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COAL MINING INVESTIGATIONS

COOPERATIVE AGREEMENT

State Geological Survey
Department of Mining Engineering, University of Illinois
U. S. Bureau of Mines

BULLETIN 10

Coal Resources

OF

District I (Longwall)

BY

GILBERT H. CADY

Field Work by G. H. Cady, K. O. White, and others
In cooperation with U. S. Geological Survey

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COAL RESOURCES OF THE LONGWALL DISTRICT OF NORTHERN ILLINOIS (DISTRICT 1)

By Gilbert H. Cady

CHAPTER I—INTRODUCTION

IMPORTANCE OF THE AREA

The amount of fuel originally available in the 1700 square miles of the Longwall District (Fig. 1 and Plate I) is enormous, being approximately 5,977,000,000 tons. Of this amount only about 3 per cent has been mined or placed beyond recovery by past mining. At the present rate of production (1913) this available coal would supply the State for about 90 years. The additional value of the millions of yards of shale and clay and cement-making limestone associated with the coal, and the location of the area near the Chicago market gives this district an economic importance second to none of the districts of the State. The mineral products obtained from the coal-bearing rocks of the area had a total value in 1912 of about eight and one-half million dollars, or about 7 per cent of the total value of the mineral products of the State for that year, although the district comprises only 3 per cent of the total area of the State. The estimate does not include the output of several zinc smelters and rolling mills and glass factories attracted to the region by the accessibility of the fuel, the value of whose manufactured products is several million dollars annually. It seems improbable that another area of the State of similar size outside of the oil fields produces from its own natural resources products having a greater value.

ACKNOWLEDGMENTS

This description of the coal resources of the Longwall District is one of a series of reports on the Illinois coal districts being prepared under the cooperative agreement of the State Geological Survey with the Department of Mining Engineering of the University of Illinois and the U. S. Bureau of Mines. The reports on coal resources cover

approximately the same areas as corresponding bulletins on Coal Mining Practice, as defined in Bulletin 1: *"A Preliminary Report on Organization and Method of Investigations."*

In the study of this region little special field work has been undertaken by the writer, but use has been made of the excellent notes taken in 1912 by Mr. K. D. White in the mines selected for field observation under the cooperative agreement. It has been the purpose to assemble also the information previously collected by other members of the Survey since its organization. Field notes by the following men have been reviewed: Messrs. Jon A. Udden, Frank F. Grout, E. W. Shaw (U. S. Geological Survey), L. W. Swett, Edwin F. Lines, E. H. Pool, and O. F. Brooks. Much of the information collected in cooperation with the U. S. Geological Survey by Professor U. S. Grant and the present writer in the study of the La Salle and Hennepin quadrangles has been incorporated in this report. The results of drilling operations conducted under the direction of Mr. G. S. Rice, now Chief Mining Engineer of the Bureau of Mines, have contributed much to our knowledge of the stratigraphy and structure of the district.

To the kindly cooperation of the various mining companies in this field, the Survey is indebted for the large amount of information. There has been a generous response to requests for drilling records and other information of a geological nature, even though much was of a confidential character. Individual mention would hardly stop short of a complete list of the companies. From the superintendents of the various mines, from the pit bosses, and not infrequently from the miners, have come many of the details of our information.

In the preparation of the report the writer is especially indebted to the Director, Mr. Frank W. DeWolf, and to Mr. F. H. Kay for kindly and helpful suggestions, and to Miss Helen Skewes, Messrs. M. L. Nebel, and L. S. Baldwin for aid in the preparation of the various diagrams and sketches.

DEFINITION AND EXTENT OF THE LONGWALL DISTRICT

The Longwall District is so called from the prevailing method of mining. The western part of the field is commonly spoken of as the "third-vein" field, because the principal coal mined at La Salle is the third bed below the surface. In the eastern part of the field this bed is known as the Wilmington coal. This "third vein" or "Wilmington" bed is coal No. 2 of the Illinois section, and is recognized by the State and U. S. Geological Surveys as approximately equivalent in age to the Murphysboro coal of southwestern Illinois. By definition it marks the base of the Carbondale formation of the Pennsylvanian system in this State.

The Longwall District includes the area underlain by coal No. 2 in commercial thickness. The area is limited on the north and east by the outcrop of the coal. On the south and west the coal probably continues beyond the limits of the area but in most places is not mined because of either its decrease in thickness or its greater depth in contrast to higher coals. To the south and west, therefore, the Longwall District merges with indefinite boundaries into the adjacent coal districts.

The accompanying map (fig. 1) shows the boundaries of the Longwall District as assumed in this report. Parts or all of the following counties are included in the area: Bureau, La Salle, Grundy, Will, Putnam, Marshall, Livingston, and Kankakee.

DEVELOPMENT OF MINERAL INDUSTRIES

This area lies near Chicago and is therefore crossed by many trunk lines, the more important of which are the Chicago, Burlington and Quincy Railway; the Chicago, Rock Island and Pacific Railway; the Atchison, Topeka and Santa Fe Railway; the Chicago and Alton Railroad; the Illinois Central Railroad; the Chicago, Indiana and Southern Railroad; and the Wabash Railroad. The transportation facilities are apparently ideal, but the present depression in the mining business of the district is thought by coal operators to be due to an artificial discrimination in freight rates between this and other districts of the State.

There are a number of important small cities in the district, the chief of these being Streator, La Salle, Peru, and Ottawa. These, and several of the smaller towns, Spring Valley, Granville, Oglesby, Coal City, South Wilmington, and Morris, owe much of their importance to the development of the mineral resources of the vicinity. The district contains rich and largely undeveloped resources of shale, clay, coal, glass sand, and limestone for cement making and for other uses. With slightly more favorable mining and transportation rates, and with useful canals traversing the district, the field might hold its own with any in the State. The coal output of the State has gradually advanced from north to south. In 1881 La Salle County led in output with 624,900 tons; in the next year it still held first place with over 2,000,000, after which the center of production moved south until the county leading in 1907 and 1908 is at the extreme southern end of the coal field. The center of production has steadily receded from Chicago markets because of (1) development of north-south railroads; (2) proportionately cheaper ton-mile rates; (3) thick coal and other conditions favoring easy mining; (4) low tonnage price paid to miners; (5) better quality of coal in the southern counties. It is thought by some that the eventual revival of coal mining in the area will depend on the use of coal at the mine to develop power, coal-gas products, and coke, so as to free the producer from much of the burden of transportation.

No oil or important gas fields have been discovered in the district, but the possibilities do not seem to have been exhausted, especially along the line of the La Salle anticline.

CHAPTER II—GENERAL GEOLOGY

INTERPRETATION BY MEANS OF BLOCK DRAWING

In order to understand the position of the coal beds in the geological formations present in the district, a knowledge of the general geological relations is necessary. In the following description of the general geology the rocks older than the "Coal Measures" or coal-bearing rocks are discussed very briefly, whereas the "Coal Measures" are considered in great detail. Operators or engineers in charge of development work will, it is hoped, find this a valuable reference chapter. The reader may, however, prefer to turn to other chapters directly and may refer to the Contents for topics of greater interest. The general relationship of the coal to the other strata is shown by the accompanying block diagram or stereogram (Pl. II). The drawing is diagrammatic and does not conform closely to horizontal scale or geographic boundaries.

The diagram represents a block of the earth's crust about as it is in the Longwall District. The block is divided into three sections along east-west lines. From the south section nearest the reader, all the strata have been removed to the base of the "Coal Measures" or Pennsylvanian series. The resulting surface represents that upon which the Pennsylvanian rocks were laid down, and is seen to be underlain by various kinds of rocks dipping eastward away from the fold, which trends approximately northwest-southwest. The fold is known as the La Salle anticline. It is shown to vary both in closeness and in height. To the south it is more gentle than to the north. Increasingly younger rocks next underlie the "Coal Measures" toward the east and toward the west from the axis of the fold as is shown in the diagram, and because of the unsymmetrical character of the anticline, which is much steeper to the west than to the east, the formations succeed one another much more rapidly to the west than to the east. In addition to the eastward and westward dip of the older strata there is also a dip toward the south, so that younger rocks are more likely to lie under the Pennsylvanian system to the south than to the north.

The middle section of the diagram (Pl. II) shows the surface of coal No. 2 as it would appear if all the overlying rocks were removed. It differs from the original surface of the coal in being folded along the axis of the anticline and in being limited on the east by an erosional, rather than a depositional, edge. The coal bed as originally formed probably had a very level surface and a gradually diminishing thickness toward the edges.

After the accumulation of the coaly material the deposition of other Pennsylvanian strata continued to a thickness of at least 500 feet above coal No. 2 in the center of the district. That this thickness persisted over all the area seems improbable. The succession evidently was thinner east of the anticline and toward the old shore line, which probably lay several miles beyond the present line of outcrop of the "Coal Measures."

At some time after the deposition of coal No. 2, and possibly after the close of Pennsylvanian deposition in this area, further movement along the line of the anticline occurred so as to fold the coal and other rocks as shown in the diagram. An earlier period of movement is described under "Structure."

The long period or periods of erosion that followed the deposition of Pennsylvanian strata removed the "Coal Measures" entirely from some areas and greatly thinned them in others. Just before the glacial period valleys had been cut so as to expose the coal, and the outcrops on the north and east were eroded back irregularly toward the center of the coal field. The boundaries of the coal could be readily traced if the covering of glacial drift were removed. The glacial material left by the ice is of general occurrence except where it has been removed by subsequent erosion, and is of irregular thickness, reaching a maximum of 340 feet. It is represented in the north section of the diagram in Plate II. The surface is in general a plain, but is cut here and there by steep-sided valleys which may or may not penetrate the underlying rock. The drift surface evidently bears no relation to the underlying rock surface, and therefore the limits of the coal beds can be determined only by extensive drilling.

This brief explanation of the stereogram (Pl. II) presents the three main groups of strata within the Longwall District and shows the general relationship existing among them. These strata in ascending order are (1) the pre-Pennsylvanian rocks ranging in age up through the Devonian and separated from the overlying rocks by an erosion unconformity that is conspicuous in parts of the district; (2) the Pennsylvanian rocks, consisting of sandstone, shales, limestones, and the thin beds of coal which are the special objects of our attention; and (3) the glacial drift. The main structural feature is a general southward dip interrupted by the pitching fold of the La Salle anticline which trends about northwest-southeast. Each of the groups of strata receives more detailed description in the pages that follow, and the structural features will be discussed at some length. There is also presented in Plate III a stereogram of the Longwall District showing the main geographic and geological features, to accompany the description of the geology.

STRATA BELOW THE "COAL MEASURES"

(PRE-PENNSYLVANIAN ROCKS)

The strata next underlying and forming the floor for the "Coal Measures" of the Longwall District as shown by Plate III range in age from the St. Peter sandstone to Devonian limestone and shale. The age of the underlying rock at Wenona, however, is unknown; it may possibly be as young as Mississippian. The Lower Magnesian limestone is the oldest rock exposed at the surface within the State. Possibly in a few places in the vicinity of La Salle it originally lay next below the Pennsylvanian or, at any rate, was separated from the Pennsylvanian by only a few feet of the St. Peter sandstone. The Lower Magnesian limestone is exposed along the Illinois River bluff between Utica and La Salle, along Pecumsaugan Creek, and along Tomahawk Creek and Little Vermilion River three and four miles north of La Salle. Where it outcrops along the streams, it forms perpendicular cliffs which reach a height of 50 to 75 feet. Figure 2

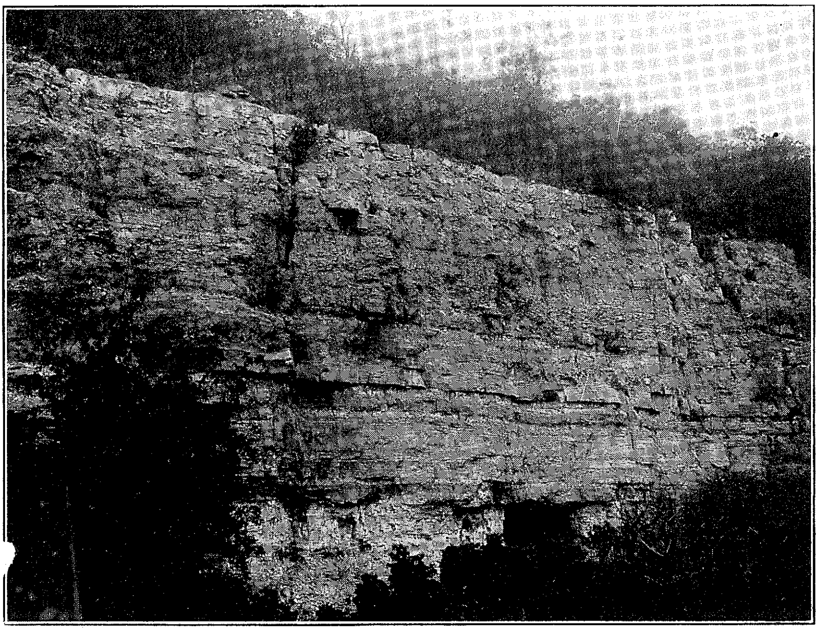

FIG. 2. The Lower Magnesian limestone outcropping along the north bluff inois River between Split Rock and Utica (photo by T. E. Savage).

FIG. 3. Lower Falls in Deer Creek Glen; a canyon in St. Peter sandstone (photo by Rhodes).

shows the character of the Lower Magnesian limestone between La Salle and Utica.

The St. Peter sandstone underlies the Pennsylvanian system extensively, particularly along the anticline on the two Vermilion rivers and along, and north of, Illinois River east of the anticline as far as a

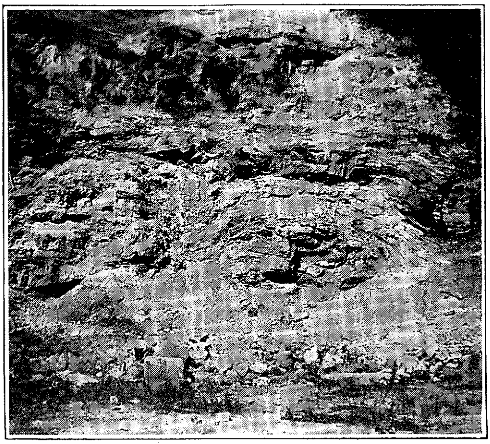

FIG. 4. The contact of St. Peter sandstone and Lower Magnesian limestone near Split Rock. (Vertical scale about 16 ft. to 1 inch)

point halfway between Marseilles and Seneca. The bluffs of Illinois Valley are largely St. Peter sandstone from Utica to Twin Bluffs on the north side of the river, and from the anticline to the mouth of Covel Creek on the south side of the river. In this rock the beautiful gorges of Starved Rock and Deer Park have been carved (see figure 3). The St. Peter sandstone is variable in thickness, largely because of the irregular surface of the Lower Magnesian limestone upon which it was deposited. Figure 4 is a photograph taken near Split Rock and shows the St. Peter sandstone resting on the uneven surface of the Lower Magnesian limestone. The sandstone varies from about 120 to 200 feet in thickness in this district. It is an important source of glass sand and also supplies some of the artesian water.

The formation overlying the St. Peter sandstone is the Platteville limestone commonly known as the Trenton limestone. This formation passes upward without conspicuous interruption into the Galena dolomite. These two formations are practically inseparable as found in this district, especially on the basis of information obtained from drill records, hence they will be described collectively as the Galena-Platteville or Galena-Trenton formation. This extends from Deer Park northward as a narrow belt along the west side of the fold under the Pennsylvanian strata. Southward from Deer Park the limestone seems to be present over the fold and to extend eastward for 12 or 15 miles.

The stereogram on Plate III shows in a generalized way the relation of the Galena-Trenton to the anticline and to the overlying Maquoketa shale. The east boundary between the limestone and the shale passes southeastward from about midway between Seneca and Morris toward Ransom in southeastern La Salle County. The Galena-Trenton is exposed along the west side of the anticline at various points on Vermilion River as far south as Lowell, at Split Rock, and along Little Vermilion River about four miles north of La Salle. East of the fold the limestone is found as a thin layer above the St. Peter sandstone and below the Pennsylvanian fire clay at various places as far as Ottawa. The Galena-Trenton averages 250 to 300 feet thick within this district.

The Maquoketa shale is present to the west of the Galena formation as a narrow belt on the west side of the anticline. On the east side of the fold it underlies the "Coal Measures" throughout most of Grundy County. In the southeastern part of Grundy, and in the neighboring parts of Livingston, Kankakee, and Will counties, the Niagaran limestone lies between the Maquoketa shale and the Pennsylvanian system. The Maquoketa is exposed along the east border of the Longwall District on the Kankakee, Dupage, and Desplaines rivers; within the district, however, it is known only from drill samples obtained from artesian wells. It has a variable thickness within the district up to about 200 feet.

The Niagaran limestone, which outcrops extensively in the vicinity of Joliet, is known within the borders of this area only from drill samples. There is evidently a considerable area in the southeast corner of the district east and south from Dwight, where the Pennsylvanian overlies Niagaran dolomite. West of the anticline, and apparently beyond the zone affected by the folding, the Niagaran is present and increases in thickness to about 400 feet in the vicinity of Depue. (See record in Chapter IV.)

The Devonian formation underlies the Pennsylvanian rocks in a small area in the Longwall District, but is not known to outcrop nearer than in the vicinity of Rock Island, Illinois. Within this area reddish Devonian shales containing *Sporangites* have been identified by Professor J. A. Udden in samples from the well at Henry, but the extent of this area of Devonian is uncertain. Devonian formations are not known below the Pennsylvanian system on the east side of the anticline.

The stereogram of the Longwall District (Plate III) shows the rocks from the surface down to sea level. This diagram and that shown in Plate II explain graphically the various relations that exist between the Pennsylvanian system and the underlying rocks in this district. The larger stereogram is drawn to scale, and the geology is represented as accurately as is consistent.

PENNSYLVANIAN SERIES OR "COAL MEASURES"

General Description

The general succession of the Pennsylvanian series in the central part of the Longwall District where conditions are most typical is excellently recorded in the detailed section by H. C. Freeman.[1] This section, with some modifications suggested by recent investigations, is reproduced in Chapter IV. Most of the drilling shown on the map, Plate I, has been done since Mr. Freeman's work, so that a more accurate knowledge of the geological conditions is now possible, and it is necessary to modify the original section in some particulars and to suggest correlations not evident to the earlier investigator.

The Illinois "Coal Measures" are divided into three formations, all of which are represented in the Longwall District. In ascending order these are the Pottsville formation, the Carbondale formation, and the McLeansboro formation. In southern Illinois, where the section is more complete and thicker, these formations are more characteristically developed, and the horizons of separation are definite. The Pottsville includes that part of the Pennsylvanian series which lies below coal No. 2, the Carbondale is represented by the portion between the base of coal No. 2 and the top of coal No. 6, and the McLeansboro formation includes all the "Coal Measures" lying above coal No. 6.

In this district the Pottsville is distinct as elsewhere and lies below coal No. 2. The boundary between the Carbondale and the McLeansboro is not so clear. Coal No. 6 is apparently not represented in the district, unless it be in the vicinity of Sparland, and it seems that the division between the two formations is at a probable unconformity between coal No. 5 and coal No. 7. The formation above this possible unconformity comprises the thickest part of the Pennsylvanian series in the northern district, and it can probably be subdivided on good stratigraphic grounds.

The Longwall District is divisible into a number of subdistricts or fields, in each of which the details of stratigraphy are fairly constant. The correlation of the sections of the various fields, however,

[1]Freeman, H. C., La Salle County: Geology of Illinois, Ill. Geol. Sur. 1867, pp. 264 to 266.

seems possible only in a general way, although certain major parts of the local sections seem to agree with certain parts of other local sections, yet the attempt to correlate smaller units, such as local beds of sand, clay, limestone, coal, or shale seems inadvisable. There are, however, some exceptional strata, including some coal beds, which are widespread and are readily identifiable from place to place.

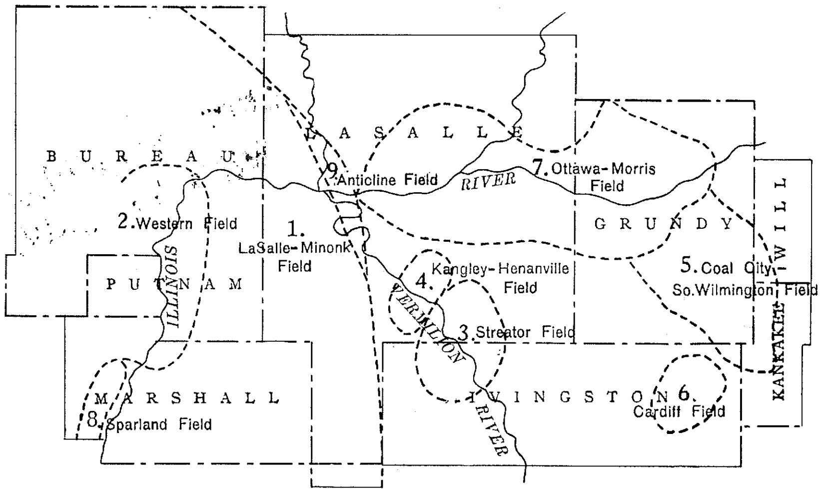

FIG. 5. Sketch map showing location of subdistricts.

The fields (see figure 5) into which the Longwall District is divisible are as follows:

(1) The La Salle, Bureau, and Putnam counties field west of the anticline and east of the bend in the Illinois: the La Salle-Minonk field.

(2) A small area in the vicinity of Bureau, Bureau County, running south possibly 10 to 12 miles and extending indefinitely westward: the Western field.

(3) The Streator field east of the anticline.

(4) The Kangley-Henanville field, a small area lying north and northwest of Streator field along Vermilion River.

(5) The Coal City-South Wilmington field.

(6) The Cardiff field.

(7) The Illinois River field from the anticline to Morris: the Ottawa-Morris field.

(8) The Sparland field.

(9) The axis of the anticline along Little and Big Vermilion rivers: the Anticline field.

Pottsville Formation

LA SALLE-MINONK FIELD

The variations in the character of the Pottsville formation among the different fields of the Longwall District are considerable. In the La Salle-Minonk field for three or four miles west of the anticline the Pottsville is unusually thick, some drillings in the vicinity of La Salle showing 200 to 275 feet of siliceous shales and sandstone. The record of the well of the Chicago Portland Cement Co. at Oglesby given in Chapter IV and reproduced on Plate IV (No. 6) is representative of this thick phase of the Pottsville. The position of this unusual thickness of Pottsville is shown in the stereogram, Plate III, in the vicinity of La Salle and Peru. The formation is shown to be thinner westward from Spring Valley to Depue. At this latter place the Devonian (?) limestone lies relatively close to the base of coal No. 2 as is shown in the record of well No. 2 of the Mineral Point Zinc Co., given in Chapter IV. Westward from Depue the underlying rock surface declines, coal No. 2 rises somewhat, and the intervening Pottsville accordingly becomes thicker.

WESTERN FIELD

The Pottsville in the small western field near Bureau is about 80 feet thick. Coal No. 2, if correctly identified in this small area, varies from about 2 feet to about 3 feet in thickness. A coal 2 feet or less in thickness is recorded in several of the logs 30 to 40 feet below coal No. 2. Some of the records also note another 1-foot bed of coal 25 to 30 feet lower in the section, and still another of about the same thickness 10 to 15 feet below. The intervening strata are blue or gray shales which in places are siliceous. One log shows a thin limestone about midway in the section. The Pottsville in the vicinity of Bureau rests on limestone, probably of Niagaran age. A record of drilling in this field is given in Chapter IV, and is also shown on Plate IV (No. 11).

Southward towards Putnam and Marshall counties along the Illinois Valley the Pottsville continues thick. Observations of drill records show at least 100 to 110 feet of sediment below coal No. 2. The formation contains one thin bed of coal near the bottom, and a sandstone about 25 feet thick near the middle of the section. In this region, at least in the vicinity of Henry, the Pottsville seems to rest upon Devonian shale. The record of strata below coal No. 2 encountered in a drill hole in T. 30 N., R. 2 W., located opposite Henry, is given in Chapter IV and is log No. 12, Plate IV.

OTTAWA-MORRIS FIELD

East of the anticline along Illinois River from the anticline to

Morris the Pottsville is in very few places over 25 feet thick. North of the river toward the outcrop it becomes still thinner and to the south, thicker. From the anticline eastward to Morris the formation is practically all fire clay, which varies in character accordingly as the underlying rock is sandstone, limestone, or shale.

ANTICLINE FIELD

In that part of the district lying along the anticline and Vermilion rivers (Anticline field), the clay is in many places separated into two

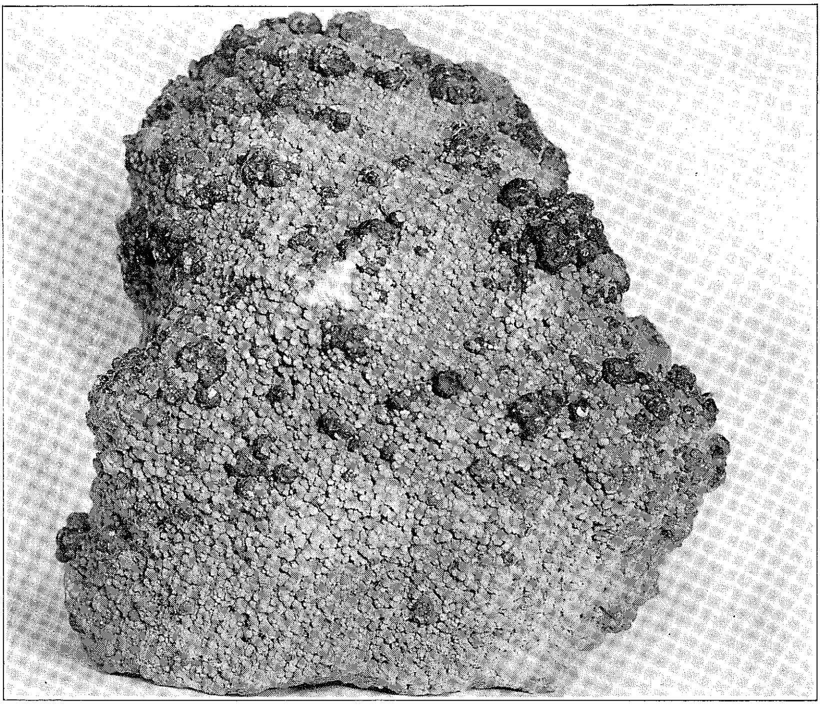

FIG. 6. Boulder of pisolitic limestone from the Pottsville formation of southwestern Illinois.

beds by a sandstone varying from 1 to 5 feet in thickness. Along Little Vermilion River the sandstone is thicker than the underlying clay except locally, whereas along Vermilion River this lower clay is of greater thickness and the sandstone plays out to the south. Above the sandstone in clay pits in the vicinity of Deer Park are found round boulders of limestone of a peculiar pisolitic structure, which upon weathering break up into small, round fragments about one-fourth inch in diameter. Most of the broken surfaces display a cross-section of each nodule and show a radiating structure. The rock therefore is easily identified. Figure 6 shows a boulder of pisolitic limestone from the same horizon in the southwestern part of the State, but similar to those found in this district. This limestone is thought to correspond to a similar bed above the Cheltenham clay at St. Louis.

