 2 W., and secs. 24, 25, 26, T. 9 N., R. 1 W. The Colchester coal has been tentatively identified in the

southern part of the county where contours have been drawn on its upper surface.

The relation between the Rock Island and the Colchester coal beds is determined in but few places since both beds are rarely recognized in any one section. In places where the identification seems accurate, the upper bed is from 17 to nearly 40 feet above the lower. The intervening rocks are shale or sandy shale except for the clay below the upper coal and the thin limestone capping the lower.

In places a thin coal is reported lying below the Rock Island bed, but is nowhere of workable thickness and is therefore not considered in an estimate of the resources of the county.

In the northeastern part of the county a few logs record the presence of a coal of workable thickness which appears to lie too high to be correlated with the Colchester coal and is tentatively classed with the coals lying above that bed.

Structure

Little information is available for the determination of the structure of the Pennsylvanian beds in Warren County. No recognizable stratum is continuous over the area which is underlain by rocks of this system nor is it possible to use any combination of two beds to determine the structure. Earlier work in the area to the south,³⁰ however, resulted in the drawing of contours on the surface of the Colchester coal in the southern part of the county.

Examination of available data brings out the point that this bed shows no marked regional dip. Instead, it appears to be involved in a series of three upwarps, one of which plunges eastward, and the other two trend southwestward. The first arching in which a relief of nearly 80 feet is indicated is in the vicinity of Roseville and involves the beds from near Smithshire on the northwest to the southeastern corner of the county. A low broad arching is similarly shown near Cameron, but here the difference in elevation is but 40 feet. Apparently the area of sharpest folding lies between Gerlaw and Utah, in the northeastern part of the county, where, although the relief is less than near Roseville, the inclination is appreciably greater.

Inasmuch as these structures, as outlined, are based on limited data, and since where information is better the structures are more complicated, it is probable that these broad features of the structure are actually modified greatly by unobserved deformations and that a

³⁰ Savage, T. E., and Nebel, M. L., Geology and mineral resources of the LaHarpe and Good Hope quadrangles: Ill. State Geol. Survey Bull. 43, p. 9, 1921.

true structural map would exhibit numerous arches, basins, and other types of structure where present data indicate only smooth gentle slopes.

COLCHESTER COAL

The most important coal in the county is that known as the Colchester coal. Over a considerable portion of the county this bed has been reported in mines and drill logs. In many of these places it has not been positively identified and about half the county is known to be underlain by it. Ranging from a few inches to about three feet in thickness, it still shows considerable uniformity and probably averages about 30 inches in the area mapped as containing workable coal. Because of its lenticular development it is probable that there are areas of thin coal within that mapped as one of commercial thickness. The thick cover of glacial drift may also conceal areas of workable coal lying outside the area mapped.

The coal is of fair quality in most places, and although mostly dull with but few bright bands, it shows no persistent partings of shale or bone. Facings of calcite and gypsum are common, as are small lenses and balls of pyrite. The roof is usually "soapstone", a light gray, rather massive shale which is sandy toward the top and in places grades laterally into sandstone. Above the shale is commonly a foot or more of fissile black shale, known as "slate" by the miners and which locally carries calcareous or pyritic nodules. The floor is uniformly gray plastic clay several feet thick.

Other Coal Beds

Because of its greater thickness and generally superior quality the Rock Island coal has been worked more than the Colchester bed. It is much less widely developed, however, and hence can not be considered as important a resource. It is known in two parts of the county, one northeast of Monmouth where it is about 42 inches thick and the other along the southeastern margin in which it is somewhat thinner.

The coal is relatively soft, and notably laminated with prominent bright and dull bands. A bony or shale parting near the middle is usually present, and the lower bench is softer than the top. Facings of calcite, gypsum and pyrite are common so that the ash and sulphur content are generally high. The roof is good, comprising a cap limestone with a foot or two of black fissile shale between it and the coal in places. The floor is sandy, either sandstone or sandy shale, which is in places overlain by a few inches of carbonaceous shale called "false bottom." A third area of workable coal has been mapped in Warren County in the extreme northeastern part where little mining or testing has been done. The data from adjoining parts of Knox and Mercer counties, however, strongly suggest the presence of a bed of coal of workable thickness east of Alexis. This bed, which seems to lie above the horizon of the Colchester coal, is estimated to be about 30 inches thick, but so little is known of its extent or character that its value as a resource can easily be overestimated.

WHITESIDE COUNTY

GENERAL STATEMENT

Whiteside County lies along the north margin of the Illinois coal basin, and includes only a few small patches of rock of Pennsylvanian age (Pl. I A). These are not known to contain any coal; hence there are no mines or prospect pits within the county boundaries.