In the Longwall District the pisolitic limestone has been seen in the clay mine of the Illinois Clay Products Co. at Deer Park, in the exposures on the north side of Vermilion River at Lowell, and along one of the gullies running through the west side of Starved Rock Park from the south. Although the limestone or the sandstone is not everywhere present in this clay, it nevertheless seems probable that over much of the area east of the anticline the Pottsville is represented by two clays, the lower one of which is not in every place easily distinguishable from the upper, but which probably represents an earlier period of deposition.

STREATOR AND SOUTHEASTERN FIELDS

In the Streator field the Pottsville has the same general characteristics as it has along the Illinois to Vermilion River. The formation is at least 20 to 30 feet thick and is composed of gray clays and sandstone. The details of the succession are not known. In the Wilmington and Coal City and the Cardiff fields the Pottsville is thicker than elsewhere east of the anticline. At Cardiff 40 feet of Pottsville are present The formation is composed of one or two thin coal beds, shales, and thin limestone and sandstones. The details of stratigraphy are known from only one or two records so that generalization is impossible.

THE CARBONDALE FORMATION

The Carbondale formation lying next above the Pottsville can be described best by considering separately the stratigraphy of certain subdistricts.

THE WESTERN FIELD

As has been pointed out in the discussions of the Pottsville certain irregularities in the "Coal Measures" in the area lying west of Depue and Granville and south of T. 16 N., make difficult the definite correlations of the coal. In the first place, throughout this area the two upper coals have been eroded and the outcrops are deeply covered by glacial drift, so they are of no aid in correlation. Secondly, the structure is uncertain, although there seems to be a rather sharp rise of the strata to the west, as is indicated on the structure contour map, Plate I. Again, several thin coal beds in the section have about the same thickness, so that the identification of No. 2 is uncertain. Finally, all our information is based upon about 10 drill records, there being no surface data whatever.

The strata of the Carbondale in this field are known only for about 100 feet above the base of the formation, the upper part having been removed by pre-glacial erosion. Of this 100 feet of strata, all but a small proportion is shale, blue, gray, and black. In several of the records a thin limestone is noted 50 to 60 feet above coal No. 2. In the lower 20 feet of the formation is a black shale which probably corresponds to the fissile shale in most places present at this horizon over large areas of the Longwall District.

LA SALLE-MINONK FIELD

Lying west of the anticline and stretching from the northern to the southern limits of the district is an area where the succession as presented by Freeman[2] in his discussion of the Geology of La Salle County seems to hold. Toward the south there are probably some changes involving the introduction of coal No. 6 and the possible elimination of coal No. 7, which have not yet been determined.

Coal No. 2 is persistent and is everywhere apparently of workable thickness, averaging 42 inches. It can be readily correlated in the different drill records. The coal will be described in detail on a later page (see Chapter IV). As a rule coal No. 2 is overlain by a gray shale or "soapstone", 12 to 18 feet thick. In places this shale is absent entirely, and the next overlying stratum rests upon the coal. Above the "soapstone" there follows a 3-foot bed of black, fissile shale, which contains in many places large nodules of black ironstone. Concretions of a somewhat different character are found for a distance of about 4 feet in an overlying gray shale. The latter nodules possess a peculiar structure due to planes of calcite passing through them, have a weathered surface that resembles the shell of a turtle, and break in a very characteristic manner. So far as known, this is the only horizon in the Carbondale of this district where such *septarian* concretions are found, and they afford a rough, but apparently reliable, means of identification of the underlying black shale. Above the septarian bed is 8 to 10 feet of grayish-blue, rather plastic shale or clay capped by a calcareous sandstone, 2 to 5 feet thick. Above the sandstone follows another black shale which in places is almost a cannel coal. This black shale differs from the black, fissile shale below in the fact that it is not so sheety, but tends to break into rectangular fragments. These are readily identifiable along the streams where they have been washed out, as along Vermilion River near Lowell. This carbonaceous bed is about 4 feet thick and is locally overlain by a thin, impure limestone. Commonly overlying the limestone is gray shale becoming more or less siliceous toward the top. This shale varies in

[2]Op. cit.

thickness to a maximum of possibly 75 feet. Along Vermilion River it does not exceed 20 feet. There follows a heavy sandstone also of variable thickness. In some places it occupies the entire horizon of the underlying siliceous shale and attains a thickness of 60 to 75 feet or more, but in other places is entirely replaced by the shale. Where the sandstone is thickest the middle bed of coal, thought to be No. 5, is absent. The sandstone is evidently in all places younger than the shale, since it seems to lie in troughs cut into the shale, and there is an abrupt change from one rock to the other. Although this is prob-

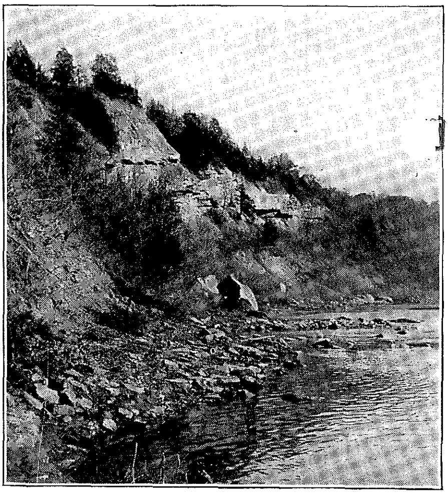

FIG. 7. The heavy sandstone below coal No. 5 (Vermilionville sandstone) outcropping along the big bend in Vermilion River between Deer Park and Lowell.

ably not sufficient evidence for believing that an erosion plane exists between these two terranes, their relationships are certainly suggestive of rapid changes in conditions of deposition. This sandstone will be called the Vermilionville sandstone in this report. Figure 7 shows this sandstone outcropping along Vermilion River between Deer Park and Lowell.

The accumulation of the peat which represents coal No. 5 seems to have taken place during an interruption in the deposition of the sandstone and sandy shale in more or less restricted areas, for of all the important coal beds in the district this is the most irregular in distribution. Coal No. 5, its underclay, and its overlying black and gray shale roof together comprise possibly 25 feet of the Carbondale section in this field. It is followed above by sandy shale and sandstone, which continues to the underclay of coal No. 7, a distance of 35 to possibly 75 feet.

The exact position of the top of the Carbondale formation in this section is not known. Where coal No. 5 is present it is certainly above that coal. Where the coal is not present the top of the formation must be regarded as indefinite. It seems probable that there were oscillations in sea level in this district during the time of the deposition of the siliceous strata associated with coal No. 5 which were about contemporaneous with similar changes in level noted by Savage[3] as existing in southern Illinois after the deposition of coal No. 6. In this region these changes were of such a nature as to give rise to several local planes of erosion. The coarse sandstones tended to be localized along the channels, to assume a lenticular cross-section as a result, and in place to cut down through and displace the coal. A continuous section of sandstone and sandy shale across the horizon of coal No. 5, such as occurs in a broad belt running north and south through the east side of Putnam County and the western edge of La Salle County, probably exists along one of these erosion lines. In such sections the top of the Carbondale may be as far below coal No. 7 as the usual interval between that and the No. 5 seam.

THE STREATOR FIELD

The Streator field lies east of the anticline in the vicinity of Streator. The Carbondale section is exposed in part down Vermilion River from Streator to sec. 32, T. 32 N., R. 3 E., and is known from mines and from shaft and drill records. The section of the Carbondale in this field differs from that of the La Salle-Minonk field, in that it is considerably thinner, and has a number of thin local beds of coal in the lower part of the section which possibly correspond to some of the black shales noted in the La Salle section.

There is sufficient evidence that the "Coal Measures" section as it rises over the anticline and extends eastward becomes notably thinner. West of the fold about 150 feet of strata lie between coals No. 2 and No. 5. In the exposures showing the succession between these two strata along Vermilion River near Deer Park, the interval between the two coals is about 100 feet. In the vicinity of Streator coal No. 5 is not present, but the interval between coals No. 2 and No. 7 is only about 150 feet, or 50 feet less than it is in the La Salle field.

It is impossible to present the lower part of the Carbondale section of this field with as great detail as for the La Salle-Minonk area because our information on this part of the section depends upon a few, rather unsatisfactorily drill records. In sinking the shaft of mine No.

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[3]Shaw and Savage, U. S. Geol. Survey Geol. Atlas Murphysboro-Herrin folio (No. 185) p. 11, 1912.

2 of the Chicago, Wilmington, and Vermilion Coal Co., from coal No. 7 to coal No. 2 the following strata were penetrated:

Partial Log of Shaft No. 2,
Chicago, Wilmington and Vermilion Coal Co., Streator

	Description of Strata	Thickness		Depth	
		Ft.	*In.*	*Ft.*	*In.*
26	Coal No. 7				
25	"Slate"	2		2	
24	Fire clay	2	6	4	6
23	Sandstone	6		10	6
22	Slate	1	6	12	
21	"Soapstone"	6		18	
20	Sandstone	2	6	20	6
19	Coal		3	20	9
18	"Slate"	12		32	9
17	Sandstone	25		57	9
16	Blue granite (?) Niggerhead	2	9	60	6
15	"Soapstone"	3		63	6
14	Flinty "soapstone"	5	6	69	
13	"Slate"	4		73	
12	Sandstone	3		76	
11	"Slate"	1	6	77	6
10	Coal	2	6	80	
9	Fire clay	3		83	
8	Sandstone	3		86	
7	Blue limestone	3		89	
6	"Soapstone" and boulders	15	6	104	6
5	Coal	2	4	106	10
4	Blue shale	14		125	10
3	"Slate"	5		125	10
2	"Soapstone"	21		146	10
1	Coal No. 2	4		150	10

In this record it seems probable that the lower four members are essentially the same as the strata in the La Salle region below the septarian shale. Coal No. 5 of the above section is possibly the equivalent of the cannel coal which lies a few feet above the septarian bed. Other parts of the section, however, cannot be identified until the heavy sandstone No. 17 of the section is reached. No. 10 does not seem to be the equivalent of any persistent bed in the La Salle field. The sandstone, No. 17, is thought to belong to the series of sandstones and shales which is associated with coal No. 5 horizon, and which outcrops in cliffs 50 to 75 feet high along Vermilion River between Lowell and Streator. As elsewhere in the Longwall District, this sandstone is of variable thickness in the Streator field. In places it lies next below coal No. 7 in great thickness, and elsewhere it is separated from coal No. 7

by a succession of shales which may contain beds of coal. The stratigraphic succession in the Kangley-Henanville field is of this latter character, which serves to separate it somewhat from the Streator field as a whole.

The correlation of formations of the Streator and the La Salle fields is based largely upon the possibility of tracing coal No. 2 with little interruption from one field to the other by the way of Vermilion River. The coal horizon goes under the river not far above Lowell. It has been found about 30 feet below the river 4 miles above the Lowell bridge in sec. 24, T. 32 N., R. 2 E., and two miles farther up stream at about the same depth. At Streator the coal is about 400 feet above sea level, or about the same elevation as at Marseilles.

The section exposed along Vermilion River south of Lowell is unfortunately not continuous, so that the upper strata cannot be traced from one field to another. In secs. 24 and 25, T. 32 N., R. 2 E. and sec. 30, T. 32. N., R. 3 E., the bluffs above Vermilion River are composed entirely of glacial drift. The essentially horizontal position of coal No. 2 through the area, as described in the preceding paragraph, makes it reasonable to suppose that the overlying rocks were horizontal before they were eroded, and that correlations across the break are fairly safe. In sec. 32, T. 32 N., R. 3 E., and secs. 5, 8, and 9, T. 31 N., R. 3 E., the river is lined on one side or the other by a practically con-

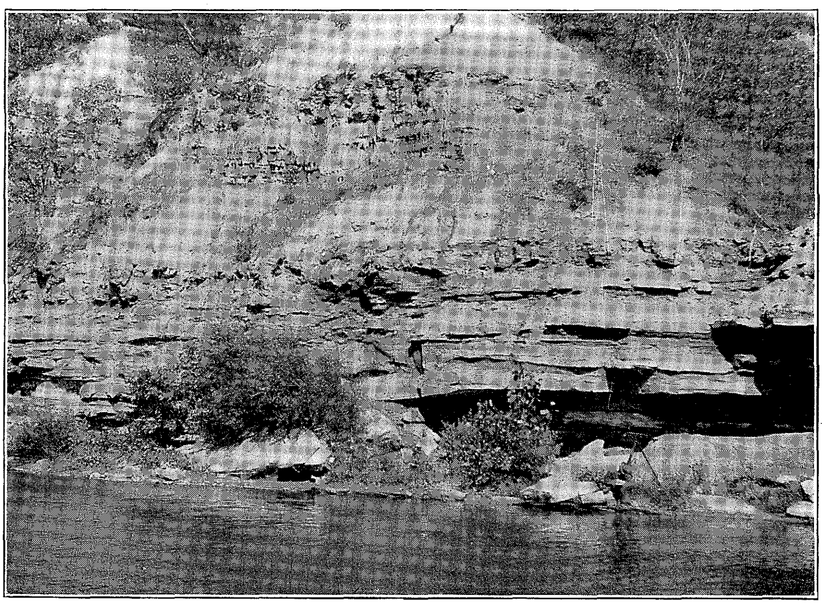


FIG. 8. Coal No. 7 and the underlying sandstone near the Kangley Bridge on Vermilion River.

tinuous cliff of sandstone. Below the sandstone is a blocky, black, fissile shale and cannel coal, which is possibly equivalent to the black, fissile shale lying 35 to 40 feet above coal No. 2 north of Lowell and along Vermilion River.

About one-fourth mile west of the Kangley Bridge over Vermilion River the surface of the heavy sandstone declines, and the Streator, or No. 7, coal, is found a few feet above the river at the level of the middle of the sandstone if it were continuous. Upstream, east of the bridge, this coal bed rises to an elevation of possibly 35 to 40 feet above the water. Below the coal for about 20 feet are clays and shales, the latter containing a black, carbonaceous stratum and streaks of coal. Below this lies the sandstone about 5 feet thick. Figure 8 shows the coal and sandstone east of the Kangley bridge. The sandstone thickens considerably again upstream, so that from where the river bends south along the north line of sec. 15, T. 31 N., R. 4 E. to the Chicago, Indiana and Southern Railroad bridge the coal is apparently absent. South from the railroad bridge the coal is again of its usual thickness and in normal relationships, so far as has been determined.

KANGLEY-HENANVILLE FIELD

The small area underlain by coal No. 7 in the vicinity of the Kangley bridge apparently is bounded on the west by the heavy sandstone which is exposed along Vermilion River, and is limited similarly by a sandstone to the east. The basin extends northeast beyond Henanville and south to the old Acme mine at Kangley. This is the Kangley-Henanville field of the Longwall District.

Mention has already been made of the existence of a local bed of coal between coal No. 7 and the heavy (Vermilionville) sandstone. In the Henanville District this lower coal is in places thick, but varies in its distance from the upper coal. At places in the old Henanville mine the two coals were in contact, the two beds having a combined thickness of about 9 feet. To the south near Kangley there is a bed of shale between the two coals and they can be worked separately.

COAL CITY-SOUTH WILMINGTON FIELD

This field is part of the eastern end of the Longwall District. It lies between the Ottawa-Morris field to the north and the Cardiff field to the south, into both of which it merges with indefinite boundaries. The relationships with the Morris area are possibly closest, and the correlations are made most accurately in that direction. Coal No. 2 is widespread in this field. Above it is a bed of shale or "soapstone" about 60 feet thick, which in places is quite sandy and elsewhere contains many fossil-bearing, ironstone concretions—the famous Mazon

Creek fossil horizon. This shale is overlain by carbonaceous beds, in places a thin coal seam, and then sandstone and sandy shale to the upper coal, which is apparently No. 7. As in the case of the fields already described the boundary between the Carbondale and McLeansboro formations is indeterminable, but not improbably it lies in the sandstone below coal No. 7, as in the Streator field.

OTTAWA-MORRIS FIELD

The transition from the stratigraphic sequence of the La Salle field to that of the Coal City field can be traced with but slight interruptions from the anticline to Morris. At Ottawa the "Coal Measures" are thin, only the lower 50 feet or so being left in the valley bluffs. The soapstone roof, characteristic of coal No. 2 in the La Salle region and also the black, fissile shale and the septarian zone above, can be traced at least as far east as Buffalo Rock. The soapstone is however about twice as thick, approximately 35 feet being measured at the clay mine of the Herrick Clay and Manufacturing Co. near Twin Bluffs. East from this location the strata lose more and more of their characteristic appearance near La Salle, and the "soapstone" continues to increase in thickness. Above the horizon of the fissile shale and septarian zone, which become less conspicuous, is another carbonaceous, sheety shale which is possibly about the same age as the blocky, carbonaceous shale found a short distance below the heavy sandstone bed at Lowell.

Between Ottawa and Marseilles the coal goes under Illinois River. At Marseilles it is about 60 feet below the surface, and the upper black, fissile shale is near the surface of the Illinois River flat. In the valley bluffs above the town a heavy sandstone, 60 feet or more in thickness, makes up the rest of the Carbondale section. The sandstone is thought to be the equivalent of the Vermilionville in the La Salle and Streator fields. A coal, possibly No. 7, is reported above this sandstone. The Marseilles section resembles both the Streator and Coal City sections, in thickness and in the disposition of the various strata.

Towards Seneca the heavy sandstone appears in the north bluff of the river, but because of the erosion of the upper part it becomes thinner eastward. About 30 feet of "Coal-Measures" sandstone underlies the town of Seneca directly below the surface deposit. It can be seen outcropping along the Illinois at the Big Four Railroad bridge. From Seneca to Morris much the same succession continues except that older and older rocks are brought to the surface in that direction, due to the slight dip to the west. At Morris the Carbondale is represented by 30 to 50 feet of shale which possibly represents the thickened gray shale or "soapstone" normally above coal No. 2 in the La Salle field. The black, fissile shale and the septarian zone above are not known to exist in the section at Morris. Southeast of Morris toward Mazon Creek this shale horizon contains the fossil-bearing nodules for which that region is famous.

CARDIFF FIELD

The Cardiff field is made a separate division of the district because of the occurrence in the Carbondale section of a thick, lenticular bed of coal which seems to have been deposited in a small channel-like basin running in a quarter circle for about two miles, with a breadth of 1000 to 1200 feet (see Plate V). At the bottom of the trough this coal (the "big vein") lies a few feet, as a rule not over 10, above coal No. 2; at a few points the beds are in contact. The bottom of the coal rises to a height of 15 to over 30 feet above coal No. 2 at the sides of the trough. Twelve feet of coal has been encountered, but the average thickness in the trough is about 9 feet. Stratigraphically the coal seems to occupy about the same position relative to coal No. 2 as the fossiliferous, nodular horizon along Mazon Creek. Its correlation with any other coal in the State is not possible at present, and it is improbable that there is a coal bed of exactly the same age. A similar channel deposit is reported near Clark City at the Old Clark City mine, 6 or 7 miles north of Cardiff. These are relatively unimportant areas in the Longwall District as a whole.

A detailed description of this field, accompanied by maps and sections is given in Chapter III.

McLEANSBORO FORMATION

GENERAL DISTRIBUTION

Within the Longwall District the McLeansboro formation has been eroded from large areas. The map showing the area underlain by coal No. 7 (Pl. VIII) is practically a map of the McLeansboro formation. Over the entire district the boundary between the McLeansboro and Carbondale is indefinite, but apparently it is not far below coal No. 7.

The McLeansboro formation is found west of the anticline to about the location of Depue, the western edge running about north and south along the east side of the pre-glacial Illinois-Rock River Valley. Southward the formation has been removed over the fold, at least as far south as Lowell and probably nearly to Leonore on the Illinois Central Railroad west of Kangley. East of the fold there is possibly a V-shaped area of McLeansboro, one side of the V, running from a point near Leonore toward Marseilles, the other side extending from Marseilles toward South Wilmington. This area, however, is much more irregular than is indicated by this description, as several lines of pre-glacial drainage cross this triangle and apparently center in a deep, broad, valley which passes out of the district between Dwight and Streator. (See stereogram for position of this drainage line, Plate III). The formation is found in only three of the subdistricts into which the Longwall District has been divided.

LA SALLE-MINONK FIELD

The McLeansboro formation extends from about midway between the middle and upper coal beds (coal No. 5 and coal No. 7) to the top of the Pennsylvanian system in this field. It includes therefore coal No. 7 and the La Salle limestone, which is used extensively in the La Salle region for the manufacture of Portland cement. The formation is thicker in this field than elsewhere in the district, extending from about 300 to 600 feet above sea level in the vicinity of La Salle and Peru. The formation seems to be divisible into at least two parts and possibly into three. The lower part of the formation is predominately siliceous and is essentially a continuation of the upper part of the Carbondale formation. About 50 to 75 feet above coal No. 7 the character of the rocks changes from siliceous to predominately calcareous, and thin limestones and limy shales comprise most of the rest of the section. Because of a marked change in the character of the fauna in one of the upper limestones exposed in the bluff of Illinois River opposite La Salle, there is possibly some basis for the division of the formation. The fauna above is composed essentially of pelecypods and that below, of brachiopods.

Within the lower siliceous section of the McLeansboro formation the coal known locally as the "first" or "upper vein," No. 7 of the Illinois section, is the most constant member and is found practically everywhere in this field, except where it has been eroded. Erosion however has been extensive. It is in most places associated with a thick underclay which has been demonstrated to be of commercial importance in some places. Locally this clay exceeds ten feet in thickness. The coal is overlain by dark shale, which grades into a siliceous shale, and that into sandstone in places. This sandstone is locally known to cut down through the coal and to unite with the sandy strata below the coal. A description of the coal is to be found in Chapter III.

Near the base of the upper section of the McLeansboro formation and 50 to 75 feet above coal No. 7, is a rather definite limestone horizon thinner and less readily identified than the La Salle limestone, but apparently more widespread. This horizon is thought to be the same as that of the Lonsdale[4] limestone in the Peoria area. This limestone has been found outcropping in the vicinity of Coal Hollow, Bureau County (sec. 17, T. 16 N., R. 10 E.), in Rocky Run east of Tiskilwa, at Sparland, and thence south toward Peoria, and possibly in the Streator field. In all places the relation to coal No. 7 is about the

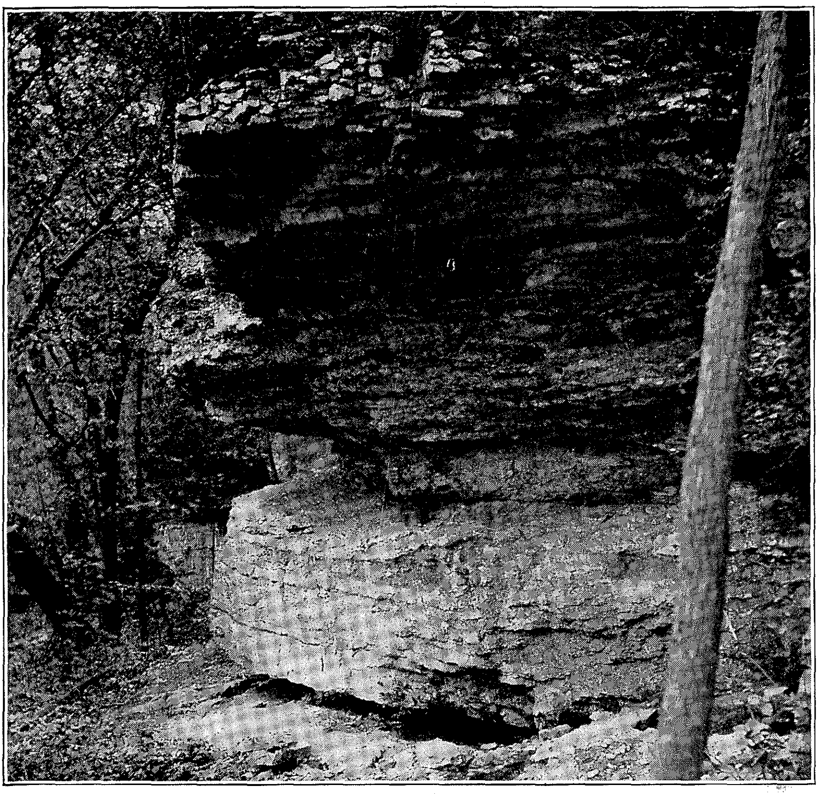


FIG. 9. The La Salle limestone along Vermilion River showing the middle part of the formation (photo by Rhodes).

same. A similar relationship is reported by T. E. Savage to exist throughout Fulton County, though the coal and limestone are somewhat nearer together than at Sparland. The identification of this horizon in the drill holes is very impracticable. The limestone contains a large amount of argillaceous material, and it is apparently only under the influence of weathering that it hardens and appears as a definite ledge of rock, whereas a few feet back it is very fragmentary. Be-

[4]Udden, J. A., Geology of the Peoria Quadrangle, Illinois: U. S. Geol. Survey Bull 506, p. 39, 1912.

cause of this characteristic, the rock is likely to be interpreted by the driller as shale, or limy shale.

The upper section of the formation which contains the limestones and limy shales has one, and possibly two, economically important limestone horizons. The most important of these commercially is the La Salle limestone, which borders both Little and Big Vermilion rivers for several miles above their mouths, and which is used in the manufacture of Portland cement by three large cement mills located at Oglesby and La Salle. The limestone reached a thickness of 25 to 30 feet. This bed lies about 400 feet above coal No. 2 or 175 feet above coal No. 7. It has a very local distribution, being confined to a belt about two miles broad and extending parallel to its outcrop along the anticline from Bailey Falls on the south to the NE. ¼ sec. 28, T. 34 N., R. 1 E., three miles north of La Salle. The belt is much wider in the

FIG. 10. Strata at the horizon of the La Salle limestone in a gulley in Peru, showing the more siliceous phase.

middle than at either end.[5] In this area much of the rock has been removed by erosion along Illinois and Vermilion rivers and their tributaries. The same horizon extends farther westward, but the lithological change is considerable, so that the stratum loses its value as Portland cement rock within two miles of the outcrop. Along the Illinois bluff to the west the bed appears as either a very siliceous, dirty limestone, or as a more or less calcareous shale. Figure 9 shows the La Salle limestone along Vermilion River, and figure 10 the siliceous limestone.

Intermediate strata between these rather characteristic limestone beds are largely limy shales and thin limestones. The strata are so variable that a generalized section is misleading. The Freeman section (Plate IV, No. 7) is as representative as is consistent. Certain of the coal beds will be considered in greater detail in the discussion of the economic geology.

About 25 feet above the La Salle limestone and near the top of the McLeansboro formation there is 24 feet of shale divided into three beds which are reddish, bluish, and yellowish in color. This shale has been used to some extent in the vicinity of La Salle for the manufacture of brick. So far as known it exists only in a small area within the city limits of La Salle and Peru, and across the river opposite these towns in another limited tract. The same stratum probably extends along Bailey Creek above the Falls, but whether the shale is of the same character is not known.

STREATOR FIELD

The McLeansboro formation in the Streator field is exposed in numerous outcrops along Vermilion River. A probable part of this formation has been already described in the discussion of the Carbondale formation of the Streator field. As it is not practicable to separate the formations at a definite horizon, the base of coal No. 7 is used as a convenient plane of separation and one which is thought to be near the stratigraphic division plane. The description of the McLeansboro formation in this field will accordingly be limited to the strata above the base of coal No. 7.

As has been previously shown coal No. 7 does not underlie this field continuously, but is interrupted in places because of the increased thickness of the underlying sandstone, as for instance to the east and west of the Kangley-Henanville area. Freeman described the coal outcropping above Kangley bridge (see figure 8) and named it the Kirkpatrick coal, not believing that this bed was the exact equivalent

[5]Cady, G. H., Cement Making Materials in the Vicinity of La Salle, Illinois: State Geol. Survey, Bull., 8, p. 127, 1907.

of the Streator coal, or coal No. 7. It is not known definitely whether the sandstone barrier to the east entirely separates the coal of the Kangley-Henanville field from both the Streator field and the La Salle field, but there are indications that such is the case. At least, it is certain that the coal is different in appearance and is associated with different strata than in the Streator and Kangley fields. Although Freeman's distinction of the Kirkpatrick coal from the Streator or No. 7 coal may not be found justified, it seems probable that the Kangley-Henanville basin was largely isolated during the deposition of coal No. 7 so that conditions there differed from those in the adjacent parts of the district. Coal No. 7 is described in detail in Chapter III.

Above the coal is a light, bluish-gray shale 35 to 40 feet thick, used by several of the brick and tile companies in the vicinity of Streator. Above the shale is a shaly sandstone about 10 feet thick. The succession above this horizon is not accurately known as exposures are poor. Within 25 feet of the sandstone there lies locally a nodular, concretionary shale, which at one place at least hardens into a heavy nodular limestone 4 to 5 feet thick. This is possibly the equivalent of the Lonsdale limestone of the La Salle and Sparland districts. This nodular shale is noted at the north end of the road bridge over the Vermilion just below the Santa Fe Railroad bridge. At this place it is 50 to 60 feet above No. 7 coal. In sec. 18, T. 30 N., R. 4 E. large blocks of nodular limestone lie on the banks of Vermilion River for a distance of about one-fourth of a mile. Although these blocks are not in place, they could not have been moved a great distance and they represent the approximate position of the Lonsdale limestone. A limestone, probably the Lonsdale, outcrops in a very similar way in Rocky Run near Tiskilwa, large isolated blocks lying in the bed of the stream or along the sides of the valley.

Between 5 and 10 feet above the sandstone noted in the preceding paragraph there is present a seam of coal about 30 inches thick in a small area in the N. ½ sec. 18, T. 30 N., R. 4 E. The coal is underlain by fire clay and overlain by gray shale. The distribution of this coal has not been determined, but it seems to be very limited.

The strata overlying the limestone are not known. Within this district east of the anticline they have a very limited distribution, and are confined to Livingston County.

SOUTH WILMINGTON AND CARDIFF FIELDS

The distribution of the McLeansboro formation in this part of the Longwall District is indicated approximately by the distribution of coal No. 7 as shown in the map in figure 27. It is a small, narrow, arrow-shaped area running from a broader base in the Cardiff region to a point near Mazonia. The strata have been removed to the east and west by pre-glacial erosion. The thickness remaining above the coal is in few places more than 50 feet and is as a rule much less, so that the formation is relatively unimportant. The formation in this field is composed almost entirely of shales, although one or two records show a thin limestone 3 to 5 feet thick, 15 or 20 feet above the coal.

SUMMARY

A section of the Pennsylvanian series of the Longwall District applicable to the different parts of the area would need to be of general character, presenting merely the salient features of the succession. It is thought that after the preceding review of the general geology of the different parts of the district the following statement will not be misleading:

(1) Coal No. 2 is of uniform character and widespread distribution so that it is rather easily identifiable in any of the fields.

(2) There is a simliar persistance of coal No. 7, although there is a greater variation in thickness and in the character of the associated strata than is true of the lower coal.

(3) The Lonsdale limestone is probably traceable from one point to another that is widely separated from it, but the identification is not readily made in drill records.

(4) So far as known no other single stratum is identifiable over the entire district.

(5) The Pennsylvanian system as a whole is lithologically divisible into three parts: the lower part is dominately shale, and contains one persistent bed of coal (No. 2) and several black "slates"; the middle part is dominately either sandstone or sandy shale, and includes two horizons where coal is likely to be found; the upper part is dominately calcareous shale and thin limestone and is barren of coal of any economic importance. This latter division contains a persistent nodular bed of limestone near its base.

(6) It is thought that any attempt to map the stratigraphic divisions, McLeansboro and Carbondale, in this district will be attended by uncertainty and inaccuracy because of the indefiniteness of the position of the contact of the two formations.

STRUCTURE

Definition

The term *structure* as used in geology commonly refers to the attitude or "lay" of the rock layers, that is, whether they are flat lying, inclined, folded, or broken by faults. Structure of this kind can be

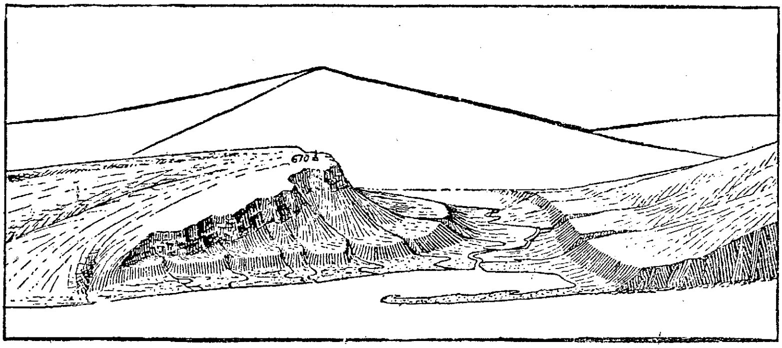


FIG. 11, *a*. Sketch of ideal landscape.

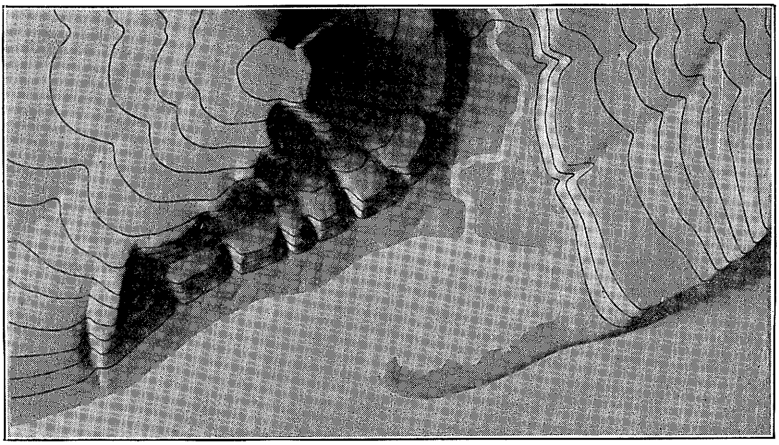


FIG. 11, *b*. Model of ideal landscape.

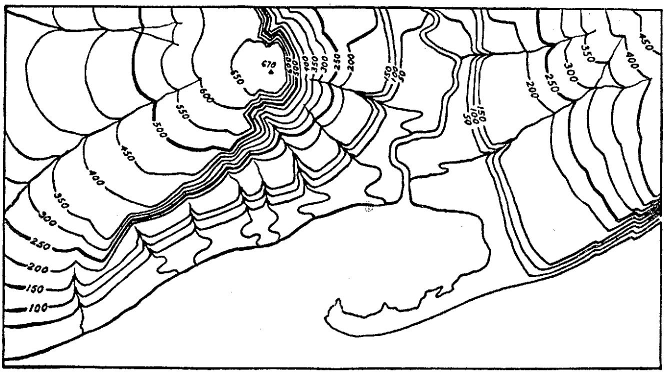


FIG. 11, *c*. Topographic map of ideal landscape.

represented by photographs and sketches, by diagrammatic cross-sections and block drawings, but most clearly and accurately by means of structural contours. As the use of contours to show differences in elevation or relief may not be familiar, the attention of the reader is called to the following explanation:

Use of Contours

The use of contours to exhibit geologic structure can best be explained to the reader by inviting attention to the similar use of contours to show relief or configuration of land forms.

The explanation can be based on the accompanying representations (Fig. 11*a, b,* and *c*) of an ideal landscape from the geological folios issued by the U. S. Geological Survey. Figure 11*a* represents a river valley between two hills. In the foreground is the sea, with a bay that is partly closed by a hooked sand bar. On each side of the valley is a terrace. The terrace on the right merges into a gentle hill slope; that on the left is backed by a steep ascent to a cliff, or scarp, which contrasts with the gradual slope away from its crest. In the model and map each of these features is indicated, directly beneath its position in the sketch, by contour lines.

Figure 11, *b* shows a model of the same landscape viewed from above. On this model lines have been drawn connecting points of equal elevation above sea level.

Figure 11, *c* shows only the level lines or contour lines. It is a contour map. The following notes may help to explain the use of contour lines.

1. A contour line represents a certain height above sea level. In this illustration the contour interval is 50 feet; therefore the contour lines are drawn at 50, 100, 150, and 200 feet, and so on, above mean sea level. Along the contour at 250 feet lie all points of the surface that are 250 feet above the sea, that is, this contour would be the shore line if the sea were to rise 250 feet; along the contour at 200 feet are all points that are 200 feet above the sea; and so on. In the space between any two contours are all points whose elevations are above the lower and below the higher contour. Thus the contour at 150 feet falls just below the edge of the terrace, and that at 200 feet lies above the terrace; therefore all points on the terrace are shown to be more than 150 feet but less than 200 feet above the sea. The summit of the higher hill is marked 670 (feet above sea level); accordingly the contour at 650 feet surrounds it. In this illustration all the contour lines are numbered, and those for 250 and 500 feet are accentuated by being made heavier. Usually it is not desirable to number all the contour lines. The accentuating and numbering of certain of them—say every

fifth one—suffices, and the heights of the others may be ascertained by counting up or down from these.

2. Contour lines show or express the forms of slopes. As contours are continuous horizontal lines, they wind smoothly about smooth surfaces, recede into all reentrant angles of ravines, and project in passing around spurs or prominences. These relations of contour curves and angles to forms of the landscape can be seen from the map and sketch.

3. Contour lines show the approximate grade of any slope. The vertical interval between two contours is the same, whether they lie along a cliff or on a gentle slope; but to attain a given height on a gentle slope one must go farther horizontally than on a steep slope, and therefore contours are far apart on gentle slopes and near together on steep ones.

Significance of Structural Contours

A structure contour map is similar to the surface contour map already explained. It differs from the surface contour map in showing the elevation of the top of a selected stratum rather than the elevation of the surface of the ground. The detail of the structure contour map is much less than that of the surface contour map, because in the latter case the elevations of all points on the surface can be readily determined, whereas in the case of the structure contour map the elevation of the stratum mapped is known only at outcrops and where it has been reached by the drill or by mine shafts and the map must be constructed from more or less scattered data.

The Accuracy of Structural Contours

In the Longwall District the structure contours shown on the map (Plate I) are based upon the top of coal No. 2. The quality of the contouring is determined first, by the number and distribution of observations; second, by the reliability of geological data, which involves the accuracy of statement by those from whom the information is sought, the accuracy of the location of the drill holes, and the correctness of correlation of strata at outcrops and in drill holes; and third, by the method of determining the elevation of the bed to be contoured. Three methods are used by the Survey to determine elevations. (1) Instrumental leveling, by which method the limit of error lies within one-tenth of a foot. Where the position of the drill hole is known only in a general way more or less inaccuracy results, but the observer attempts to eliminate errors greater than two or three feet. (2) Elevations obtained by hand-level from adjacent bench marks. The error in extreme cases amounts to 5 feet, but most elevations are correct within 2 or 3 feet. (3) Elevations estimated from topographic maps. Elevations estimated from accurate contour maps may possibly be in error as great as the contour interval which varies from 10 to 20 feet in the different types of maps. These maps are of two grades of accuracy. The new La Salle, Hennepin, Ottawa, and Marseilles topographic sheets (1910-1914) are considerably more accurate than the old Morris and Wilmington sheets made twenty years ago. These latter are of about the same degree of accuracy as a series of county contour maps prepared by Professor C. W. Rolfe for the Board of World's Fair Commissioners in 1893 and based upon railroad elevations and barometer readings. In rough country they are unsatisfactory. Unfortunately many of the errors in the contours of the older maps are more than the contour interval, hence it is possible that elevations estimated from these maps are inaccurate to an extent of 25 feet. In a few cases rough estimates of elevation are based upon railroad elevations of the neighboring stations. This is not done when any marked surface irregularity is known to be present.

The surface of the coal is somewhat more irregular than the contours indicate. There are local variations as great as 10 or 15 feet in the elevation of the coal that cannot be shown because of the large contour interval. The interval is sufficiently large, also, to minimize the effect of slight errors in elevation to which the map is liable, at the same time it is sufficiently adequate to show the main structural features of the district. If a knowledge of the detailed structure of a small area is desired, more careful leveling, more numerous observations, and a map having a smaller contour interval is necessary.

The most accurately mapped area within the field is that of the La Salle and Hennepin quadrangles (see Plate I) where the contours on coal No. 2 are thought to be accurate everywhere within 10 feet. South of these quadrangles the companies who drilled the holes obtained accurate elevations for the prospects in T. 31 N., R. 1 W., and for a number of holes in the various townships in R. 2 W. In the vicinity of Streator the State Survey has obtained instrumental elevations of all the mines of coal No. 7 at the various brick and tile pits, and of a few drill holes. The flatness of the upland around Streator reduces the chance for great error in this area, however. All elevations within the Coal City-South Wilmington field are determined by estimate from topographic maps. This area is a plain, sloping gently toward Illinois River, and the changes in elevation are slight in any direction, so that the chances for error are not great. The same conditions hold in the Morris area. In the Cardiff field accurate elevation on a company datum had been determined for the various drill holes and shafts. These elevations were approximately adjusted to sea level and were incorporated in the map. The accuracy of the elevations of the various drill holes shown on the map (Pl. I) is indicated by the different patterns, as explained in the legend of the map.

Having determined at numerous points the elevation of the top of the coal, contour lines are drawn on the assumption that slopes between adjoining points of different elevations are uniform. An element of error enters here, which increases with the distance between points, for it is obvious that between two points of observation one-fourth of a mile apart, there is less chance for irregularities in the elevation of the coal than between points a mile apart. For this reason, the structure map as constructed, has been slightly modified to eliminate unnatural angles that would appear if the data employed were strictly followed.

Uses of the Structure Map

The primary purpose of the structure map (Plate I) is to show the structural features. The coal stratum slopes away or dips as shown by arrows from contour lines of higher elevation to those of lower. Remembering that the strata slope away from the anticline or upward fold, toward the east and west (see stereogram), and from the west side of the district toward the syncline or downward fold, the local relationship of structure can be readily determined.

In addition to the usefulness of the structure contour map in showing the lay of the coal, it can be used to determine the approximate depth of the coal bed. In case the depth of the coal is desired at some point crossed by a structure contour line, it can be readily calculated by subtracting the elevation shown on the contour line from the surface altitude. If the point lies between two contour lines, its relative distance from them is observed, and the elevation of the coal approximated accordingly, after which process the regular calculation can be made.

One of the special services of the coal structure map in Illinois has been to determine the possible areas of oil and gas accumulation. It has been found as a rule that structural features affecting the "Coal Measures" affect also the underlying rock to a considerable depth in the same way, though possibly to a greater or less degree. A relationship of areas of accumulation to anticlinal folds and domes is known to exist, and the fact that, at least in some places, domes in the coal strata indicate conditions favorable for oil and gas has given added value to structure contours on the coal beds.

There has been no adequate testing of this area for petroleum except indirectly by the deep water wells. These wells are located in many places in the Longwall District, many penetrating to the

Galena-Trenton limestone, several to the Lower Magnesian limestone, and three or four to the Potsdam or Cambrian sandstone. If oil or gas was discovered in these wells it was not in sufficient quantity to stimulate further drilling. The few oil prospects are not any deeper than many of the artesian wells and no more advantageously located. None are known to have been successful. It is reasonably certain that where these artesian wells are located oil or gas is not likely to be found. Various apparently unsuccessful "wild-cat" explorations have been made within the area. These wells were located near the following places: southeast of Streator, and at Odell in Livingston County, at Minooka in Grundy County, at Lowell and Tonica in La Salle County, and at Tiskilwa in Bureau County. Others may have escaped notice. (For discussion of drift gas wells see page 57.)

La Salle Anticline

DESCRIPTION

The La Salle anticline is the most conspicuous structural feature of northern Illinois. Its continuation into southeastern Illinois is marked by the oil and gas fields of Clark, Crawford, and Lawrence counties which are situated along its crest. The anticline crosses Illinois in a northwest-southeast direction, forming a broad arch along the Illinois-Wisconsin line. The fold is steeper and narrower, but well developed, between Oregon and Dixon in Ogle and Lee counties. Between Dixon and the La Salle region the fold is again broader, and the crest lower. Near La Salle and for a distance of about 10 miles the fold is sharp, and the west limb very short, being less than a mile in length. The crest of the arch, from which strata slope in all directions at various angles, seems to be about where it is crossed by Illinois Valley; thence to the south, as to the north, the fold pitches downward, and the crest becomes less and less sharp. Through Livingston County it seems to continue as a broad arch. Its character farther south is not well known until it reaches the main oil fields as a sharp anticlinal fold.

Within the area of the Longwall District, the anticline is best exposed along the Illinois and the two Vermilion rivers. The Illinois valley crosses the fold at a right angle, so that the entire thickness of the "Coal Measures", 125 feet of Galena-Trenton limestone, the entire thickness of St. Peter sandstone, and about 100 feet of the Lower Magnesian limestone is exposed within a distance of less than a mile along the north bluff of the river in the vicinity of Split Rock (NW. ¼ sec. 13, T. 33 N., R. 1. E.). Along Little Vermilion River similar sections passing from the Pennsylvanian through Galena-Trenton limestone, St. Peter sandstone, and into the Lower Magnesian limestone, can be found. Since the anticline pitches southward the sections exposed along Big Vermilion River do not include formations older than St. Peter sandstone, as at Deer Park. That the Lower Magnesian limestone is relatively close to the surface, however, is shown by drilling.

Our information in regard to the details of the structure has been considerably enhanced by the development in the Black Hollow mine of the Illinois Zinc Company, near Deer Park. The workings of this mine have been carried down the west limb of the fold practically from the top of the arch to the bottom of the trough. Observations on the dip have been taken constantly under the direction of Mr. J. A. Ede, Mining Engineer in charge, so that the structure of the coal bed at this place is very well known. The coal at the entrance of the slope has a dip of about 10 per cent (6°); for the first 1150 feet in the direction of slope the dip increases to 15 per cent (9°); in the next 200 feet it increases to 34 per cent (20°); in the next 100 feet to 71 per cent (37°); and in the next 250 feet to 100 per cent (45°). The physical changes in the coal resulting from the folding have been studied in considerable detail by Mr. Ede, and he reports a harder, more brittle, and a somewhat shattered coal on the flank of the fold than is found near the trough. The roof shale in the mine is much broken and difficult to control, and the floor is exceptionally liable to heave.

Of special interest is a comparison of the structure of the surface rocks with that of the strata in the mine. The La Salle limestone is exposed along Vermilion River practically directly over the observations in the mine at the foot of the slope. It is apparent that the high dips which characterize the coal do not continue upward and affect all the overlying strata. It is not clear whether this is because there were two periods of folding, one during the Pennsylvanian period and one later, or whether it is because of the softer and incompetent character of the lower rock which would accordingly yield to minor folds that would not have a very great horizontal distribution. The fact that small faults cut the coal in the vicinity of the anticline, but apparently are not distributed throughout the measures as a whole, seems to indicate that the weaker strata were more severely affected by the folding than the more resistant layers, rather than that there were two periods of folding since the deposition of the coal.

The problems involved in mining coal in the Black Hollow mine where there are constantly changing conditions of dip, broken roof, and soft floor, are such as are not encountered elsewhere in the State.

Exceedingly interesting mining methods have been put into practice in order to reach the bottom of the incline. These methods have been described to some extent by Mr. S. O. Andros in Bulletin 6, Mining Practice in District I.

The difficulties encountered in this mine are so well known that it is improbable that other mines will undertake the development of the coal under similar conditions, at least not until the value of the fuel has considerably increased. It is to be remembered, however, that the closeness of the fold probably decreases to the south, so that mines opened along the anticline in southern La Salle County would probably not encounter conditions so difficult as are found in the vicinity of La Salle.

HISTORY OF THE LA SALLE ANTICLINE

The anticline affects all exposed strata in the region older than the Pleistocene. Two periods of folding are evident, one pre-Pennsylvanian and the other post-Pennsylvanian. The pre-Pennsylvanian folding certainly took place after the deposition of the Galena-Trenton limestone, and probably before the deposition of the Maquoketa shale

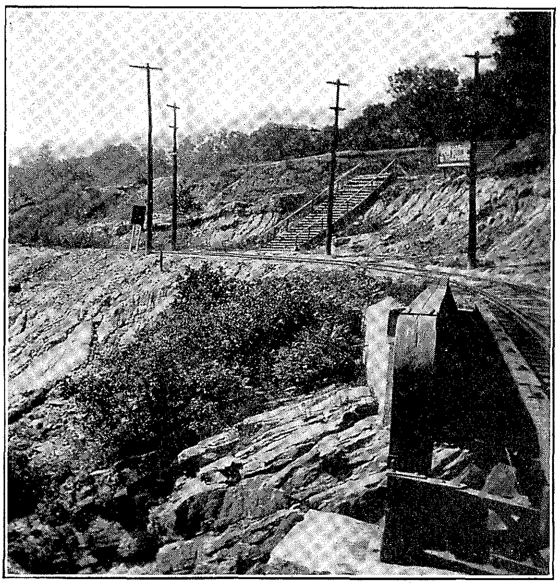


FIG. 12. The unconformity between the Pennsylvanian series and the St. Peter sandstone at Split Rock. The dip of the Pennsylvanian (12 to 15 degrees) is shown by the ledge of sandstone outcropping under the stairs. The dip of the St. Peter sandstone (20 to 30 degrees) is shown in the strata in the foreground.

It seems to have been about contemporaneous with the arching of the Cincinnati anticline in Ohio, Indiana, and Kentucky.[6]

The age of the post-Pennsylvanian and pre-Pleistocene folding is not known exactly. There is some doubtful evidence that there was movement during the Pennsylvanian. The greater angle of dip of the strata associated with coal No. 2 as compared with the strata of the upper part of the McLeansboro formation has been described. This, as has been said, may be due to another cause. There is also the

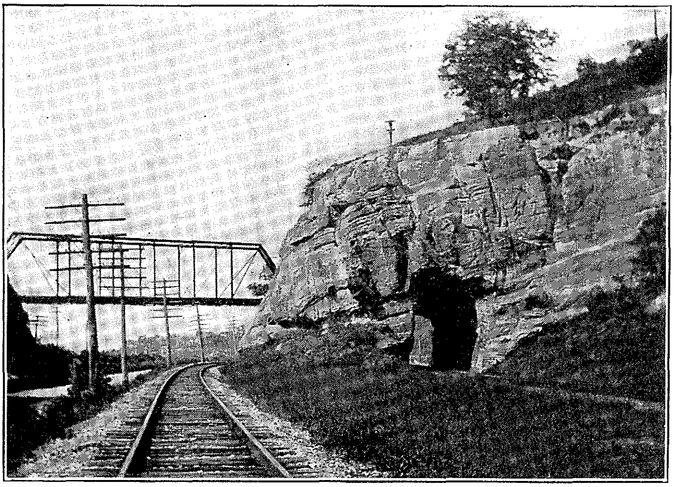


FIG. 13. Split Rock from the east showing the dipping St. Peter sandstone. The picture shown in Fig. 8 was taken at the west end of the tunnel shown in this picture.

difference in thickness of the Pennsylvanian series on the two sides of the anticline that is suggestive of movement after the deposition of coal No. 2 and before the deposition of coal No. 7. If the relative thinness of the "Coal Measures" to the east is due to elevation on that side of the anticline, the movement apparently occurred at about the time of the break or change in deposition which inaugurated the McLeansboro epoch.