STRATIGRAPHY

PENNSYLVANIAN SYSTEM

The presence of Pennsylvanian rocks is known from outcrops, quarries, and borings. These show that the distribution of the beds is irregular, but the precise area underlain by them is not known. The section known comprises sandstone with thin interbedded shale. Fair exposures are found in the old quarries at Unionville and also about five miles southwest in secs. 19 and 20, T. 21 N., R. 4 E. Not more than 12 feet is exposed in any place, and while the rocks show some variation in bedding, it is nearly uniform in character. It is white sandstone of essentially clean quartz, iron stained on weathered surfaces, and not well cemented. It contains impressions of plant stems, and appears to have been deposited in fresh water or shore phase of the sea. From the relation in elevation between the Unionville quarry and the outcrop of Niagaran (?) limestone one mile east, and the absence of evidence of inclination of the sandstone bed, it appears probable that the Pennsylvanian rocks occupy depressions in the old limestone surface of pre-Pennsylvanian time. In this case they presumably are erosion remnants of a more widespread formation laid down near the margin of the area of Pennsylvanian deposition. The stratigraphic position of these sandstones is not clear. There is no available evidence suggesting whether they were deposited in early or late Pennsylvanian time. If a late overlap of Pennsylvanian phase occurred in Henry and Rock Island counties, it is logical to assume that these beds belong to that time.

SUMMARY

SUMMARY OF COAL RESOURCES

For convenience of reference the tabulated matter presented in Table 4 has been repeated in part in the reports for each county. All available data have been utilized in the estimation of the coal resources, but it is obvious that such estimates must be approximate. The area underlain by workable coal was measured by planimeter from a base map on which the coal fields were plotted. Where two beds underlie the same field, the smaller area is not included in the total area for the county, although it is included in the estimate of total available tonnage. The average thickness of the coal beds in different parts of each county were combined with reference to the areas involved in each in arriving at an average thickness for each county.

Production figures have been taken from the reports of the Department of Mines and Minerals, which contain the most nearly accurate record of statewide production. Recognized inaccuracies appear here also, particularly in the decades preceding 1900, but these are mainly of omission and correction of them would serve to slightly increase the estimated production.

On the commonly accepted assumption that nearly as much coal has been rendered unfit for mining as has been mined, an idea of the present available tonnage is obtained by subtracting from the estimated originally available tonnage about 1.8 times the recorded total production.

Because of the overlapping of the adjoining districts the inclusion of certain counties in the figures for District III has necessarily been arbitrary. Thus in the case of Bureau County, so small a part of the whole county is included in the district that figures for area and production are not significant, and are omitted. Similarly for Fulton, Jersey, Knox, Madison and Mason counties the figures for production are not presented because of the impossibility of separating the small tonnage properly to be credited to the coals of District III from that for the whole county. Estimates of area of workable coal, average thickness, and original tonnage for these counties are, however, included, except that no attempt has been made to include the area underlain by the lower coals where the upper coals are of importance.

County	Area of	Average	Original	Produ	ction
	coal	thickness	tonnage	1881-1923	1923
	Sq. mi.	Inches		Tons	Tons
Adams	369	$24^{ m b}$	838,720,000	464	
Brown	182	24	412,820,000	26,489	150
Calhoun	8	24	17,900,000	96,087	
Cass	265	36	897,000,000	182,609	9,014
Fulton ^a					
Greene	204	24	461,000,000	407,006	8,811
Hancock	7	30	19,270,000	243,473	9,313
Henderson ^a	22	29 ^b	59,580,000		
Henry	307	43 ^b	1,247,530,000	4,754,791	58,074
Jersey ^a	11	24	24,600,000	_,,.	
Knoxª	517	36 ^b	1,727,000,000		
Madison ^a	29	24	65,750,000		
McDonough	267	24	604,700,000	2,204,138	39,275
Mercer	127	34 ^b	412,130,000	13,689,352	400
Morgan	533	27^{b}	1,340,500,000	83,219	25,964
Pike ^a	85	24	193,000,000		
Rock Island	63	29 ^b	171,760,000	3,098,876	63,035
Schuyler	202	28^{b}	538,100,000	598,927	25,636
Scott	124	24	280,000,000	547,836	5,120
Warren	281	32 ^b	866,500,000	513,381	10,312
Whiteside					
Total	3,603		10,177,860,000	26,446,648	255,104

TABLE 4.—Summary of coal resources in District III

^a Statistics not available.

^b Figure obtained by calculation involving areas of different beds.

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