Because of the pre-Pennsylvanian period of folding along the anticline, the "Coal Measures" overlie strata varying in age from the Niagaran limestone and possibly Devonian shale to Lower Magnesian limestone (see pages 19 to 23). As the older strata have been affected

[6]Savage, T. E., Unpublished paper on the Maquoketa of Illinois, presented before Ill. Acad. Sciences, 1912. For a discussion of the age of the fold see also Cady, G. H., Geological sequence in the vicinity of La Salle as revealed by recent drilling: Trans. Ill. Acad. Sci., Vol. V, p. 87, 1912.

by two movements these strata show higher angles of dip along the fold. The "Coal Measures" at Split Rock dip 12 to 15 degrees, whereas the adjacent St. Peter sandstone slopes with twice that angle. Figure 12 shows the relationship of the "Coal Measures" to the older rocks. Figure 13 shows the character of the dip in the St. Peter sandstone.

TROUGH WEST OF THE ANTICLINE

Just as the crest of the anticline pitches to the north and south from the region of Oglesby and La Salle, the trough west of the fold becomes shallower in the same directions. The elevation of coal No. 2 in the various mines from La Salle south to Minonk reveals the character of the slope of the trough parallel to the anticline. At La Salle the coal has an altitude of 109 feet, at Oglesby 100 feet, at Wenona 123 feet, at Rutland 197 feet, and at Minonk 219 feet. Apparently the rise is slight as far south as Wenona, and from that point increases rapidly. Northward from La Salle the trough rises rapidly and practically loses its character about where the anticline crosses the La Salle-Bureau county line. Although there may be no causal relationship between the facts, it seems that the best coal No. 2 in the La Salle-Minonk field lies in the trough.

Minor Structural Features

All the structural features not associated with the anticline are of minor importance as compared with the main fold. The greatest irregularities are found in the Coal City-South Wilmington region. Differences of 50 feet in the elevation of coal No. 2 within distances less than a mile have been encountered near Coal City (see page 73). The larger features of the structure include a domelike elevation on the west side, and a depression through the center of the field. The combined features resemble a wave in the general eastward rise of the coal from an axis of low elevation that runs southward from Marseilles.

The beds near the western margin of the district like those near the eastern rise toward the outcrop. The rise between Depue and Bureau, if the correlations are correct, amounts to about 100 feet in 1½ miles. This area of steeper dip on the west edge of the district continues northward, but to the south the dip becomes gentler. It may be worth noting that the 300-foot contour line follows closely the Illinois Valley below the bend.

Faults

So far as the field in general is concerned no faults of importance are known. Displacements affecting the thickness of the coal have been encountered in some of the mines, but fracturing of great thicknesses of strata does not seem to have taken place even along the La Salle anticline. Several small faults will be considered in the descriptions of the coal (see page 73).

GLACIATION IN THE LONGWALL DISTRICT

The Pre-Glacial Surface and the Thickness of the Drift

Glaciation had a widespread effect upon this district. From the stereogram (Plate III) some idea of the thickness of the glacial deposits in different parts can be gained. Sufficient drift is present everywhere away from the streams to give the country a distinctly glacial topography. Hard rocks control the topography as a rule only where erosion has removed the glacial material along Illinois Valley and some of its tributaries.

Mine shafts except in the new, rock-bordered valleys, have usually been sunk through a considerable thickness of drift, some of which is very likely to be water-bearing gravel. In general it is true that where the surface elevation exceeds an altitude of 600 feet, drift is probably present. Where the La Salle limestone outcrops along the anticline, it reaches an altitude of 625 feet, as does the St. Peter sandstone and the Lower Magnesian limestone near the anticline; but these are unusual altitudes for the rock surface.

The pre-glacial surface has a relief of 250 to 300 feet and varies in altitude from about 650 feet near the anticline to about 350 feet

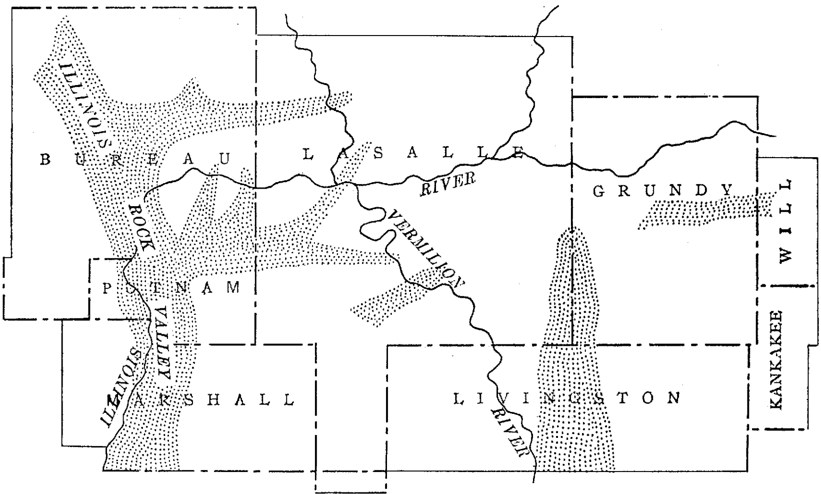


Fig. 14. Sketch map of Longwall District showing approximate position at pre-glacial valleys.

along the Illinois-Rock or Illinois-Mississippi valley. Leverett[7] has described the pre-glacial valley which ran north and south on the west side of this district. The center of the valley passes about under Princeton and Bureau in Bureau County, under Hennepin, Putnam County, and a little east of Lacon, Marshall County. The older valley then, although it ran in the same direction as the present Illinois below the bend, lay slightly to the east. Lateral valleys drained toward this pre-glacial stream on either side (see figure 14). One valley apparently extended east along a line running from Hennepin to north of Granville and Cedar Point, where two branches entered, one from the direction of Oglesby and another from the direction of Lowell. South of Cedar Point in sec. 8 the surface of the rock has an altitude of about 460 feet, and the drift has a thickness of 170 feet. This valley seems to lie about in the position of Allforks Creek as it runs from the east. There was a similar valley north of the present Illinois, running from the east between the present positions of Cherry and Ladd. It apparently started east of Little Vermilion River, since the Vermilion crosses it about two miles south of Troy Grove in secs. 10 and 11. Valleys tributary to these secondary valleys extended to the north and south, and some of them are now crossed by the present valleys. For instance, the Illinois crosses an old valley which drained to the south from the area just east of Spring Valley. The older valley is now filled with gravel and sand and till, but its cross-section is clearly shown, especially on the south bluff, by the shape of the glacial deposit. There are several interruptions in the continuity of the "Coal Measures" between La Salle and Marquette, where Illinois River crosses drift-filled valleys.

Eastward from the anticline these interruptions in the rock bluff above the river are rare. At Utica there is evidence of a pre-glacial valley along Clark Run north of town. This possibly is a continuation of the valley intersected by the Illinois north of Oglesby. Between Utica and Ottawa the rock seems to be continuous along the Illinois bluff. The drift at the end of Fox River Valley is thick, but does not extend below the river. The rock surface rises toward Marseilles and falls again to the east. At Seneca there is no rock in the river bluffs, but the "Coal Measures" are only a few feet below the surface upon which the town is located. Eastward toward Morris the topography is subdued but the rock surface rises somewhat in that direction. From Seneca southeast toward Mazon in Grundy County and southwest toward Kernan in La Salle County, the drift is thick, and the rock surface has a correspondingly low altitude. The direction and the position of the pre-glacial drainage lines have not been determined

[7]Leverett, F., Illinois Glacial Lobe: U. S. Geol. Survey Mon. 38, p. 483, 1899.

for this area, but apparently the drainage was to the south into Livingston County. The elevation of the rock floor in the vicinity of Ransom is about 350 feet above sea level, as determined by a well on the farm of Ernest Pancake 2½ miles east of town. About 2 miles south of Mazon where the surface elevation is about 600 feet, 160 feet of glacial drift was encountered. In the intermediate area the drift is everywhere reported thick and the altitude of the rock very inconstant. Because of this fact the coal underlies the drift only in patches and has a very uncertain and irregular distribution. This strip of thick drift extends southward into Livingston County between Dwight and Streator.

In the Coal City field the coal outcrops to the north along the side of a pre-glacial valley that runs east and west, north of Carbon Hill. Some of the mines at the north end of the field have been made dangerous by beds of sand and gravel that reach the coal and are a source of quantities of water.

At Cardiff the drift is from 80 to 100 feet thick and obscures the very irregular distribution of the upper coal (No. 7). This bed is near the top of the "Coal Measures," however, and is apparently of no economic importance.

Mention has already been made of the pre-glacial valley that runs from near Lowell toward the west. Upstream about three miles above Lowell a wide, drift-filled valley, the bottom of which has not been reached by the present stream, is crossed by the Vermilion (see stereogram, Plate III, and fig. 14). The bearing of this valley is not known, but if it follows a southwesterly course toward the Illinois, some of the coal beds must have been removed along its course. Where it crosses the Vermilion, strata at the horizon of coal No. 7 have been removed, and possibly to a limited extent coal No. 2, though this is not certain. If the pre-glacial valley continues in a westerly direction the lower coal is almost certainly removed over the fold along the line of erosion.

Upstream from this locality through La Salle County the river bluffs are lined on one side or the other with rock. In the SE. cor. sec. 1, T. 30 N., R. 3 E., Livingston County, at the dam above the pumping station of the Streator Aqueduct Co., a thick filling of drift was noted in the valley.

In the vicinity of Sparland the Pennsylvanian rocks outcrop in the bluff above town, and the modern Illinois Valley apparently occupies the west side of the pre-glacial Rock-Illinois valley. Below Lacon and for several miles to the east, thick deposits of drift are the rule. In the explorations that have been carried on east of the Illinois in R. 2 W., the lowest altitude at which the surface of the rock has been encountered is 350 feet above sea level about two miles west of Granville. Several holes to the south indicate elevations varying from 367 to 400 feet for the surface of the rock. The east slope of the old valley seems to lie through the west side of R. 1 W., where elevations of the rock surface vary from about 450 on the west to about 525 and 550 on the east. At Toluca and Wenona the drift is about 100 feet thick, and the surface of the rock has an altitude of about 600 feet.

North of Illinois River in Grundy County the thickness of the drift varies considerably and increases for the most part toward the northwest.

For more detailed discussion of the drift in the various counties, the reader is referred to Monograph XXXVIII, U. S. Geol. Survey.

Glacial Topography of the Longwall District

There are four conspicuous topographic features that are controlled by the drift or the modified drift: till plains, moraines, lake plains, and terraces. These have been described by Leverett in part, and in more detail, locally, in a folio on the La Salle-Hennepin quadrangles which is in preparation.

The upland surfaces are in general relatively flat or only gently rolling till plains. It is not unusual to hear the term "plateau" applied to the upland above the Illinois. A surface of conspicuous flatness surrounds the city of Streator, another borders the Chicago and Northwestern Railroad which runs north from Spring Valley. The surface is nearly level west of Fox River for six or eight miles.

Interrupting the continuity of these level tracts are several rather conspicuous, more or less concentric morainic ridges (see stereogram, Plate III). Along these ridges the drift is commonly thicker than elsewhere, and the surface material more largely clay than gravel and sand. The drift ridges or moraines seem to have no relation in their distribution to the underlying rock surface.

The third type of glacial topography is that arising from combined lake and glacial action—the lake plains. The most conspicuous of these is the Morris Basin, surrounding the town of Morris and merging toward the southeast into a similar plain bordering Kankakee River and known as Lake Kankakee. Sand hills formed by blown sand are not uncommon on the east side of the Morris Basin and on the Kankakee Plain.

Along Illinois River below the bend at Bureau there are large gravel terraces of about uniform altitude, which represent valley filling at the time of one of the glacial advances. As these terraces lie above the pre-glacial valley, most of the surface deposits underlying them are thick, and extend down to an altitude of about 400 feet above sea level.

Similar terraces, though on a much smaller scale, are found along practically all the streams of the district, at least as far east as the mouth of Fox River, and still farther up that stream. East of the bend on the Illinois the gravel is confined almost entirely to streams tributary to the major stream. These gravel deposits, especially below Bureau, are a very important source of road metal and ballast.

These four topographic features resulting from glacial action are the most conspicuous of the district. Since glacial time streams have cut more or less deep valleys into the plains and through the morainic ridges. The Illinois has been especially effective because of the large amount of water it received for a long time while it served as an outlet to the Great Lakes. The depth to which the Illinois has cut its valley increases greatly west of the La Salle anticline in the Pennsylvanian rocks. Recent exploration near La Salle by the Matthiessen and Hegeler Zinc Co. shows an extreme thickness of about 90 feet of alluvium in the flood plain south of the city. The depth seems to increase somewhat toward the anticline, as a thickness of about 130 feet has been reported about on the line of the fold. The rock floor of the valley from here rises very rapidly to a point about a mile east of Little Rock, where the channel of the present Illinois is cut into rock. We have no data on the depth of the alluvium in the flood plain of the Illinois between Peru and the bend at Bureau. Below that point it is impossible to distinguish between Illinois Valley alluvium and the material filling the pre-glacial valley.

Character of the Drift

There are two kinds of glacial deposits, till and stratified drift. The greater part of the area is covered with till, which is in most places a rather stiff clay containing stones scattered throughout, and commonly called "hardpan" by drillers. In this district there are tills of several glacial advances, the lower clays being as a rule somewhat harder than those above. A sudden increase in hardness of the "hardpan" in drilling operations is due commonly to the penetration of an older till. In many places the different tills are separated from one another by layers of gravel (see record p. 113). It must not be supposed that all the tills are present in each section of the drift, for the occurrence of each is very irregular.

Most of the stratified drift is concentrated along drainage lines. Old valleys are likely to contain considerable amounts of porous gravel interbedded with the till, as the area seems to have been affected by several advances of the ice each of which deposited its layer of gravel and till. Where the drift is thickest it is not uncommon to find several layers of till separated by beds of water-bearing gravel, and in places even beds of black muck representing buried soils. In the vicinity of Princeton, Bureau County, a great many water wells that penetrate 100 to 300 feet of drift encounter beds of gravel that yield gas. The source of the gas is apparently the buried soils or mucks associated with the gravel. Drift wells that yield more or less gas are located also in the southern part of Grundy County near Kinsman, near Tonica in La Salle County, near Granville in Putnam County, and probably elsewhere.

From the preceding discussion it is obvious that the distribution of the glacial deposits has economic significance. Glaciation has concealed the outcrops of the important horizons so that their area is not readily ascertained; it has imposed a covering of till and stratified drift over the surface, the thickness of which depends somewhat on the type of the deposit; it has effectively concealed the position and direction of lines of pre-glacial drainage which have a marked control on the areas of the coal beds; and it has brought to the region great quantities of sand and gravel that are easy of access.

CHAPTER III—ECONOMIC GEOLOGY of COALS AND ACCOMPANYING STRATA

NAMES OF COAL BEDS

As designations for the Illinois coal beds, the State and Federal Surveys have in general preferred place names to numerals. Hence we have introduced for No. 7 coal, Danville coal; for No. 6 or the "blue-band" coal the local names, Herrin or Belleville coal; for coal No. 5, Springfield or Harrisburg coal; and for No. 2 coal, Murphysboro or La Salle coal. The place names have been selected because of the characteristic development of the coal bed in the locality indicated. Since the numerical system of nomenclature is more established, it has not been rejected by the State Survey in the various reports, and it will be used wherever greater clearness will result. It is the feeling that since most of the place names for Illinois coal beds are taken from towns not within the Longwall District, a consistent adherence to the numerical nomenclature throughout, with proper reference and correlations, should be the rule in this report.

DISTRIBUTION OF COALS

The coal beds of the Longwall District are at least 6 in number. These are No. 2, No. 5, No. 6, No. 7, the thick bed at Cardiff, and a local bed present in a small area in Livingston County southeast of Streator. In addition there are a few thin beds of little or no economic importance.

The bed most extensively mined is coal No. 2 which is everywhere worked by the longwall method. This coal is known at La Salle as the "third-vein" and in the Coal City-South Wilmington field as the Wilmington coal. This is the bed worked at La Salle, Spring Valley, Ladd, Cherry, Seatonville, Marquette, Oglesby, Deer Park, Granville, Cedar Point, Standard, Wenona, Rutland, Minonk, Toluca, Eureka, Sparland (one mine), Streator (two mines), Morris, Coal City, South Wilmington, and Cardiff. Coal No. 2 is thickest in the trough west of the La Salle anticline and in the Coal City-South Wilmington field; elsewhere it becomes thinner toward the outcrop, especially in the vicinity of Bureau in Bureau County, and east of the anticline and north of Illinois River. In this last-named area, besides being thinner than elsewhere, the coal has a very thin roof so that it is probably of no value commercially. Also south of Marseilles and Seneca, there is an area where the commercial recovery of the coal is rendered doubtful by its irregular distribution resulting from preglacial erosion. Over the rest of the Longwall District coal No. 2 is exceedingly regular and constant. It underlies about 1800 square miles.

Coal No. 5 is confined to the La Salle-Minonk field but is not continuous. It has been worked somewhat in the La Salle region and is known locally as the "middle" or "second vein." The Matthiessen and Hegeler Zinc Co. is operating the only mine in this bed at present, though it is only since the Cherry disaster that the No. 5 coal bed was abandoned at the Cherry mine. Formerly it was worked at several of the shafts in the vicinity of La Salle among which are the shafts of Cahill Coal Co. and Oglesby Coal Co. This coal bed has an irregular distribution, and it is impossible to determine its total area with accuracy. Although the horizon of coal No. 5 is more widespread than that of coal No. 7, the lower coal itself is not present over considerable areas, so that it underlies an area less in extent than that underlain by coal No. 7, or about 500 square miles.

Coal No. 6 is present in the vicinity of Sparland. South from Sparland it becomes more important and reaches a workable thickness at Chillicothe. A thin coal bed, which in places combines with coal No. 7, is found at Streator, especially in the Kangley-Henanville field. This coal is known locally as No. 6, but it is very doubtful whether the correlation is correct. Coal No. 6 consequently is relatively unimportant in this district, and can practically be neglected in a consideration of the coal resources of the region.

Next to coal No. 2, coal No. 7 is the most widespread coal bed in the district. It is mined at Streator and Sparland, and was formerly worked in the La Salle field. This coal bed is known as the "Streator coal" at Streator, and as the "upper" or "first vein" at La Salle and Sparland. The area underlain by this coal is equal to about one-third that underlain by the lower coal, or 550 square miles.

In the vicinity of Cardiff there is an important bed of coal a few feet above coal No. 2, and it is known locally as the "thick vein". So far as known, the area underlain by this coal does not exceed 3 or 4 square miles.

Southeast of Streator in sec. 18, along Vermilion River a coal about 30 inches thick has been worked at local banks. This coal seems to lie 40 to 50 feet above coal No. 7 and below a bed which is possibly at the horizon of the Lonsdale limestone. The area underlain by this coal is not known, but it probably is small.

CORRELATION OF COALS

METHODS OF CORRELATION

The correlation of strata from place to place where the outcrops are discontinuous is accomplished by two methods. Of these two the paleontological method is the most convincing. The discovery that a certain fossil or association of fossils is characteristic of a certain bed makes it possible to identify the same bed elsewhere. The presence of a certain species of *Fusulina* in the limestone over coal No. 6, but not found in limestones associated with other coal beds, definitely identifies No. 6. The shale overlying coal No. 2 carries certain fossil plants which identify this horizon from Murphysboro to the La Salle region.[1] Unfortunately our present knowledge of the "Coal Measures" does not warrant many such definite correlations, so that for the most part we are limited to the second method of correlation, or the comparison of the physical characteristics of the coal and associated strata, to identify the coals in the different fields. Similarity of interval between coal beds is an aid to correlation. Because of the relative uniformity in dip of the Illinois "Coal Measures" over large areas, identification of strata can commonly be made with reasonable correctness on the basis of similarity in elevation and thickness when points of observation are not separated by more than two or three miles. The greater the number of drillings the greater the safety in this method.

CORRELATION OF COALS OF THE LONGWALL DISTRICT

COAL NO. 2

Coal No. 2 of the Longwall District is correlated with No. 2 of western counties and of the Jackson County area on the basis of plant fossils in the roof shale. The same bed is recognized under a different number in western Indiana. Within the district the coal and associated strata have fairly constant physical characters which are described in a later part of the chapter.

COAL NO. 5

So far as known coal No. 5 cannot be correlated over the State by means of fossils. In some areas but not in the northern district it has a rather constant interval below coal No. 6. In the western part of the Longwall District the coal lies from 150 to 206 feet above coal No. 2, and variations are shown in Table 2. "Horsebacks" or

[1]White, David (U. S. Geol. Survey), Paleontological Work in Illinois in 1908; Ill. State Geol. Survey, Bull. 14, p. 293, 1909.

clay veins in the coal resemble those in No. 5 of the Springfield area; the roof materials are also similar. The characters of the coal bed and accompanying roof and floor strata are described on later pages of this chapter.

COAL NO. 6

Coal No. 6 is the most readily correlated of all the coal beds in the State where it exists under normal conditions. It is called also the "blue-band" coal because of a thin bed of shale or clay ½ inch to 6 inches in thickness which lies in most places 12 to 18 inches from the base of the bed. Commonly also a limestone cap rock is found above the coal at intervals varying to a possible maximum of 15 to 20 feet. This limestone contains a species of *Fusulina* which in size and shape resembles a slender grain of wheat. The coal where typically developed averages 7 to 9 feet thick, has a top bench 12 to 36 inches thick, an intermediate bench, and a bench below the blue band. Coal No. 6 is not typically developed in the Longwall District. The coal described as No. 6 near Sparland has a limestone cap rock resembling that above coal No. 6 in the Peoria region and elsewhere in the State, but no *Fusulina* was found even after considerable search. The coal where observed was only about 2 feet thick, and there seemed to be no blue band. The only adequate reason for correlating this bed with No. 6 is its apparent continuity with the No. 6 coal at Chillicothe. The coal developed in small areas in the vicinity of Streator and in some places combined with the overlying coal No. 7, is thought to be local. Descriptions of No. 6 coal and accompanying strata are presented later.

COAL NO. 7

The correlation of coal No. 7 (Streator coal) in the Longwall District with coals similarly numbered in the Danville area and the Peoria region, is doubtful. It is the only thick bed in the McLeansboro formation as now defined. The usual means of identification of this coal in the Longwall District is not by physical characteristics, nor by fossils, but by its position 25 to 70 feet below the Lonsdale limestone. The interval is about 50 feet at Streator and in the La Salle-Minonk field. Apparently this limestone outcrops in Rocky Run near Tiskilwa and along Bureau Creek east of Princeton.

The coal seems to vary so much even locally, that physical characteristics are of no service in identification. There is reason for believing that coal No. 7 represents, not a single widespread bed, but a number of beds distributed locally and lying at about the same horizon.

PHYSICAL CHARACTERISTICS AND DISTRIBUTION OF COALS AND ASSOCIATED STRATA

Coal No. 2

DISTRIBUTION AND THICKNESS

Coal No. 2 underlies approximately 1800 square miles of the Longwall District, and is or has been minable under 1200 to 1400 square miles. The coal varies in thickness from less than 1 foot to 54 inches, but in general is very regular. The average thickness in the La Salle region is 42 inches, and in the Coal City region about 37 inches. Between Deer Park and Ottawa the thickness ranges from 24 to 36 inches and northward along Fox River it diminishes to less than a foot near the northern limit of the district. Thin coal also underlies areas in southern Bureau and in Putnam counties.

The thickest observed section is in the Oglesby mine, where the thickness is between 4 and 5 feet, but is due to overthrust faulting. In the adjacent Black Hollow mine of the Illinois Zinc Co., unusual thicknesses have been encountered near the foot of the anticline.

PHYSICAL CHARACTERISTICS

Coal No. 2 is a long-grain coal, splitting most readily parallel to the bedding and having cleat everywhere poorly developed. The coal is relatively hard but brittle, the top coal being harder than that below, where there is any difference.

The coal bed is interrupted by thin layers, lenses, or balls of sulphur (pyrite or marcasite), mother coal, and dirt, and in places by bone coal. The bedded impurities do not make up a large percentage of the coal. In the La Salle region, at least, this is the cleanest of the three coal beds.

There follow a number of detailed observations made on the coal bed in the mines by K. D. White, of the Cooperative Mining Investigations, and other members of the Geological Survey.

OGLESBY COAL COMPANY

Section 1, face, 9th left off convict entry.—Thickness, 46 inches. Bed is about same in quality throughout except near bottom where it is softer and breaks into finer coal; the bed is only slightly banded. Coal is bright, medium hard, and the fracture sub-conchoidal; texture is uniform. The few mother coal partings are compact and soil the fingers but slightly; coal contains considerable sulphur mostly in bands, although balls are present irregularly; near the top of the bed the sulphur is mixed with carbonaceous dirt bands; sulphur occurs also mixed with calcite in veins roughly perpendicular to the bedding.

Section 2, 10th right, off convict entry.—Thickness 39 inches. Coal much purer than in section 1; very little sulphur; calcite in thin plates, with only a little sulphur.

Section 3, face main south entry.—Thickness 42 inches. Bed solid, not banded; makes large blocks. Coal hard and bright. There is sulphur mixed with the mother coal and carbonaceous dirt in lenses and bands throughout; calcite in veins exists in small amounts, and little or no sulphur is associated with it; mother coal partings are fairly sooty.

Two graphic sections of the coal in this mine are shown in figure 15 (Nos. 1 and 13).

LA SALLE COUNTY CARBON COAL CO., LA SALLE SHAFT

Section 1, 15th northeast, Rockwell.—Coal hard, bright, having hackley fracture and smooth texture. Contains some sulphur that is separated from the coal with difficulty.

Section 2, 14th east, 1st left north.—Thickness 41 inches. A portion of the bed has a banded appearance but the remainder presents a solid face; there is no regularity in the position of the banded portion. Coal very bright, hard, brittle, clean, save for sulphur bands and balls; sheets of calcite and sulphur along the cleavage planes give the coal a whitish appearance; the occurrence of the calcite is irregular; a band of sulphur balls which is persistent at this place, lies 21 inches from the top of the coal.

Graphic sections 10, 11 and 12, figure 15, are drawn from detailed measurements of the coal in this mine.

ILLINOIS ZINC COMPANY, BLACK HOLLOW MINE

Section 1, face, main slope.—Thickness 44 inches. The coal is solid, is not banded, and has about the same character from top to bottom. Coal strikes N. 17° W. and dips 30° southwest. Coal hard, bright, and brittle. Large amount of calcite and sulphur along faces; veins of calcite and sulphur traverse the bed at right angles to the dip; bands of sulphur balls lie 16 and 18 inches from the bottom of the bed, but are in many places absent; bottom of coal is very clean.

SPRING VALLEY COAL CO., MINE NO. 5, DALZELL SHAFT

General description.—Maximum thickness 48 inches; minimum 28 inches; average 39 inches. The coal occurs in two benches, the division being 13 inches from the top of the seam. The coal is harder at the top, is bright, blocky, with smooth texture. A clay ½ to 4 inches thick containing bands of pyrite, lies between the draw slate and the coal; this is absent when the coal is overlain by black slate; it is "frozen" to the coal and brings the draw slate with the coal. Veinlets of calcite and sulphur occur irregularly.

Section 1, main east entry.—Thickness 37 inches. Top 13 inches bright, clean, solid, blocky, and not banded; lower coal slightly banded. Top 13 inches contains very little mother coal and small amount of calcite; mother coal parting 13 inches from top; bands of mother coal are numerous in lower part of bed and in places are filled with sulphur; sulphur band 6 inches from bottom is fairly persistent. Cleat is poorly developed.

Section 2, 2d left, off main east entry.—Thickness 41 inches. Coal generally similar to that observed at section 1. Partings 13 inches from the top and 6 inches from the bottom; middle of the bed has several bands of sulphur and mother coal; a few vertical streaks of sulphur are present.

For a graphic section of the coal in this mine see figure 15, No. 15.

ST. PAUL COAL CO., CHERRY MINE, CHERRY.

Coal varies from 52 inches to 24 inches, with an average thickness of 42 inches.

Section 1, main west entry.—Thickness 43 inches. Upper foot of the coal solid, not banded. Parting lies 13 inches from the top; 16 inches from the top occurs a mixture of 4 inches of sulphur and coal, which is discarded in mining; the lower 2 feet of the bed contains calcite plates, though not in large amount.

For a graphic section of the coal in the mine, see figure 15, No. 14.

MARQUETTE THIRD VEIN COAL CO., MARQUETTE MINE, MARQUETTE

Maximum thickness 48 inches; minimum, 38 inches; average 40 inches.

Section 1, face, 7th west, south entry.—The coal is hard and brittle, and cleat is poorly developed. There are a few layers of bone and mother coal; the sulphur occurs in balls, few in number, easily separated from the coal; calcite is found in vertical veins about 1 inch thick and in small amounts along the faces.

WENONA COAL CO., WENONA

Maximum thickness 48 inches; minimum, 38 inches; average 40 inches.

Section 1, face, straight west entry.—Thickness 45 inches. Coal is hard, solid toward the top, slightly banded near the bottom; the edges of the fractures are sharp. Cleat north 47° west is strongly developed. There is considerable mother coal near the bottom, making that part of the bed rather soft; sulphur exists in small balls and calcite lies along cleavage planes.

Section 2, 27th north, 3d east entry.—Thickness 38 inches. The coal is solid, hard, and brittle; the fracture is slightly conchoidal; cleat is poorly developed. Calcite occurs in veins throughout the bed.

WILMINGTON STAR COAL CO., MINE NO. 7, COAL CITY

Section 1, face, 7th west, south entry.—The coal is hard and brittle, and cleat the top coal is harder than the bottom and in most places is brighter. The cleat is poorly and irregularly developed. The coal shoots into good-sized blocks. There is very little calcite present; near the middle of the bed there is a band of mother coal and sulphur in parts of the mine.

CHICAGO, WILMINGTON, AND VERMILION COAL CO., MINE NO. 1, SOUTH WILMINGTON

Maximum thickness 39 inches; minimum 36 inches; average 37 inches.

Section 1, face, main southeast heading.—Thickness 38 inches. Coal hard and brittle, fracture slightly conchoidal; the bed is solid and not laminated; the coal is in general similar from top to bottom. Impurities are mother coal in streaks and bands, sulphur in balls and lenses; the sulphur "freezes" to the coal but is separated in mining. The middle 8 inches of the bed 13 inches from the top contains the most of the impurities and seems to be a little softer than the remainder.

TOLUCA COAL CO., TOLUCA

Maximum thickness 40 inches; minimum 26 inches; average 34 inches.

Section 1, face, main west entry.—Thickness 35 inches. Coal brittle, cleavage irregular; the coal is slightly banded near the bottom. The top 6 inches of coal is especially bright. Calcite occurs in small amount in vertical veins about 12 inches apart, and in thin plates throughout the bed; sulphur occurs in irregularly scattered lenses in the seam with the long axes parallel to the bed; there are a few lenses of "jack."

Section 2, room 5, 1st left, second east, off second south entry.—Thickness 33 inches. The coal is similar to that at the other localities, but contains more sulphur. The top 3 inches of coal is as a rule much brighter than the rest of the bed.

The observations that precede are based on the field work of 1912 by the Cooperative Investigation and include only the mines chosen by this Bureau. Observations previously made are less full, but usually describe the coal with considerable detail. Several descriptions of the coal in mines not included among those on the list of Cooperative Investigation follow herewith.

ILLINOIS THIRD VEIN COAL CO., LADD MINE, LADD

Section in room 1, 1st west main, 1st south of 1st left entry

	Thickness *Inches*	Depth *Inches*
Coal	6	6
Mother coal and sulphur	¼	6¼
Coal	6½	13¾
Mother coal	¼	14
Coal	5½	19½
Mother coal	¼	19¾
Coal	12	31¾
Sulphur	1	32¾
Coal	7	39¾

The sulphur band varies in thickness but usually occurs at about the same horizon. A few scattered lenses of sulphur were also noted. The two upper coals were brighter and harder than the lower seams.

JAMES CAHILL, CAHILL MINE, PERU

Section in 1st north, 2d west, straight north

	Thickness *Inches*	Depth *Inches*
Coal	32	32
Sulphur and bone	½ or less	32½
Coal	9	41½

The sulphur and bone is not persistent. There are very few places in the mine without a sulphur streak in some part of the seam.

MINONK COAL CO., MINONK

Section 1 in 15th west entry, 1000 yards out

	Thickness *Inches*	Depth *Inches*
Coal	4	4
Sulphur	½	4½
Coal	30	34½

Section 2 in the right off 2d right off the 10th west entry

	Thickness *Inches*	Depth *Inches*
Coal with transverse sulphur vein	17½	17½
Coal	11	28½
Shale band	½	29
Coal	4	33

The sulphur band in section 1 is not persistent. The lower coal has a ½-inch soft streak in the middle.

CHICAGO, WILMINGTON AND VERMILION COAL CO., MINE NO. 2, STREATOR

Section in end, left-hand cross road off straight north entry about 1300 feet northwest of shaft

	Thickness *Inches*	Depth *Inches*
Coal	6	6
Sulphur	⅛	6⅛
Coal	30	36⅛

The foregoing section and descriptions are sufficiently scattered to include every part of the Longwall District. The coal is similar in many respects in regard to hardness and brittleness, distribution of sulphur lenses and calcite plates. The quantity and position of the impurities differ from place to place. In a few mines the coal occurs in benches and in some places persistent impurities are present over considerable areas. It is hoped that these sections together with the general descriptions that preceded them will give an adequate idea of the physical character of coal No. 2 in the Longwall District.

ROOF OF COAL NO. 2

The typical roof of No. 2 coal is a gray shale or soapstone. This is in places replaced by black, fissile shale or "slate" which is 3 feet thick and contains large ironstone concretions or niggerheads. This black shale ordinarily lies 12 to 18 feet above coal No. 2 over large areas, but the interval is not a constant one, the shale in many places rolling down toward or even on to the coal.

East of the fold the gray shale becomes thicker, and the black shale thinner. Between Morris and Coal City especially in the vicinity of Mazon Creek, the shale over the coal contains many fossiliferous concretions. The shale here is sandy, not the typical soapstone of the La Salle region. In the vicinity of Cardiff a thick coal bed occupies part of the section of the soapstone, being separated from No. 2 coal by but a few feet of the shale.

Draw slate above coal No. 2 is not common, but is present in a number of mines.

The following summary presents the data relative to the roof conditions in a number of mines in the Longwall District as observed by members of the Survey.

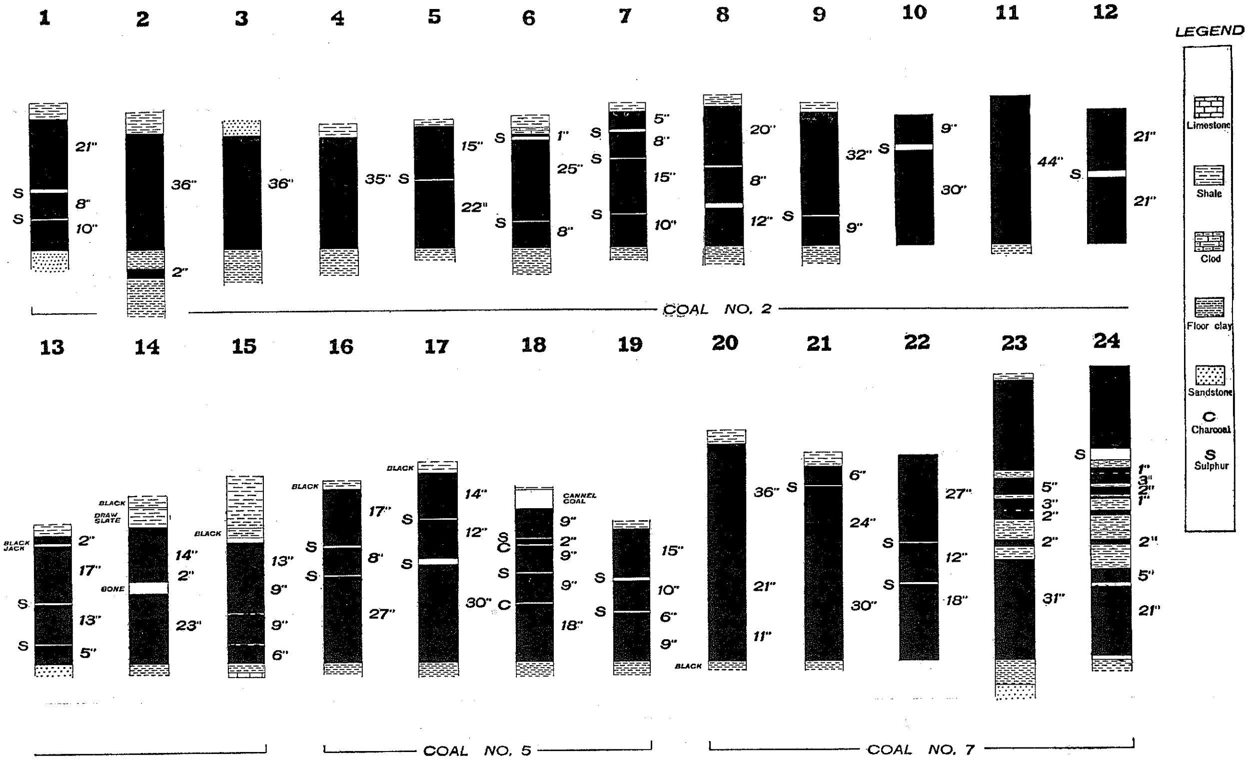


FIG. 15. Graphic sections of coal beds in the Longwall District

TABLE 1.—*Summary of roof conditions of coal No. 2 in various mines in the Longwall District*

Company	Mine	Cap rock			Immediate roof		Draw slate
		Character	Thickness	Height above coal	Character	Thickness	
			Feet	*Feet*		*Feet*	
Oglesby Coal Co.	Oglesby	Black shale	4 to 5		Gray shale	0 to 18	None
La Salle County Carbon Coal Co.	La Salle	Black shale	3 to 5	0 to 50	Gray shale Average	0 to 50 15 to 20	Gray shale
Spring Valley Coal Co.	Dalzell No. 5	Black shale	3 to 15	0 to 30	Gray shale	0 to 30	Gray shale
Marquette Third Vein Coal Co.		Black shale	2 to 4	5 to 10	Gray shale	5 to 10	None
Illinois Zinc Co.	Black Hollow	Black shale	1	0 to 18	Gray shale (average)	16 to 17	Gray shale
St. Paul Coal Co.	Cherry	Black shale	1⅔		Gray shale		Gray shale
Wenona Coal Co.	Wenona	Black shale	4 to 6	0 to 11	Gray shale	0 to 11	None
Toluca Coal Co.	No. 1 & No. 2	Unknown			Gray shale	20	Gray shale
Wilmington Star Mining Co.	No. 7	Shaly sandstone	50		Sandy shale		None
Chicago, Wilmington & Vermilion Coal Co.	No. 1	Black shale		20	Gray shale	20	Gray shale
Illinois Third Vein Coal Co.	Ladd	Black shale	5	18	Gray shale	18	Gray shale
Braidwood Wilmington Mfg. Co.					Hard shale		
Big Four Wilmington Coal Co.					Shale and sandstone		
Rutland Coal Co.					Soapstone		
Minonk Coal Co.					Soapstone, gray to black		

Additional and more detailed observations on the character of the roof of coal No. 2 as noted in a few of the mines follow.

OGLESBY COAL CO., OGLESBY MINE

General description.—The normal gray shale exists over all but about 5 per cent of the mine. Where the gray shale lenses out, it is in most places accompanied by a "roll" which cuts down the thickness of the coal. Where the roll begins the parting is not sharp, but stringers of coal about 2 inches thick occur, mixed with shale, and stringers of coal run into the shale. Toward the center of the roll the contact between the coal and the roof is sharp. It is reported that where the black shale forms the roof the temperature is always higher and the black shale itself is reported to be warm.

Face, 9th left off convict entry.—The roof is a gray shale full of slip surfaces and slickensides. The shale is bedded, and slickensided horizontally along bedding planes. At the locality of observation there is 3 inches of draw slate and a layer of coal ½ inch thick between the shale and the coal. The contact between the coal stringer and the coal bed is slickensided. The line of contact between the coal and shale is very sharp.

10th right off convict entry.—The roof is a gray shale with sandy sulphurous nodules in elongated, thin lenses parallel to the bedding. The shale is slickensided horizontally along the bedding planes. The line of contact with the coal is sharp.

MARQUETTE THIRD VEIN COAL CO., MARQUETTE MINE

In this mine the gray, shale roof is 9 feet thick. Above the gray shale is black "slate". The roof shale is dark gray in color, contains no sand, and is separated into benches.

ST. PAUL COAL CO., CHERRY MINE

The roof is a gray shale or "soapstone", rather soft, and contains very little sand and black shale; it is bedded by distinct partings. The black shale is present in rather irregular, long, thin pencils; forms lenses and commonly cuts out about a foot of coal where the lens starts. The black shale contains pyrite balls.

WENONA COAL CO., WENONA

The roof is commonly a gray shale containing variable amounts of sand. In a small area it is black "slate" with limy concretions. The shale in parts of the mine is massive, not bedded, and nearly free from sand (soapstone); in other parts of the mine it is interbedded and streaked with white sand. Many sulphur balls are distributed irregularly in the shale.

TOLUCA COAL CO., TOLUCA NO. 1 AND 2

The roof, a gray shale, is in no place less than 10 feet thick. The shale is bedded and contains slickensided partings called "smooths". In brushing the roof an effort is made to brush to a "smooth". The shale contains ironstone concretions, ½ to 1 inch long in bands parallel to the bedding.

CHICAGO, WILMINGTON AND VERMILION COAL CO., MINE NO. 1

The roof is a laminated, light-gray shale. Ironstone nodules occur in bands parallel to the bedding. These nodules are lenticular, the longer axis being 2 inches or less. The layers are smooth along the bedding planes.

The roof of No. 2 coal is excellently adapted to the longwall method of mining. By undercutting the coal in the floor clay or if the fire clay is too sandy in the lower few inches of the coal, sufficient leverage is applied by the settling roof shale to break down the coal during the night. Because of the method of mining, the use of explosives in the No. 2 coal is very uncommon and never desirable. In some mines the clay shows a tendency to fall as high as the black "slate" even along the roads.

The gray shale, as has been noted in some of the observations, contains rather numerous nodules which have a rather high percentage of iron sulphide. Upon exposure to the air in the waste piles with dirty coal and refuse the sulphide oxidizes and burns, the light blue color of the flame being visible only at night. Eventually the gray waste pile changes to a reddish color as a result of the oxidation, and patches of yellow sulphurous material are found scattered over the heaps where the material is relatively fresh. The shale as it goes to pieces at the surface breaks up more or less concentrically, possibly around the small concretions.

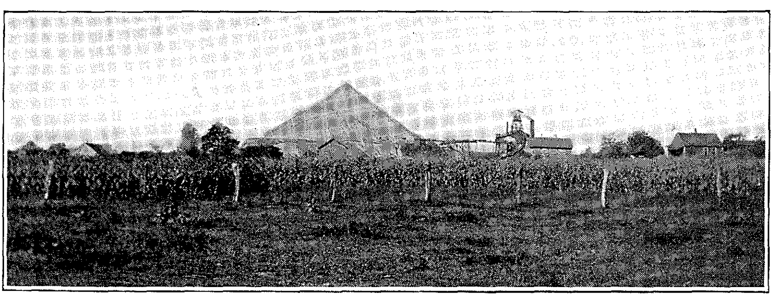


FIG. 16. The rock dump at mine No. 3, Spring Valley Coal Co., a characteristic scene in the Longwall District.

The roof shale has been put to very little use within the district, although it has been tested at some mines. Some is being used by one of the brick plants near La Salle, but only incidentally. The shale has also been shipped from Coal City and Minonk. Extensive collection of samples was made by the Cooperative Mining Investigation, and a bulletin will soon be issued in cooperation with the Ceramics department of the University of Illinois. The burned shale from waste piles has been used somewhat near La Salle as road ballast. It makes an excellent, smooth road while it lasts but apparently is not very durable. The rock dump such as is shown in figure 16 is one of the characteristic features of the landscape in the Longwall District.

FLOOR OF COAL NO. 2

Most of the material underlying coal No. 2 is a dark gray clay. West of the anticline this clay is thin and in places absent, the coal resting directly on a sandstone or sandy shale, which makes undercutting difficult. Where no clay is present the coal is commonly cut rather than the material below.

East of the anticline and parallel with it the underclay thickens very considerably, so that clay 20 to 25 feet thick is known in places. Two stratigraphic horizons are possibly represented in the underclay where it is thick, the true underclay of coal No. 2 not being over 4 or 5 feet in thickness (see discussion Chapter I). This thick clay is of considerable importance at various places in the district as a source of fire clay and pottery clay.

Along the anticline where the water has rather easy access to the thick clay, the floor in the mines heaves very badly. This is true in the Black Hollow mine of the Illinois Zinc Co., and is also true in the Rockwell mine of the La Salle County Carbon Coal Co. Great difficulty is encountered in keeping the rooms and entries open because of the rapidity with which the clay squeezes into them. In a number of places in the Black Hollow mine the present road bed is above the original timbering.

The observations on the character of the floor in various mines in the district are given in brief form below.

OGLESBY COAL CO., OGLESBY MINE

The floor is fire clay of unknown thickness. It varies in the quantity of contained sand, in the tendency to heave, and in hardness. Where soft and free from sand the clay heaves badly, where sandy it heaves but slightly.

LA SALLE COUNTY CARBON COAL CO., LA SALLE MINE

The fire clay has a maximum thickness of at least 20 feet and is of uniform character. It is dark and hard, with breaking faces smoothed. Below the clay a hard, sandy shale is reported, which in places cuts out the clay. A few ironstone concretions are reported to be scattered through the clay. Undercut about 8 inches.

ILLINOIS ZINC CO., BLACK HOLLOW MINE

Fire clay floor is reported 12 to 15 inches thick and of uniform character. The floor is reported to heave very badly whether wet or dry. During a night it is reported to swell so badly that roads have to be graded to pass loads. It will completely close an entry in twelve hours.

SPRING VALLEY COAL CO., DALZELL MINE NO. 5

The floor is a light gray, micaceous, clayey sandstone grading into clay. Its thickness is 6 to 12 inches and averages 6 to 8 inches. It contains a few root impressions. The miners undercut generally about 12 inches of the bottom, sometimes as much as 24 inches.
Clay Co., Streator.

ST. PAUL COAL CO., CHERRY MINE

The floor is a dark gray shale or clay, with plant impressions. The thickness varies to a maximum of 15 inches, averaging 8 inches. The clay varies in the amount of sand contained. Sandstone is reported to lie 4 feet below the coal. The undercutting is generally in the 10 inches below the coal, but there is some mining in the coal.

MARQUETTE THIRD VEIN COAL CO., MARQUETTE MINE

The floor is a clay 3 to 5 feet thick. The clay shells off and does not have to be shot. The undercutting is in the clay to the first parting, which varies from 8 inches to 3 feet below the coal. The clay above the parting heaves, but that below is solid. Sandstone is reported below the clay; and boulders at a depth of 5 feet.

WENONA COAL CO., WENONA MINE

The floor clay averages from 3 to 9 inches in thickness. The undercutting is in the upper bench of clay, which thickens locally to 12 inches. The lower bench is harder and more sandy, and is not mined. Where the upper bench lenses out the mining is in the coal.

TOLUCA COAL CO., MINES NO. I AND 2

The floor is clay at least 3 feet thick. It is of uniform character and heaves slightly.

WILMINGTON STAR MINING CO., MINE NO. 7

The floor is fire clay averaging about 7 feet in thickness, is uniform in character, and heaves somewhat. Undercutting is done in the clay to a depth of 18 to 24 inches. Shale is reported to underlie the clay.

CHICAGO, WILMINGTON & VERMILION COAL CO., MINE NO. I

The floor is a fire clay averaging about 3 feet in thickness. It is fairly uniform in character. The clay is dark gray at the top, becoming lighter toward the bottom. Near the top it contains considerable carbon and a small amount of root remains. The clay heaves considerably in the air and very badly when wet. The undercutting has an average thickness of 8 to 9 inches, but varies up to 9 inches.

GRAY AND JONES COAL CO., SENECA MINE

The floor is a thick fire clay which heaves when wet. There is at least 12 feet of this material present, but the bed has not been penetrated in the mine. The clay is hard and gray but becomes lighter with depth.

STREATOR CLAY MANUFACTURING COMPANY

At the clay mine in the floor clay of coal No. 2 the clay is 14 feet thick and rests on a 5-foot bed of sandstone.

IRREGULARITIES IN COAL NO. 2

No. 2 coal is very regular in character and thickness over large areas. The character of the bed varies but little within any field, but there is some difference from field to field. Variations in the impurities have already been described at some length. The few structural

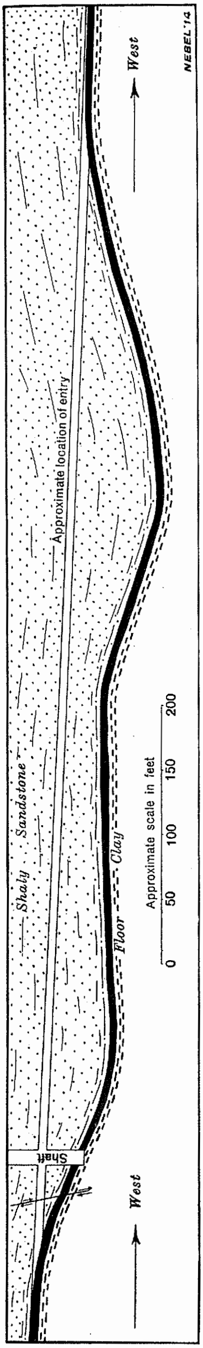


FIG. 17. Syncline in mine No. 7, Wilmington Star Mining Co.

irregularities are interesting, but are not especially important as factors affecting the mining of the coal over the field as a whole. These minor irregularities are small folds and faults or unusual depressions or elevations in the coal bed, and are too broad apparently to be due to folding. In order to give an idea of the lay of the coal in a local area, a contour map of part of the Ladd mine prepared by Mr. F. D. Chadwick, engineer of the Spring Valley Coal Co., is presented in Plate VI. The slight unevenness that is shown presents no great difficulties in mining as long as there is no large quantity of water. Almost any stratum of the "Coal Measures" would be found to vary as much in altitude in an area of the same size.

Possibly the most significant example of variation in the elevation of the coal bed within a short distance, aside from the LaSalle anticline, is found in the Coal City field. This field is especially characterized by the unevenness of the floor. Some indication of this appears in the contour map of the coal (Plate 1). The accompanying sketch (fig. 17) is a copy of one made in the field by Mr. K. D. White to illustrate the conditions in mine No. 7 of the Wilmington Star Mining Co. The shaft was sunk near the trough of a wide basin, where the coal was about 50 feet lower than on either side. After the coal was removed from the trough an entry was driven at the level of the shaft bottom toward the coal on either side. The position of this trough is only roughly indicated on the structure contour map by the depression occupied by the Coal City group of mines.

The variations in the position of the coal along the anticline have already been described.

Faults are not large or common, though small ones have been observed. The largest that have been noted are along the anticline in the Oglesby and Black Hollow mines. One of the most interesting was seen on the east side of the Oglesby mine. A thrust-fault plane cuts the coal at a very low angle, and as a result of a movement in an almost horizontal direction the coal is practically doubled in thickness for a distance of 15 to 20 feet. Apparently the fault plane varies considerably in amount of dip, as later observations by Mr. White indicate a dip of about 45 degrees. The accompanying sketch (fig. 18) drawn by Mr. White shows the condition where he observed the fault.

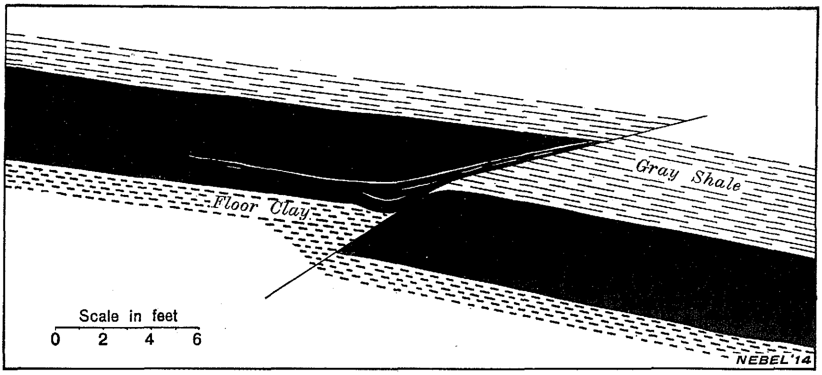
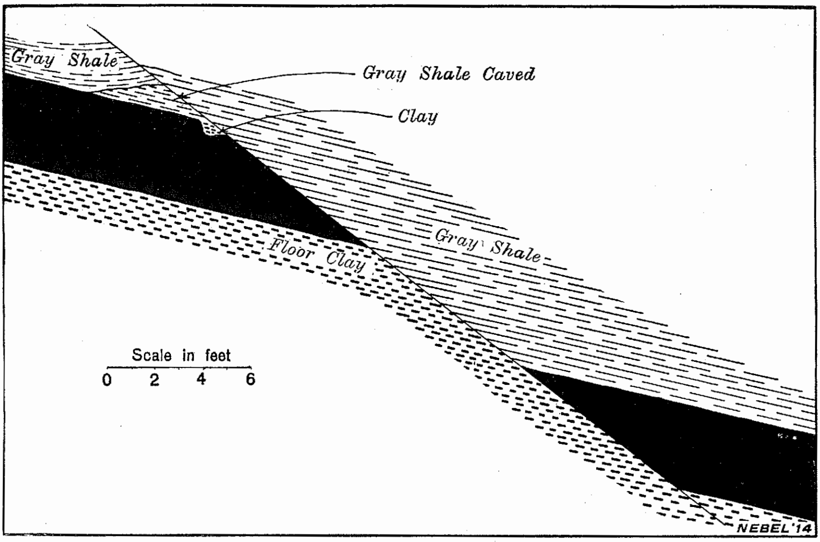


FIG. 18. Thrust fault in the Oglesby mine

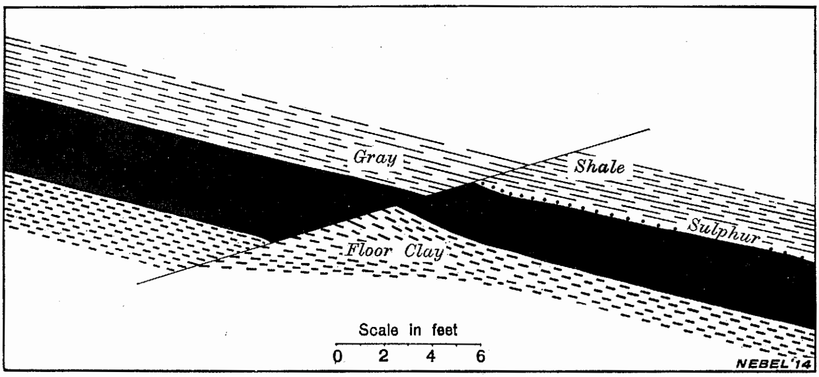
In the Black Hollow mine which follows down the west limb of the fold, at least two faulted zones are present. In one of these the fault plane dips toward the west and in the other about at right angles to it. A sketch of the faults is shown in figure 19, *a* and *b*.

Such faults as are found along the anticline are not common over the area as a whole. A few small faults have been noted however in areas not immediately adjacent to the fold. For example, in mine No. 5 of the Spring Valley Coal Co. at Dalzell the coal has been rather intricately broken by a compound fault, the result of which is a normal fault having a throw of about 3 feet. A sketch of this structure is shown in figure 20. Small faults have been noted in the La Salle shaft of the La Salle County Carbon Coal Co. in mine No. 7, Wilmington Star Mining Co. in mine No. 7, Chicago, Wilmington & Vermilion Coal Co., and in the mine at Wenona. In no case was the throw or vertical displacement sufficient to remove the coal entirely from the face. It is not unlikely that most of the mines in the district have small faults of the character described, though our attention has not been directly called to them.

Irregularities known as *rolls* are in some places faults or faults in part, and in other places a replacement of the upper part of the



A



B

B. Fig. 19. Normal faults in Black Hollow mine

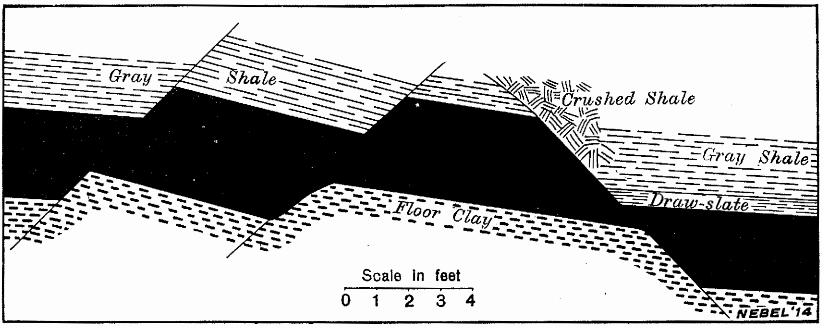


Fig. 20. Step fault in Dalzell shaft, Spring Valley Coal Co.

coal by clay or shale, the roof apparently rolling down into the coal. Such rolls are common, though not sufficiently common to present any great obstacle to mining. The miners' term "fault" would probably include any irregularities where the coal becomes thinner, or is replaced by clay or shale, or is displaced along a fracture line. It is a term that is considerably broader than the geologist's *fault,* which refers only to a *displacement along a line of fracture.*

In parts of the Black Hollow mine, in the clay pits south of Starved Rock Park, and in Bottomly's country bank on the Vermilion River below Lowell, altogether occurring from place to place over 15 to 20 square miles along the anticline and east of it, large, calcareous, boulder-like masses of rock lie in the coal bed, and in some places entirely eliminate the coal. The material of which the boulders are composed seems to be a mixed-up mass of calcareous and carbonaceous rock, which in some places is also somewhat sandy. The origin of the rock is not well understood, but the general impression gained after seeing six of the boulders is that at the time of deposition the organic debris of the coal was mixed with calcareous material, resulting in a rock that is neither coal nor true limestone. Both calcareous and organic matter seem to penetrate the whole rock rather than to occur as fragments. It does not appear, therefore, as has been suggested, that the boulders are residuals of earlier erosion, like the Trenton limestone boulders resting on the St. Peter sandstone below, nor do they appear to have been rolled into the coal after its accumulation. Why they are localized along the fold is not clear, and their distribution may have no relation to the anticline.

In a number of mines west of the fold where the black, fissile shale rests on the coal bed, the seam in most places is reported to be thinner and harder than elsewhere, as though the bed had been more compressed below the harder shale.

Coal No. 5

DISTRIBUTION AND THICKNESS

The area underlain by coal No. 5 lies west of the La Salle anticline. Strata at this horizon outcrop along the sides of the pre-glacial valleys forming the Illinois-Rock system between Princeton and Seatonville and east of the present Illinois valley south of the bend. The distribution of the coal as determined mainly from drill holes and mines, is shown in Plate VII. The holes where the coal is missing are indicated by small circles. Of the three important coals of the district, No. 5 occupies the least area. As has been suggested, this is largely because of the absence of the bed east of the fold, but also because the coal is not everywhere present west of the anticline. The irregular distribution of the coal may be due to lack of deposition or to erosion subsequent to deposition. In places the sandstone or sandy shale which lies in the section above coal No. 5 is continuous with the sandstone below the coal and cuts out the coal altogether. The bed appears to occur in more or less trough-like bodies between areas of sandstone. For example, in T. 31 N., R. 1 W. in the southeast corner of Putnam Co. a tongue-shaped area of this coal extends from sec. 3 to sec. 14 in a southeast direction. The drill holes on either side show sandstone or sandy shale at the same horizon. The isolated character of the bodies of this coal is well shown by the small body of coal that occurs in a small trough in the sandstone along the Vermilion River about a mile below Lowell in sec. 8, T. 32 N., R. 2 E. The coal bed has been exposed by the river and its lenticular character and relation to the adjacent sandstone is clear.

There seems to be an area running southward through the district about along the line of the Third Principal Meridian as a center in which there is a large number of holes showing coal No. 5 to be absent, and the mines also have found the coal unworkable (see Plate VII). This area possibly swings more to the east, north of the Illinois River, but the exact extent is not known very definitely. This coal was formerly worked at the Cherry mine and unsatisfactory conditions were encountered toward the east side of the mine; similarly in the M. & H. mine the coal is found difficult to handle toward the west. It is reported that the upper bed in the mine of the Cahill Coal Co. was not workable at least to the north. It seems probable therefore that there is considerable area where the bed is of unsatisfactory character between La Salle and Spring Valley.

In the northern part of the La Salle-Minonk field the No. 5 coal has been mined at a number of places, but is worked at present only by the Matthiessen and Hegeler Zinc Co. at La Salle. The St. Paul Coal Co. mined this coal at Cherry before the disaster. Our best observations of the characteristics of this coal are from the M. & H. mine. This is supplemented by information from drill records and observations at Cherry.

In the M. & H. mine the coal varies in thickness from 24 to 54 inches and has an average of 48 inches. (See figure 15, Nos. 16, 17, and 18). Irregularities or impurities are not continuous, but balls and lenticular bands of sulphur as much as 1 inch in thickness may be seen in small amount. The coal is medium hard, bright, blocky, and possesses a banded texture.

"Horsebacks" and rolls of clay and sandy material form the more common impurities. At irregular intervals and apparently without much association, cracks due probably to shrinkage penetrate the coal bed from top to bottom. These cracks under normal conditions are filled with gray clay in fragmentary form and traversed with slickensided surfaces. Where the coal is otherwise normal these "horse-backs" do not disturb the coal beyond their immediate edges which are relatively sharp. They have a width varying from a few inches to about a foot, and a horizontal extension of at least the width of a room. In most places they have little effect on mining. The clay seems to have been squeezed in from below, as it resembles the floor clay in character. The fissures extend into the roof but are not known to continue into the floor.

It is thought that the occurrence of these cracks in this thick bed, and not in the thinner No. 2 coal, arises from the greater irregularities in thickness within short distances, a more plastic floor which squeezes into fissures, a greater variability in the roof which changes from more or less plastic shale to hard sandstone or even limestone, and from a greater general thickness. Strains resulting from the different degrees of compressibility upon solidification of adjacent strata might be sufficient to cause fissuring. The correlation of this coal with the No. 5 or Springfield coal is based partly upon the presence of these "horse-backs."

A peculiar condition of the roof and coal known locally as "white top", exists on the west side of the M. & H. mine (fig. 21) on the east side of the Cherry mine (middle bed), and, according to report, in the Cahill mine. At Cherry this consists of a white to gray sandstone or sandy, gray shale which replaces the usual gray and black shale of the roof and permeates the coal down to a band of clay found about 14 inches from the floor. Large pieces of white sandstone are found scattered through the bed so that the whole resembles a conglomerate. Slickenside surfaces are quite common throughout the "white-top" areas, and the roof is commonly rough and broken, so that it is very difficult to keep the roads clear. The impurities at some of these places exceed one-half of the total thickness of the bed, and render the coal worthless. Fig. 21 shows an occurrence of "white top."

A satisfactory explanation of the "white top" has not been reached. It is believed however that the interruption in the bed arises from some cause associated with the interruption in deposition, or even erosion after the deposition, of coal No. 5. The shifting of sand and silt from the surface into partly weathered coal would possibly result in a more or less intimate mixture of coal and sand such as characterizes "white top." None of the mines have been extended very far into these areas, but have skirted the edges, and felt out the boundaries. As a result it is not known whether the presence of "white top" is an indication of the entire failure of the coal in adjacent areas. In the old reports Freeman states that the "middle vein" is absent through Peru and northward. If the statement is correct, the occurrence of "white top" seems to be a condition bordering the productive area.

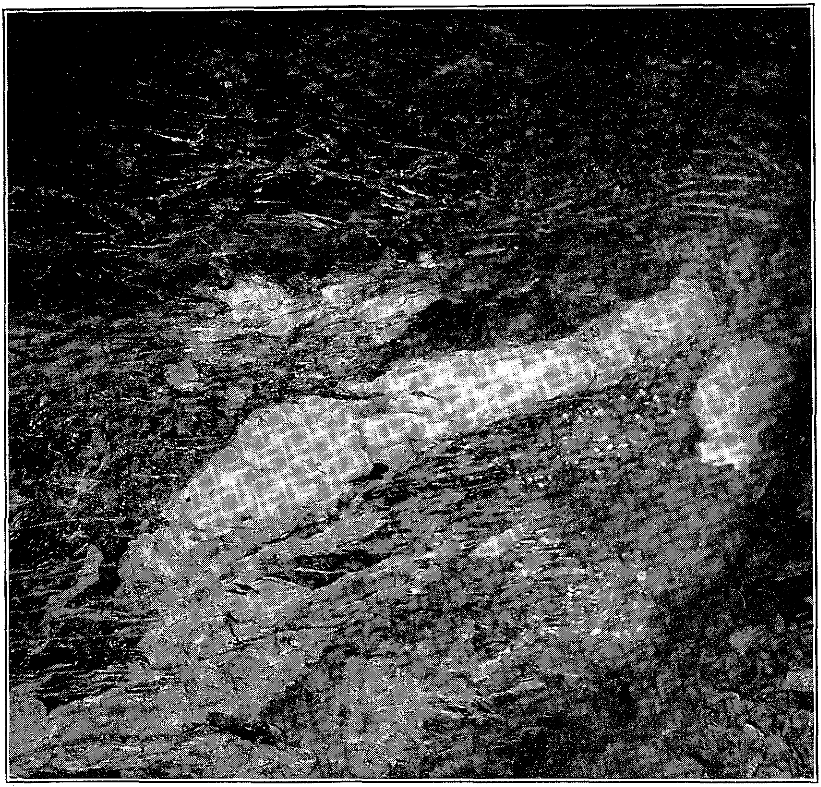


FIG. 21. "White top" in coal No. 5 in the northwest side of the M. and H. mine, La Salle.

Practically all the white shown in the picture is sandstone, even the thin seams in the roof. The roof here is a black shale and is penetrated by these thin lenses of sand that seem to lie parallel with the bedding. The large mass of white in the centre is a sandstone "horseback" which in many respects resembles the clay "horsebacks" found elsewhere in the mine and in the upper coal (see figure 22). It will be noted that the contact between the coal and the sand is sharp, even where points of coal extend down into the sand. Thin seams of sandstone extend into the coal on the right, whereas to the left the material is a mass of broken fragments of coal, arranged roughly parallel with the bedding, and much interrupted by *sand*. Slickensided surfaces are common.

The information regarding coal No. 5 elsewhere in the district is largely obtained from records of drill holes and shafts. In regard to the coal bed itself a record tells little of value except its depth and thickness. The depth at the different localities can be determined roughly from the structure contour map. The records show a great variation in thickness to a maximum of 75 inches. Out of 66 records the thicknesses are distributed about as follows:

Bore hole records showing thickness of coal No. 5

No. of records	Variation in thickness *Inches*
6	2—10
7	11—20
7	21—30
9	31—40
13	41—50
14	51—60
5	61—70
5	71—75

Within the area in which these holes were drilled there are several holes that showed no coal, as is indicated on the map (Pl. V).

The interval between coal No. 2 and coal No. 5 varies somewhat in different parts of the field. Investigations within the area of the Hennepin quadrangle show a range of interval between the two seams of 152 to 191 feet, or 39 feet, the average being about 180 feet. On the La Salle quadrangle the range of interval was 55 feet, from 150 feet to 205 feet, the interval increasing somewhat from north to south and from east to west. The interval between coal No. 2 and coal No. 5 is greater than the interval between coal No. 2 and coal No. 7 east of the anticline. For the most part, there seems to be no systematic distribution of the variations in interval, closely adjacent holes being almost as likely to show considerable variations as those that are more widely separated.

Table 2 shows the intervals between No. 2, No. 5, and No. 7 coals in a large number of the drill holes and mines of the western part of the Longwall District. The five observations shown at the end of the table are on mines in the Streator region east of the anticline, and the intervals between coals No. 2 and No. 5 are notably less than for the other observations tabulated.

TABLE 2.—*The depth to coals No. 2, No. 5 and No. 7 and the interval between the tops of the beds in certain mines and drill holes in the western part of the Longwall District*

BUREAU COUNTY

ALL IN RANGE EAST

Name or company No.	Location ¼	Location ¼	Sec.	T. N.	R.	Depth to coal No. 2	Interval: top coal No. 2 to top coal No. 5	Depth to coal No. 5	Interval: top coal No. 5 to top coal No. 7	Depth to coal No. 7	Interval: top coal No. 2 to top coal No. 7
H	SW	NE	34	17	10	474	170	304	..	-E-	...
54	NW	NW	3	17	11	...	...	321	39	282	...
..	SW	SW	15	17	11	427	138	269?	..	-E-	...
22	SW	NW	19	17	11	446	169	277	..	-E-	...
F	SE	NW	3	16	10	467	171	296	..	-E-	...
N	NW	SE	5	16	10	359	...	-M-	..	115	244
L	NW	NW	6	16	10	421	183	238	43	195	226
J	NW	NE	7	16	10	393	179	214	44	170	223
M	SW	SE	7	16	10	378	181	197	..	-E-	...
K	NW	SE	8	16	10	341	186	155	44	111	230
Heathcock	SE	NE	17	16	10	...	...	186	33	153	...
Walton	....	....	17	16	10	...	...	146	51	95	...
R	SE	NE	19	16	10	378	183	195	40	155	223
U	SE	SW	12	16	9	382	194	188	38	150	232
18	....	NW	19	17	11	454	174	280	..	-E-	...
17	SE	NE	20	17	11	414	149	265	..	-E-	...
21	NE	SE	20	17	11	407	143	264	50	214	193
21	SW	SW	24	17	11	444	152	292	43	249	195
8	E½	SW	25	17	11	463	170	293	42	251	212
26	NW	SE	27	17	11	452	158	294	47	247	205
Cherry	SW	NW	27	17	11	480	163	317	36	271	209
2	SW	NW	27	17	11	475	158	317	42	275	200
6	W½	NW	29	17	11	416	154	262	41	221	195
35	S½	SW	30	17	11	440	160	280	44	236	204
51	NE	NE	33	17	11	...	...	305	42	263	...
53	NW	SW	34	17	11	450	165	285	39	246	204
53	NW	SW	34	17	11	439	159	280	41	239	200
28	SW	SE	1	16	11	459	177	282	40	242	217
10	N½	NW	7	16	11	465	178	287	40	247	218
4	N½	SE	8	16	11	424	175	249	36	213	211
9	SE	NE	11	16	11	452	171	281	35	246	206
G	NE	SE	2	16	10	422	168	254	..	-E-	...

TABLE 2.—*Continued*

PUTNAM COUNTY

ALL IN RANGE WEST

Name or company No.	Location ¼	¼	Sec.	T. N.	R.	Depth to coal No. 2	Interval: top coal No. 2 to top coal No. 5	Depth to coal No. 5	Interval: top coal No. 5 to top coal No. 7	Depth to coal No. 7	Interval: top coal No. 2 to top coal No. 7
..	NE	SE	1	32	2	386	185	205?	..	...	...
2	SW	NE	1	31	1	536	...	-M-	..	318	218
11	NE	SW	2	31	1	503	137	366	60	306	197
4	NE	SW	3	31	1	489	...	-M-	..	261	228
3	NE	NW	9	31	1	454	...	-M-	..	227	227
6	NW	SE	10	31	1	485	210	275	24	251	234
10	SW	NE	11	31	1	489	147	342	51	291	198
4	SE	SW	11	31	1	488	...	-M-	..	250	238
3	SE	NW	12	31	1	519	...	-M-	..	301	218
8	NW	SE	14	31	1	497	164	333	47	286	211
7	Near	Center	15	31	1	465	...	-M-	..	240	225
..	NE	NW	2	32	1	528	128	400	50	350	178
6	NW	NW	3	32	1	425	181	244	35	209	216
Granville	NW	NE	8	32	1	457	194	263	35	228	229
10	SW	NE	8	32	1	468	187	271	34	237	231
1	SE	NE	9	32	1	468	173	295	41	254	214
Berry	NE	SW	11	32	1	498	177	321	37	284	214
9	NE	NE	23	32	1	543	...	-M-	..	304	239
8	NE	NW	29	32	1	499	...	-M-	..	304	195
58	NW	NE	29	32	1	507	...	-M-	..	286	221
1	SW	NE	35	32	1	562	...	-M-	..	335	227
3	SW	NW	30	33	1	276	211	65	..	- E-	...

MARSHALL COUNTY

ALL IN RANGE EAST

4	SW	SW	4	29	1	...	...	364	57	307	...
3	SW	NE	5	29	1	499	157	342	54	288	211
2	NE	NE	5	29	1	501	170	331	43	288	213
5	SW	SW	5	29	1	...	...	306	32	274	...
6	W½	NE	7	29	1	...	...	320	36	284	...
7	SW	NW	8	29	1	...	...	314	43	271	...

TABLE 2.—*Concluded*

LA SALLE COUNTY

ALL IN RANGE EAST

Name or company No.	Location ¼	¼	Sec.	T. N.	R.	Depth to coal No. 2	Interval: top coal No. 2 to top coal No. 7	Depth to coal No. 5	Interval: top coal No. 5 to top coal No. 7	Depth to coal No. 7	Interval: top coal No-2 to top coal No. 7
..	NW	NE	19	34	1	462	216	246	..	-E-	...
4	NW	SE	28	34	1	474	186	288	40	248	226
3	SW	SW	33	34	1	496	...	-M-	..	259	237
5	SW	NW	34	34	1	425	180	245	43	202	223
Caledonia	NW	NW	3	33	1	536	179	357	34	323	213
11	SE	SW	13	33	1	308	191	117	53	64	244
13	Cent	W½	13	33	1	237	172	65	..	-E-	...
7	SW	NW	13	33	1	323	182	141	59	82	241
La Salle	SE	SE	15	33	1	386	153	233	58	175	211
8	SE	SW	13	33	1	320	169	151	..	-E-	...
Oglesby	NE	SW	25	33	1	462	150	312	53	259	203
3?	NE	SE	30	33	1	330	182	148	41	107	223
Cedar Point	W½	SW	4	32	1	541	198	343	43	300	241
4	SE	SE	5	32	1	511	194	317	37	280	231
14	E½	NE	8	32	1	528	196	332	35	297	231
15a	NW	SW	12	32	1	553	191	362	39	323	230
2	NE	NE	12	32	1	464	173	291	59	232	232
3	SE	SE	13	32	1	499	206	293	36	257	242
6	NW	NE	17	32	1	493	180	313	37	276	217
2	SE	NE	26	32	1	559	184	375	40	335	224
13	SE	NE	27	32	1	...	...	380	47	333	...
17	NW	NW	29	32	1	526	...	-M-	..	300	226
4	NE	SW	31	32	2	563	189	374	47	327	236
14	SE	SW	5	31	1	555	123	432?	64	368?	187?
16	SE	SE	14	31	1	583	169	414	50	364	219
15	NW	SW	16	31	1	545	190	355	35	320	225
..	SE	NW	18	31	1	442	174	268	41	227	215
C. W. & V. No. 1	....	....	10	31	3	207	...	-M-	..	92	115
Star C. Co.	....	....	21	31	3	196	...	-M-	..	55	141
C. W. & V. No. 3	SW	SW	24	31	3	216	...	-M-	..	72	144
Peanut No. 2	....	....	35	31	3	181	...	-M-	..	51	130
C. W. & V. No. 2	NW	SW	19	31	4	245	...	-M-	..	103	142

Table 3 shows the interval between coal No. 2 and coal No. 7 for Grundy County and Eastern Livingston County.

E=Eroded.
M=Missing.

THE ROOF OF COAL NO. 5

The roof of coal No. 5 varies from a gray shale to black "slate", sandstone, and locally limestone. The normal roof is a gray shale or a black shale called "slate", the latter containing some "niggerheads" or ironstone concretions. In most places where black slate is present, the upper 4 to 8 inches of the coal resembles cannel coal. Under the normal roof the coal is regular and uninterrupted, but under the sandstone roof the coal is commonly thinner. The sandstone displaces the light and dark shale and more or less of the coal, and furthermore its presence in the roof is generally accompanied by a depression of the floor. This seems to mean that the additional relative incompressibility of the sand as compared with the adjacent coal and shale made itself felt in the rock underlying the coal, a condition that seems to exist elsewhere in the field. The limestone roof is only locally present.

The roof in the area of "white top" is badly broken and is composed of white, sandy material like the material in the coal mixed with black shale and fragments of coal. The first sign of the "white top" in the M. & H. mine is a speckled condition of the roof due to the presence in the shale of small spots of the white sand, which develop into stringers of white sandstone. The sand then penetrates farther and farther into the coal bed, though locally with considerable abruptness.

The sandstone which lies above the coal in places is unconformable with the underlying strata, cutting across coal, gray shale, and black "slate." It is quite possible that farther west where the coal is reported missing the sandstone replaces the coal completely. The contact between the sandstone and the shales is sharp, and the roof in places falls to the sandstone.

THE FLOOR OF COAL NO. 5

The floor of coal No. 5 is a gray clay 2 to 4 feet thick in the M. & H. mine and about 1 foot thick at Cherry. The stratum underlying the clay is either a brownish, micaceous, sandy shale or a sandstone.

Coal No. 7

GENERAL DESCRIPTION

Coal No. 7 has been next to coal No. 2 in economic importance in the Longwall District, but is now largely worked out. This coal is known at Streator as the "Streator coal" and in the La Salle field as the "first" or "upper vein." It is being worked at Streator and at Sparland, and in former years was worked at La Salle, especially along the outcrop north of Illinois River. The M. & H. Coal Co. mine the clay below this coal but have never taken the coal.

The coal underlies approximately 550 square miles of the Longwall District as included in the area of this report and as shown in the map in Plate VIII. The bed is considerably more irregular in its occurrence than coal No. 2, especially along the anticline and eastward as far as Streator. Interruptions in the continuity of the bed also arise from erosion within the limits of the field in the center of the district and on both margins. The coal has been removed in the eastern side of La Salle County and in Livingston County by pre-glacial erosion. The pre-glacial, Rock-Illinois valley gives rise to irregularities on the west side, and the area of the coal to the east is quite uncertain because of the covering of glacial drift. Because of the two sorts of interruptions in the regularity of the coal the estimates of the area underlain by the bed must be regarded as very uncertain. It is certain, however, that the area is less than that underlain by coal No. 2 and greater than that underlain by coal No. 5.

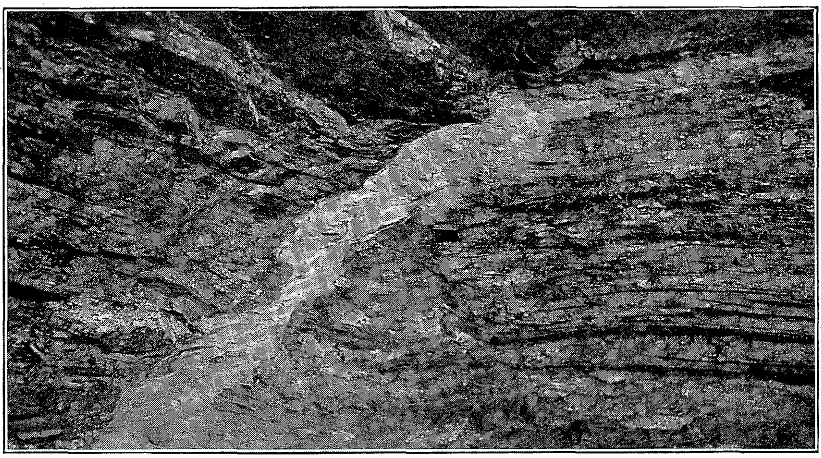


FIG. 22. Coal No. 7 cut by a "horseback" in the M. and H. mine, La Salle.

The thickness of coal No. 7 varies considerably and reaches at least 9 feet in the Kangley-Henanville field at the old Henanville mine. The average thickness of the bed in the Streator field is about 48 inches, not uncommonly increasing to 60 inches or decreasing to 36 inches. In the La Salle region the coal measured 46 inches at the M. & H. clay mine at the only place where it had been entirely penetrated (see figure 22). The drill holes in the La Salle region and in Bureau County show an average thickness of 46 to 48 inches, the extremes being 24 and 60 inches in the same region. The coal was formerly opened at Ladd but was found to be very dirty and was abandoned. Toward Sparland the upper coal, probably No. 7, varies from 42 to 48 inches. At Toluca thicknesses between 38 and 58 inches were encountered in the various holes. At South Wilmington the coal is from 36 to 48 inches.

The irregularities in the coal No. 7 are probably more common than in coal No. 2 and less than in coal No. 5.

The coal bed has not been seen at La Salle by members of the Survey except at one place in the M. & H. clay mine. The picture shown in figure 22 is a view taken in the mine showing coal No. 7 at a place crossed by a "horseback". The coal seen to the right in the picture is apparently about normal. It is 46 inches thick and has no very distinct partings so far as could be determined.

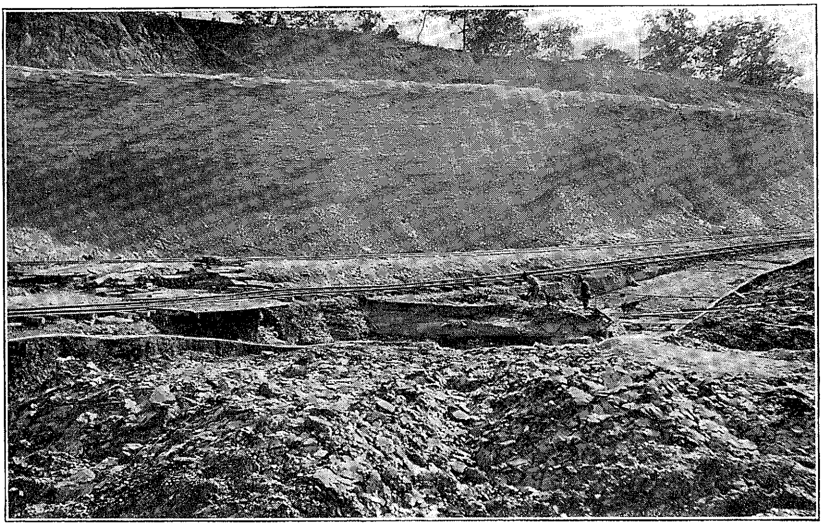


FIG. 23. A broad synclinal depression in coal No. 7 in the pit of the Barr Clay Co., Streator.

COAL NO. 7 IN THE STREATOR FIELD

This coal is best known from its commercial development in the vicinity of Streator. Besides being worked in several mines it has been uncovered by stripping at several clay pits in the same vicinity. The pit of the Barr Clay Co. south of Streator affords one of the best opportunities of viewing the coal that is found in the district. The face of the bed is open for several hundred yards, and the surface has been uncovered for hundreds of square feet, so that exceptional opportunity is given to see the coal both at the face and from the top. A description of the coal as seen in this pit will answer for the entire Streator field.

Section of coal No. 7 in the pit of the Barr Clay Co., Streator

	Thickness *Inches*	Depth *Inches*
Top coal	18	18
Dirt and coal—		
Dirt	1	19
Coal	2	21
Dirt	3	24
Middle Coal	6	30
Dirt and coal	6	36
Bottom coal	12	48

This sequence and the division of the bed into three parts holds over the entire pit, and apparently over the field generally. Each bench is mined separately. Figures 23 to 26 illustrate conditions in this pit.

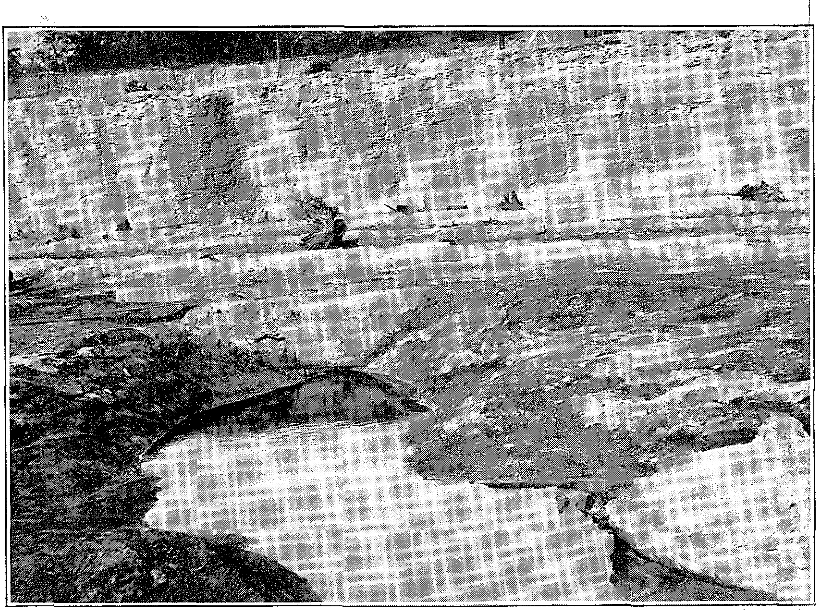


FIG. 24. A "roll" in the surface of coal No. 7 in the pit of the Barr Clay Co., Streator. The water has partly filled the hole from which the clay has been dug.

The surface of the coal is irregular, there being rather numerous depressions in the surface a foot and a half in depth and 5 or 6 feet in breadth and in a few places as much as 15 to 20 feet long. These depressions are filled with roof clay, and where they occur the top coal is missing. As a rule the "rolls" do not displace any of the middle or lower bench. Figure 24 shows the surface of the coal across one of these "rolls". These rolls are very common but of irregular occurrence.

The physical character of the coal in the different benches is similar. The upper bench is relatively free from bedded impurities. There are a few streaks of mother coal, which seem to contain an unusual amount of sulphur, but they do not make up more than 1 per cent of the total thickness. The upper bench where slightly weathered is banded with dull and bright coal. The bright bands are rarely over ¼ inch thick but they make up possibly one-third of the thickness of the bench. They are free from impurities or laminations, are more brittle than the rest of the bed, and break with conchoidal fracture. The duller coal seems to be laminated throughout, is blocky, and breaks straight across the band.

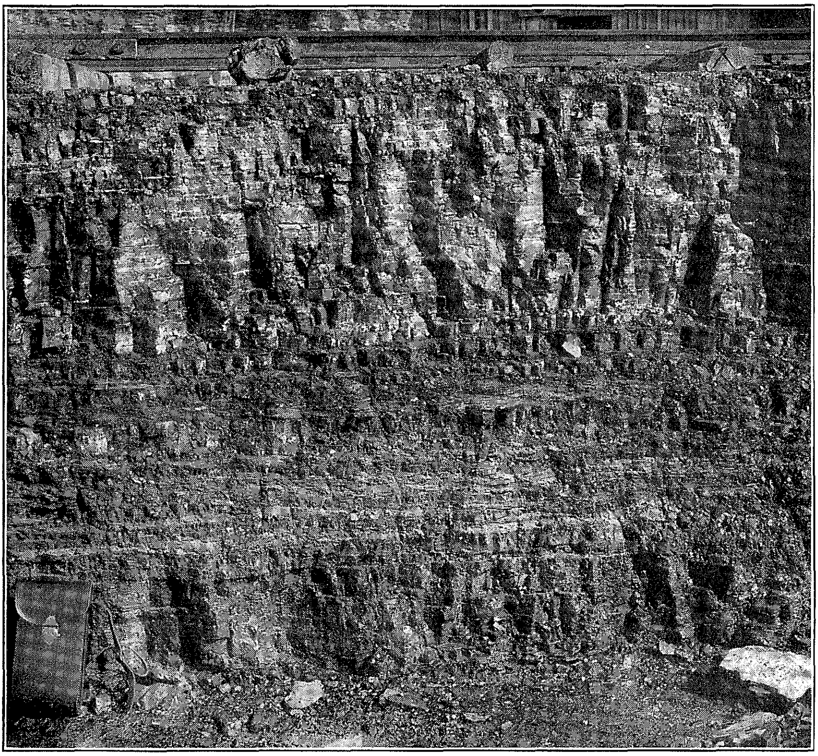


FIG. 25. Coal No. 7 in the pit at the Barr Clay Co., Streator.

The second bench of coal contains dirt, for the most part interbedded as clay streaks which contain much sulphur. The streaks are fairly persistent. The 6 inches of good coal in the middle of the middle bench is constant; above are three coal seams, 1, 1½, and 2 inches thick, interbedded with clay; below there is a succession of interbedded clay and coal seams.

The lowest bench resembles the top in its general characteristics.

Coal No. 7 in the Streator field is very irregular in elevation. Variations in the altitude of the bed as great as 25 feet have been noticed in surface outcrop along Vermilion River. At the Chicago, Indiana, and Southern Railroad bridge the coal rises over the heavy sandstone underlying it, the altitude changing from about the level of the water in the river to 25 or 30 feet above it within a horizontal distance of 100 feet. At this place, at least, the underlying rock does

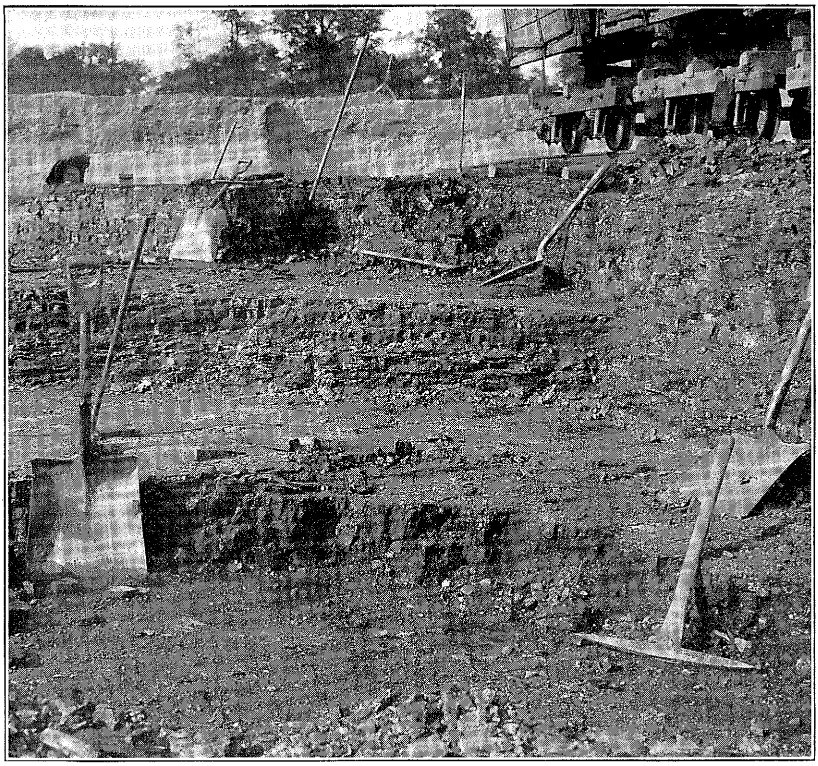


Fig. 26. Method of digging the three benches of coal in the pit of the Barr Clay Co., Streator.

not partake of the structure of the coal. A smaller variation in level is well exposed in the Barr Clay Co. pit (fig. 21). In about the center of the opening there is a syncline possibly 200 feet across, where the strata in the trough are depressed about 10 feet. The axis of the fold runs about north and south. The overlying strata so far as exposed bend down more or less with the coal, though the fold tends to play out upward. The coal is reported to be a little better in the trough and possibly a little thicker than elsewhere.

Another depression, but on a larger scale, was noted at the position of the Harrison mine in sec. 31, T. 31 N., R. 4 E. The coal bed is reported to be about 40 feet lower at the bottom of the shaft, than a short distance to the south. It will be noted from the structure contour map that the elevation of the coal at the old Acme Coal Co. shaft is about 520 feet above sea level, whereas at the C. W. & V. C. Co. shaft No. 2, and in sec. 1, T. 30 N., R. 4 E., it is about 555 feet. This depression apparently trends northeast-southwest but the area affected is not known.

Additional observations on the coal bed in the Streator field have been made in a few of the mines. Notes by Mr. K. D. White are as follows:

CHICAGO, WILMINGTON, AND VERMILION COAL CO., MINE NO. 3, STREATOR

Section 1, room 72, 3rd right, off 71st east entry

	Thickness *Inches*
Top coal	29
Blacksmith coal, clean and bright	7
Parting of carbonaceous clay	..
Dull coal	3
Parting of mother coal	..
Bottom coal	29

Thickness 68 inches. The entire bed is dull, and is irregularly laminated. The bottom coal is duller than the top, is softer, contains dirt partings, and the bottom 6 inches is bony. About 2 inches from the bottom a sulphur band occurs; calcite is found in fair amount throughout the bed.

Section 2, in room 29 off the 4th right off the main south entry

	Thickness *Inches*
Top coal	32½
Parting of mother coal	..
Splint coal	3½
Mother coal and sulphur	1
Bottom coal	29

The bottom coal is harder than the top. The top coal is fairly bright and soft, having a hackley fracture. Calcite occurs along the cleavage faces; there are lenticular streaks of mother coal; sulphur is present with the mother coal and clay, but only a small amount in balls or lenses; a band of sulphurous mother coal is found in places about 8 inches from the roof. The sulphur in the bed occurs in balls generally, but they are few in number and difficult to separate because they freeze to the coal.

Graphic sections of the coal in this mine are shown in figure 15, Nos. 20, 21, and 22.

Observations by Grout at the No. 2 mine of the Acme Coal Co., which has been abandoned, give the following section of the coal.

ACME COAL CO., MINE NO. 2, STREATOR

Section 1, room 7, 5th left entry

	Thickness Ft.	Thickness In.
Hard "soapstone"	10	
Top coal		28
Middle coal—		
Clay		2
Coal		5
Clay		½ to 1
Coal		3
Clay		½
Coal		2
Hard shale		6
Coal		2
Hard shale		12
Bottom coal—		
Coal		1
Coal		30
Shale		8
Sandstone		..

These 6 clay bands extend throughout the mine but do not everywhere make up so large a part of the seam, since each band varies in thickness.

A section, as follows, was measured by Mr. Jon Udden in 1908.

Section 2, in room 10, 5th left off 4th south entry

	Thickness Ft.	Thickness In.
Shale	5	
Top coal		29
Sulphur ball 4 by 5 inches		
Middle Coal—		
Clay		2½
Coal		1⅜
Clay		¼
Coal		3
Clay		1
Coal		2½
Clay		½
Coal		¾
Clay		3¾
Coal		1¼
Clay		7
Coal		1¾
Clay		7¾
Coal		¾
Clay		1

Bottom coal	21½
Bone coal, soft	1 to 8
Fire clay	3 to 6

Sections No. 23 and 24 of figure 15 are graphic representation of the coal in this mine.

These sections all show the same general characteristics of the bed at the different places where it has been observed. A division into three benches characterizes the coal in this locality, and the middle bench is everywhere dirty.

The roof of coal No. 7 at Streator is a gray siliceous shale 35 or more feet thick, and the floor a gray clay, 2 to 3 feet thick, resting on sandstone. In one mine, at least, black shale lies between the coal and the floor clay. This is probably the same as the bone coal noted at the bottom of the bed in the last section.

COAL NO. 7 IN THE KANGLEY-HENANVILLE FIELD

Northwest of Streator in the Kangley-Henanville field the occurrence of coal No. 7 is somewhat different than in the Streator field. The coal outcrops along Vermilion River above Kangley bridge in sec. 10, where the following section was measured:

Section of the McLeansboro formation on Vermilion River above the Kangley bridge in sec. 10, T. 31 N., R. 3 E.

	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pleistocene:				
Glacial drift	20	..	20	..
Pennsylvanian:				
Shale, dark gray.............6 to	10	..	30	..
Shale, black, almost fissile, with ironstone concretions	6	..	36	..
Coal No. 7	4	8	40	8
Clay band	..	4	41	..
Coal	1	6	42	6
Fire clay, gray................8 to	15	..	57	6
Shale, black, fissile	3	..	60	6
Shale, black and coal..........1 to	1	6	62	..
Shale, gray micaceous	4	..	66	..
Sandstone, micaceous..........0 to	10	..	76	..
Shale, grayish brown	10+	..	86	..
Coal, cannel ....4 to	..	8	86	8

This association of strata is not constant even in the Kangley-Henanville field. At Henanville coal No. 7 is reported to be 9 feet thick and to be a combination of two beds of coal. The lower bed may be the equivalent of the 18-inch bench below the clay seam in the coal exposed on the Vermilion, or it may represent one of the lower carbonaceous shales.

The coal at Henanville has already been described (see Chapter I). There is apparently a more or less isolated basin extending northeast-southwest from Henanville toward Kangley, and separated from the Streator field by a sand ridge to the southeast. Probably another ridge separates it from the La Salle field to the west. In this basin the accumulation of peat apparently began earlier than in the other areas, and continued with interruptions until coal No. 7 was deposited. As a result, the Henanville-Kangley basin has below coal No. 7 a number of unusual carbonaceous shales and thin coals. The distribution of the different shales and coals in the basin itself is very irregular.

COAL NO. 7 AT SPARLAND AND TISKILWA

Coal No. 7 in the Sparland field is isolated by erosion from the rest of the district, and belongs in its relationships as much with the Peoria-Springfield District as with the Longwall District. It outcrops along Illinois River bluff and the tributary streams a few feet above the level of the Chicago and Rock Island Railroad tracks at Sparland. The coal is worked at a number of local banks in the vicinity of town and at two shipping mines. Where observed in a local bank about one-half mile west of Sparland it is 42 to 48 inches thick. The roof is a hard, gray shale, containing a few large "niggerheads" or ironstone concretions up to 18 inches in diameter. It resembles the gray shale over the coal at Streator. The coal is much cleaner than that at Streator, sulphur balls and sulphur streaks being uncommon, in which respect the bed resembles the upper bed at La Salle. Where seen at the outcrop, the roof shale is a dark gray shale 2 to 3 feet thick and above it is at least 20 feet of light gray shale carrying small concretions similar to those seen in the shale above No. 7 coal at Streator.

Coal No. 7 has also been observed in the west part of the district at an outcrop along Rocky Run west of Tiskilwa in southern Bureau County. The coal at this place measures 37 inches in one place and 39 inches in another, and is reported to be locally only 24 inches thick. The coal is rather dirty and is traversed at frequent intervals by more or less vertical seams of clay, resembling those in coal No. 5. The roof immediately above the coal is "soapstone" 1 foot or so in thickness. Above the "soapstone" is a dark shale, in places interbedded with streaks of limy ironstone 1 to 2 inches thick, there being 2 such layers in a foot of shale. In other places the limy ironstone is not

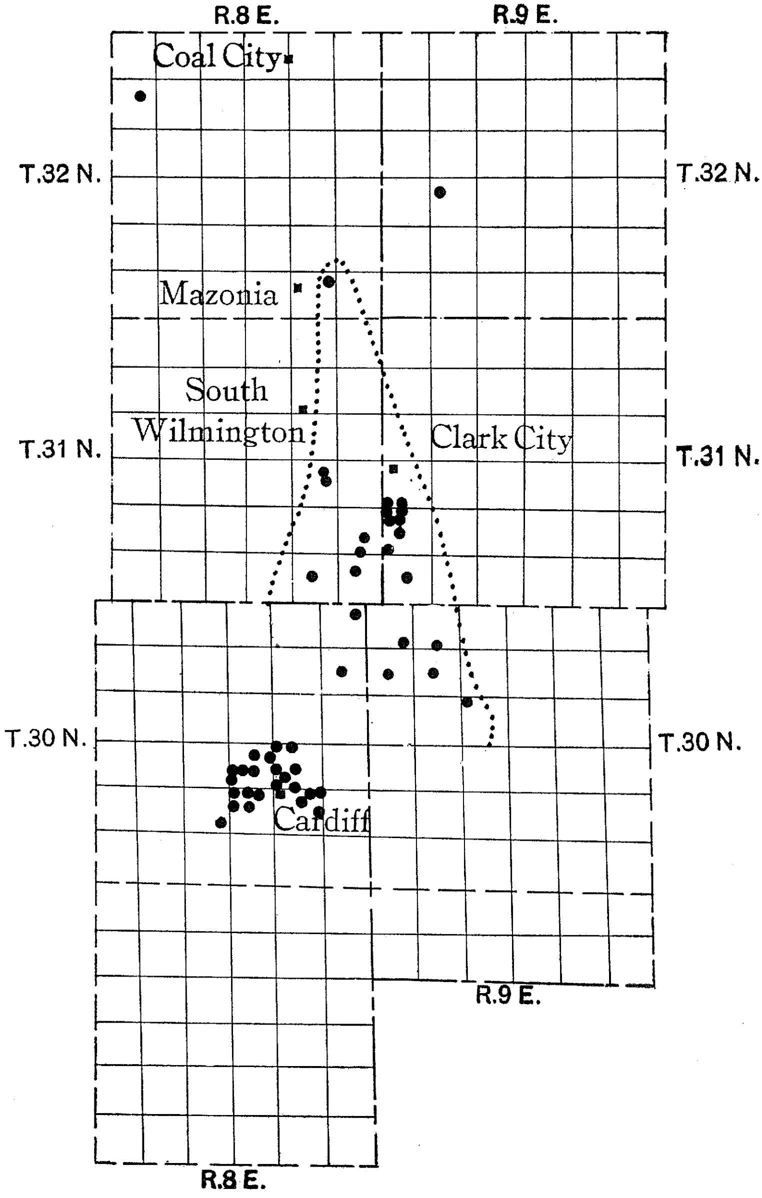


FIG. 27. Approximate outcrop of coal No. 7 in the Coal City, South Wilmington, and Cardiff fields.

present, and the shale becomes darker and more fissile. Four feet of this darker shale may be observed. Above it lies at least 10 feet of gray shale like that at Sparland above the coal. A fine, smooth, and plastic gray fire clay below the coal is reported to be 6 feet thick.

COAL NO. 7 IN THE SOUTH WILMINGTON-CARDIFF FIELD

Coal No. 7 in the South Wilmington-Cardiff area is confined to the southern part of Grundy County near South Wilmington, to the northwest corner of Kankakee County, and to Livingston County, including the Cardiff field. This coal was mined about 20 years ago at Clark City, but unsuccessfully. It is impossible to draw the boundary of the coal bed with much accuracy, because of the uncertainty regarding the depth of the pre-glacial erosion and the thickness of the drift. The approximate area underlain by coal No. 7 in the Cardiff-South Wilmington field is shown in figure 27. Further uncertainty in regard to the area of the coal arises from more or less unsatisfactory correlations of the upper coals in the Cardiff field. In a number of the holes in the center of the field there is a bed of coal 36 to 60 inches thick immediately below the drift that is interpreted as being coal No. 7. If so, the interval between coal No. 2 and coal No. 7 is considerably greater than that farther north in the South Wilmington field.

Table 3 shows the interval between coals No. 2 and No. 7 in the 28 holes in which coal No. 2 was encountered. There is also shown the character of the roof of No. 7 coal and the overlying strata and the floor and the strata below that. This compilation is introduced largely because of the lack of direct observations of the coal since it is not mined in this part of the district.

Following the first two holes described in Table 3 are nine from the Cardiff region in which the interval between the two coal beds is considerably greater than in the others. In the area outside the Cardiff field the average interval is roughly between 50 and 75 feet, but in these holes the interval is 117 to 146 feet. It is also seen that the strata associated with the coal in the Cardiff area are different from those encountered in the other holes in the general region. About halfway between coal No. 7 and coal No. 2 there are two thinner coals, the distribution of which seems to be limited to the area of the Cardiff basin or about the same as the area underlain by the "big vein." (See sections on Plate V.) One of these coal beds is the more persistent within the Cardiff field and may possibly be the real coal No. 7. In Table 4 the particulars of the stratigraphy of this coal are shown similar to those of the higher coal in Table 3.

TABLE 3.—*Stratigraphic data showing the interval between coal No. 2 and coal No. 7, and the character of the strata associated with No. 7 in the South Wilmington-Cardiff field*
(Based upon drill records)

No.	Location			Interval above coal No. 2	Roof			Strata above roof			Floor			Strata below floor		
	Sec.	*TN*	*RE*	*Feet*		*Ft.*	*In.*		*Ft.*	*In.*		*Ft.*	*In.*		*Ft.*	*In.*
14	1	30	8	62	Black slate	3	3	"Soapstone"	2	1½	Fire clay	8	10	Sandstone	27	7
19	12	30	8	66	"Soapstone"	10	..	Fire clay	3	4	Fire clay	2	5	Sandstone	20	8
2	22	30	8	138	Soft shale	7	..	Drift	..	..	Dark shale	..	2	Sandy shale	18	6
10	22	30	8	117	"Soapstone"	19	..	Rock	3	..	"Soapstone" & fire clay	4	..	Shale	7	..
6	23	30	8	143	Hard rock	..	6	"Soapstone"	2	..	Shale	9	6	Sandstone	10	..
								Drift								
4	23	30	8	134	Dark shale	6	5	Clay shale	7	..	Gray sand shale	1	..	Light shale	10	..
7	23	30	8	134	Shell rock (?)	5	6	Drift	..	..	"Soapstone"	18	..			
11	23	30	8	146	"Soapstone"	17	..	Rock	2	..	"Soapstone"	6	..	Coal	1	..
											Rock	4	..			
21	23	30	8	124	Drift	..	..				Sandy shale	65	..			
17	26	30	8	133	Black slate and coal	2	..	Sandstone	3	..	Sandstone	51	..			
18	26	30	8	118	Soft sandstone (drift?)	..	..	Drift	..	..	Slate	1	..	Black slate	7	..
											Shale	1	..			
C. W. & V.	23	31	8	75	Black clod	..	..	Soft white clay	..	..	Fire clay	..	..	White calcareous sandstone	..	..
C. W. & V.	23	31	8	80	Black clod	..	..	Limy shale	..	..	Fire clay	..	..	White hard sandstone	..	..
9	25	31	8	47	Black slate	7	..	"Soapstone"	8	..	Fire clay	7	2	Shale	5	..
10	25	31	8	54	Black slate	7	..	"Soapstone"	7	..	Fire clay	2	..	Sandstone	20	..

TABLE 3.—*Concluded*

No.	Location			Interval above coal No. 2	Roof			Strata above roof			Floor			Strata below floor		
	Sec.	*TN*	*RE*	*Feet*		*Ft.*	*In.*		*Ft.*	*In.*		*Ft.*	*In.*		*Ft.*	*In.*
11	35	31	8	44	Black slate	5	..	"Soapstone"	12	..	Fire clay	10	..	Sandstone	10	..
15	36	31	8	63	Black slate	5	8	Sandstone	24	..	Fire clay	..	3	Limestone	6	..
7	35	32	8	86	Drift	..	..				Fire clay	2	2	Sandstone	..	8
45	7	32	8	81	Drift	..	..				Fire clay	8	..	Sandstone	39	..
43	8	32	8	75	Fire clay	2	6	Black slate	4	..	Fire clay	4	..	Sandstone	42	..
18	5	30	9	(No. 2 absent)	Black stone	7	7	"Soapstone"	6	6	Fire clay	10	8			
17	6	30	9	78	"Soapstone"	2	6	Drift	..	..	Fire clay	2	7	Limestone	12	..
16	7	30	9	80	Black slate	5	..	Fire clay	6	2	Fire clay	7	9	Limestone	2	..
20	8	30	9	36	Dark clod	6	3	Black slate	9	..	Fire clay, slate & clod	6	2	Coal	..	10
														Fire clay	..	1
22	16	30	9	84	Black slate	3	8	Drift	..	..	Fire clay	8	..	Calcareous sandstone	20	..
41	19	31	9	46	Black slate	6	6	"Soapstone"	13	..	Fire clay	13	..	Limy sandstone	3	9
42	19	31	9	(No. 2 absent)	"Soapstone"	4	6	Black slate	6	..	Fire clay	1	1			
45	30	31	9	(No. 2 absent)	Black slate	8	8	"Soapstone"	13	..	Fire clay	6	..	Black slate	5	..
46	30	31	9	56	Black slate	6	2	"Soapstone"	11	6	Fire clay	3	..	Calcareous sandstone	2	..
48	30	31	9	(No. 2 absent)	Hard, gray sandstone	15	3	"Soapstone"	30	..	Fire clay	..	9			
49	30	31	9	(No. 2 absent)	"Soapstone"	4	6	Black slate	8	2	Fire clay	1	..			
50	30	31	9	(No. 2 absent)	"Soapstone"	6	..	Black slate	7	..	Fire clay	1	..			
51	30	31	9	(No. 2 absent)	"Soapstone"	3	..	Black slate	6	..	Fire clay	1	..			
35	30	31	9	(No. 2 absent)	"Soapstone"	5	5½	"Soapstone"	7	10	Fire clay	4	5			
12	31	31	9	77	Dark clod	6	10	Black slate	3	6	"Soapstone"	6	..	Fire clay	10	..
														Sandstone	20	..
2	20	32	9	56	Drift	..	..	Sandstone	15	..						

TABLE 4.—*Stratigraphic data showing the interval between coal No. 2 and an intermediate coal (possibly No. 7), in the Cardiff field; showing also the thickness of the upper bed, and the character of the associated strata*

(Based upon diamond drill records)

Log No.	Location			Interval No. 2 to No. 7	Strata above No. 7				Strata below No. 7			Thickness of coal
	Sec.	*T. N.*	*R. E.*				*Ft.*	*In.*		*Ft.*	*In.*	*Inches*
1	27	30	8	73	1	Soft light shale	..	7	Dark shale	1	1	10
					2	Black shale	2	6	Fire clay	9	..	..
					3	Fire clay	12	6				
2	22	30	8	41	1	Dark stone	..	10	Fire clay	5	..	42
					2	Dark coal rock	1	2	Hard brown shale	3	..	..
3	22	30	8	86.8	1	Light shale	..	4	Light shale	5	4	4
					2	Black stone	2	..	Lime shale	3	..	..
4	23	30	8	46	1	Black stone	3	10	Light clay shale	3	..	38
					2	Dark shale	2	..	Light shale	3	..	..
5	23	30	8	84.6	1	Soft gray shale	2	2	Brown shale	..	6	40
					2	Black shale	2	..	Light shale	5	..	..
					3	Gray shale	5	..				
6	23	30	8	44	1	Light shale and coal	5	..	Light shale	1	..	24
					2	Gray shale	1	6	Fire clay and hard rock	7	6	..
					3	Limestone	3	..				
7	23	30	8	58	1	Black stone	2	9	Fire clay	2	4	17
					2	Dark shale	..	6	Limestone	3	..	..
					3	Dark shale with rock	32	..				
8	23	30	8	47	1	Black stone	1	2	Fire clay	13	4	24
					2	Hard dark rock	..	6				
					3	Black stone	2	..				

Table 4.—*Continued*

Log No.	Location			Interval No. 2 to No. 7	Strata above No. 7				Strata below No. 7			Thickness of coal
	Sec.	*T. N.*	*R. E.*				*Ft.*	*In.*		*Ft.*	*In.*	*Inches*
9	23	30	8	67	1	Black stone	..	6	Fire clay, limestone bands	10	..	24
					2	Hard gray rock	..	6	Dark shale	12	..	..
					3	Black stone	2	6				
10	22	30	8	36	1	Dark shale	..	6	Fire clay	..	8	42
					2	Fire clay	2	..	Light shale	5	..	..
					3	Dark shale	..	6				
11	23	30	8	46	1	Dark shale	2	..	Fire clay	4	6	42
					2	Light shale	5	..	Hard limestone	1	..	..
12	27	30	8	38	1	Black stone	2	6	Gray shale	1	..	..
					2	Dark shale	1	6	Fire clay	5	..	..
13	22	30	8	76	1	Dark shale	..	6	Hard sandy limestone	2	4	20
					2	Hydraulic rock	1	..	Fire clay	9	6	..
14	27	30	8	41	1	Black stone	1	8	Light shale	11	9	43
					2	Fire clay	..	..	Gray shale	1	..	..
17	26	30	8	37	1	Black shale	18	..	Light shale	1	..	36
					2	Black stone	3	..	Fire clay and sulphur	21	..	..
18	26	30	8	58	1	Sandy shale	5	..	Fire clay	2	..	36
					2	Hard sandy shale	5	..	Light shale	20	..	(clay & stone)
19	26	30	8	42	1	Sandy shale	15	..	Sandstone	8	..	36
					2	Black stone	4	..	Sandy shale	10	..	..
20	26	30	8	88	1	Dark shale	6	..	Light shale	..	7	41
					2	Light shale	6	2	Soft light shale	19	..	..

TABLE 4.—*Concluded*

Log No.	Location			Interval No. 2 to No. 7	Strata above No. 7				Strata below No. 7			Thickness of coal
	Sec.	*T. N.*	*R. E.*				*Ft.*	*In.*		*Ft.*	*In.*	*Inches*
21	23	30	8	60	1	Light shale	3	..	Gray shale	2	..	36
					2	Dark shale	2	..	Sandstone	2	..	..
22	22	30	8	83	1	Light shale	9	..	Light shale	3	..	6
					2	Dark shale	2	6	Clay shale	8	..	..
23	22	30	8	85	1	Black shale	2	..	Gray shale	6	..	24
					2	Light shale	3	4	Limestone	..	6	..
24	23	30	8	84	1	Light shale	3	..	Light shale	4	3	9
					2	Dark shale	2	..	Sandstone	17	..	..
25	23	30	8	84	1	Dark shale	3	..	Light shale	12	2	10
					2	Light shale	11	8	Sandstone	15	..	..
26	26	30	8	63	1	Light and dark shale	6	..	Light shale	12	6	42
					2	Limestone	2	..	Sandy shale	5	..	..
27	26	30	8	61	1	Black shale	4	6	Light shale	6	9	33
					2	Light clay shale	8	11	Light shale	4	..	..
28	26	30	8	51	1	Dark blue shale	8	9	Light blue shale	7	11	40
					2	Limestone	..	..				
30	22	30	8	81	1	Dark shale	1	..	Light shale	25	..	16
					2	Light shale	12	9				
31	23	30	8	85	1	Blue shale	3	..	Light shale	3	8	28
					2	Light shale	10	..	Light shale	5	..	..
32	28	30	8	71	1	Sandstone	4	..	Fire clay	5	..	30
					2	Fire clay	4	..	Sandstone	2	..	..

The roof of this coal bed is more regularly dark shale like the roof of coal No. 7 elsewhere in the district, and the interval between this coal and coal No. 2 approaches the average for the district. There are certain holes, however, those in which the "big vein" is found, where the interval is much less than average (see also cross-sections, Plate V). In thickness the coal is unusually variable and thins out, especially in those holes around the border of the Cardiff basin.

It is thought that this field presents a good opportunity to study the relative amount of shrinkage of coal and associated strata. There seem to be differences as great as 40 feet, and certainly as great as 20 feet, in the interval between coals No. 2 and No. 7 (?) in the holes in which the "Cardiff vein" was encountered, as compared with those in which it was not present. The greater interval of about 80 feet between coal No. 2 and coal No. 7 was found regularly where the "big vein" was missing, whereas in every hole in which the interval was 60 feet or less the thick coal was found. It seems not unlikely, therefore, that variations in interval as much as 20 feet may be due to causes not related to shrinkage of the Cardiff bed, whereas additional variations possibly as much as another 20 feet may be due to differences in the amount of shrinkage of the coal and shale. Variations in interval as great as 20 feet not due to differences in shrinkage of underlying strata are found at various places in the Wilmington-Cardiff field, as can be seen by referring to Table No. 3.

The thickness of this intermediate coal bed at Cardiff ranges up to 43 inches, the average in 28 holes being 28 inches of coal. Of these 28 holes, 13 show 36 inches or more of coal, and 4 show 42 or 43 inches. This coal bed seems to be more variable in thickness than coal No. 2 and to be limited in workable thickness to approximately the area of the "big vein." The coal is thinner than the upper bed which has been tentatively correlated with coal No. 7 in this report, but is more widespread, as it has not been anywhere removed by preglacial erosion.

Pottsville Coals

Coal No. 1, or the Pottsville coal, is of no economic importance in the Longwall District, so far as is known. Thin seams of coal below coal No. 2 are encountered in drilling in the field in the vicinity of Bureau, west of Marquette and Granville. The coal beds are apparently two or three in number, each having a local distribution and a thickness not exceeding 2 feet (see Plate IV, Nos. 11 and 12). East of the anticline and along the fold itself stringers of coaly matter have been noted in a few places in the clay underlying coal No. 2. Such a thin coal bed occurs in the clay at the exposure near the Bottomly local mine along Vermilion River about three-fourths of a mile below Lowell. In the Coal City and South Wilmington field and in the Cardiff field thin stringers of coal have been observed in the underclay of coal No. 2.

Local and Thin Coal Beds Between Coal No. 2 and Coal No. 7 (Not Including Coal No. 5).

CARDIFF COAL

The coal bed between coals No. 2 and No. 7 except for coal No. 5, that is of economic importance is the "big vein" in the Cardiff field, which we will call the Cardiff coal. The exact correlation of this coal with others in this district or in the State has not been determined. It has already been suggested that this coal may be about the same age as the fossil-insect and leaf bed along Mazon Creek in Grundy County, which was deposited soon after the accumulation of the peat of coal No. 2.

In order that the relationship of the Cardiff coal to the other strata in the section may be made as clear as possible, a map showing the location of the various holes and cross-sections of the field is presented in Plate V. The contours are drawn on the base of coal No. 2 and to that extent represent an enlargement of a portion of the map of the Longwall District (Plate I). The positions of the three cross-sections is indicated by the heavy straight lines on the map. The details of the sections are not shown, but the thicknesses and intervals between coals are drawn to scale so that the relations are apparent. The thickest core of the Cardiff coal was 150 inches, though this was not all good, clean coal. The coal thins to 5 or 6 feet and becomes dirty toward the eastern end of the field and to the west is split up by bone and shale. The coal stops abruptly north and south.

The shape of the coal bed is strikingly lenticular and crescentic in cross-section. The edges of the bed dip strongly toward the trough, possibly even more so than is indicated by the drawing. The feathering of the bed at the edges as shown in cross-section Plate V, *D* represents the conditions as shown in the drilling records; it is reported however that the bed tapers out on either side rather than feathers out, the bottom of the bed rising toward the top. There was possibly about 600 to 1000 feet of relatively flat-lying coal north and south along the axis of the trough. The coal is reported to contain more impurities toward the southeast and to be divided by a layer of clay. The shale which forms the floor of the Cardiff coal and the roof of coal No. 2 is commonly a thin sandstone and pebble conglomerate overlain by a thin black shale or hard underclay which locally merges with the bottom part of the upper bed and makes it bony and unmarketable.

The sections presented in Plate V show graphically the relation of the Cardiff coal to coal No. 2 and to the overlying strata. Plate V, *C* and *D* both show how the upper coals decrease in altitude where the Cardiff coal lies below. It is thought probable, as has already been suggested, that the relatively greater shrinkage of the strata containing the Cardiff coal as compared with the amount of shrinkage of a corresponding original thickness of shale would account for this decrease in interval between coal No. 2 and the coals above the Cardiff bed. There seems to be some response on the part of coal No. 2 where the Cardiff coal is present above. The sections suggest that this coal rises toward the Cardiff bed, but not all the profiles bear this out.

The coal bed that lies from 40 to 85 feet above No. 2 coal at Cardiff has already been described as possibly being coal No. 7. This coal has about the same distribution as the Cardiff bed, but is of little or no economic importance.

In the vicinity of Lowell a thin bed of cannel coal less than a foot in thickness is exposed along the Vermilion and its tributaries. The coal lies below the heavy sandstone underlying No. 5 coal. It is associated with 2 or 3 feet of black, carbonaceous shale into which it grades, and which locally becomes more like coal. This bed is of no economic importance, at least at present.

COAL NO. 6 AT STREATOR

In the Kangley-Henanville field and possibly along the south edge of the city of Streator, a coal is locally developed a few feet below or immediately below coal No. 7. The mine at Henanville is reported to have worked both beds where they were together and measured about 9 feet thick. At present the lower bed is worked in local banks east of Kangley at Spring Hill. It is thought that this coal bed is confined to about the same basin as is the Henanville-Kangley No. 7 coal, and lies at a lower horizon in this basin, and that it is not found generally outside of the basin. On the other hand, certain records of drilling south of Streator in Livingston County show at the horizon of coal No. 7, a thick split bed of coal which suggests the presence of two beds of coal in close proximity. The characteristics of these local beds are not well known, but so far as can be determined none possesses the "blue band," or has the *Fusulina*-bearing, limestone cap rock.

COAL NO. 6 AT SPARLAND

Coal No. 6 at Sparland lies about 25 feet below the "upper vein" or coal No. 7. In the immediate vicinity of the town it varies from a very thin bed to about 2 feet. Farther south certain drill records in T. 29 N., R. 9 E., show the lower coal from 30 to 50 feet below coal

No. 7 and varying in thickness up to 56 inches. This coal becomes workable in the vicinity of Chillicothe where it has been identified as No. 6. The coal in the vicinity of Sparland has been seen only where it is very thin, but it seems not to possess a blue band. Locally, within 4 or 5 feet above the coal, in the Sparland field is a yellowish, fossiliferous, earthy limestone resembling very much the limestone commonly forming the cap rock above coal No. 6 in Peoria and Fulton counties and even in the southern part of the State. No *Fusulina* have been found in the stratum in this field, however. The fauna which it contains is suggestive of the Carbondale rather than of the McLeansboro formation, so that the coal is probably at least as old as coal No. 6.

Local and Thin Beds of Coal Above Coal No. 7

The only coal of possible workable thickness above coal No. 7 is a bed found locally along Vermilion River in sec. 18, T. 30 N., R. 4 E., Livingston County. The coal outcrops along the sides of a valley tributary to the Vermilion, near the mouth of the creek. Where observed the bed is 30 inches thick, is underlain by a shale resembling fire clay, and overlain by gray shale. To the west and south along Vermilion River the coal does not seem to be present, the horizon being occupied by siliceous strata. So far as known the coal is of but local extent, but there is lack of drilling to confirm this assumption.

In the vicinity of Spring Valley and south of the town on the opposite bluff of the Illinois, a thin bed of coal a foot or so in thickness outcrops near the foot of the bluff in some of the ravines. It appears in a cut along Spring Creek almost at the water's edge across from mine No. 1 of the Spring Valley Coal Co. Here it is only a few inches thick. Along the south bluff of the Illinois at the mouth of some of the ravines in secs. 28 and 29, T. 33 N., R. 1 W., Putnam County, the coal is a foot or so in thickness and has been used somewhat by farmers. This coal is about 50 feet below the horizon of the La Salle limestone.

So far as known, only the coals described in the preceding pages have been mined or stripped and used for fuel within the Longwall District. Some of these are of little or no economic importance, but their position in the section is worthy of note, because a few are associated with other strata that may be of some value. Other small coal beds are scattered throughout the Pennsylvanian system in this district, such as the stringer of coal associated with the black slate under the La Salle limestone. This coal is of rather widespread occurrence and of some value in tracing the horizon of the limestone, but is of no importance as fuel. The upper calcareous portion of the McLeansboro formation above the Lonsdale limestone horizon contains possibly a greater number of these thin coal stringers than the underlying portions of the Pennsylvanian, at least down to within 50 feet of coal No. 2.

CHEMICAL COMPOSITION AND HEAT VALUES OF COALS

A detailed report on the chemical character and heat values of coals in this district and in other districts of the State is being prepared by Prof. S. W. Parr as Bulletin 3 of the Illinois Coal Mining Investigations. Only general features are presented here. Plate IX shows graphically the relative composition of the coals of Illinois.

COAL No. 2

The composition of the coal in the Longwall District has been determined from samples collected in 1913 by members of the Coal Mining Investigations from three different working faces in each of eleven mines. The average analysis of the samples from each of the mines is shown below, and also the average of the 33 samples.

TABLE 5.—*Average analysis of samples of coal No. 5 collected from mines in the Longwall District—Made under the direction of Professor S. W. Parr*

Co-op. No.	Moist-ure	Volatile matter	Fixed carbon	Ash	Sul-phur	CO_2	B. t. u.	Unit coal
1	16.19	37.79	38.06	8.00	3.24	.82	10787	14476
	Dry	45.06	45.40	9.54	3.86	.98	12869	
2	14.60	39.88	36.97	8.55	3.97	.81	10904	14475
	Dry	46.70	43.29	10.01	4.65	.95	12768	
3	15.05	39.76	37.00	8.19	3.30	.59	10899	14454
	Dry	46.80	43.56	9.64	3.88	.69	12830	
4	16.93	37.57	39.57	5.93	2.53	.37	11188	14696
	Dry	45.22	47.64	7.14	3.05	.44	13468	
5	16.01	39.32	38.51	6.16	2.75	1.32	11104	14463
	Dry	46.83	45.84	7.33	3.28	1.57	13221	
6	19.53	37.59	37.94	4.94	2.01	.70	10818	14447
	Dry	46.71	47.15	6.14	2.61	.87	13444	
7	16.29	38.46	40.53	4.72	2.17	.48	11394	14579
	Dry	45.94	48.42	5.64	2.59	.57	13613	
8	16.50	38.48	37.59	7.43	2.40	1.16	10868	14493
	Dry	46.02	45.02	8.90	2.90	1.39	13108	
9	17.45	38.98	34.52	9.04	3.18	1.49	10391	14403
	Dry	47.22	41.82	10.95	3.85	1.81	12587	
10	16.13	38.82	38.36	6.69	3.15	.70	10994	14463
	Dry	46.28	45.74	7.98	3.76	.84	13108	
11	13.28	40.58	37.71	8.43	3.04	.60	11435	14856
	Dry	46.80	43.48	9.72	3.51	.69	13186	
Aver.	16.18	38.84	37.89	7.98	2.88	.82	10980	14528
	Dry	46.33	45.21	8.45	3.45	.98	13101	

In order to show a comparison of the heating quality of this coal with that of other coals in the State, Table 6 showing the average and extreme values for the coals of 9 different districts is inserted. (See also Plate IX.)

TABLE 6.—*The comparative heating value of the various Illinois coals*
(Data after Parr)

District		B. t. u.		
		Minimum	Maximum	Average
La Salle, No. 2	As rec'd	10391	11435	10981
	Dry	12587	13468	13101
Franklin, Williamson, and Perry, No. 6	As rec'd	11335	12127	11825
	Dry	12583	13366	13025
Harrisburg, No. 5	As rec'd	12053	12550	12276
	Dry	12784	13490	13165
Springfield-Peoria, No. 5	As rec'd	10230	10951	10514
	Dry	11995	12700	12384
Danville, No. 6	As rec'd	10508	11228	10920
	Dry	12449	12925	12764
Danville, No. 7	As rec'd	.....	.....	11151
	Dry	.....	.....	12807
Belleville, No. 6	As rec'd	10438	11207	10847
	Dry	12150	12801	12406
Murphysboro, No. 2	As rec'd	12260	12651	12488
	Dry	13565	14044	13765
Rock Island, No. 1	As rec'd	10336	10880	11036
	Dry	12548	12737	12753
Average	As rec'd	10944	11624	11388
	Dry	12776	13181	12797

The preceding table shows that in heating quality the No. 2 coal of the Longwall District, as received from the mine, ranks sixth among the coals of the State, being surpassed by No. 2 coal of Jackson County, No. 5 coal of the Harrisburg District, No. 6 coal of Williamson, Franklin, and Perry counties, No. 7 coal of the Danville District, and No. 1 coal of the Rock Island District. It has higher heating value than No. 5 coal of the Springfield-Peoria District and No. 6 coal of Belleville and Danville District.

The amount and character of the impurities in No. 2 coal is shown in the preceding tables. These have an important effect on the heating qualities of the coal and the ease with which it is burned. The proportion of water in this coal is greater than in any other coal in the State, and its effect is, of course, to reduce the heating value in proportion. Parr[2] has stated that the heat of vaporization at 212 degrees F. is 972 B. t. u. per pound of water. The average amount of moisture present in the Longwall coal is 16.18 per cent, that is, a pound of coal is 16.18 per cent moisture; so the heat required to vaporize the water would be 156 B. t. u., and the available B. t. u. would be reduced by that amount.

The average ash content of Illinois coals on a moisture-free basis is 10.07 per cent, and the sulphur 3.21 per cent. The Longwall coal has an average ash content (8.45 per cent) that is less than the average for the State, and a sulphur content (3.45 per cent) that is only slightly above the average. The amount of sulphur is usually regarded as an index of the clinkering properties because of its association with iron which tends to fuse with the siliceous matter of the ash to form clinkers.

Coal No. 5

The chemical character of coal No. 5 in the Longwall District has been determined by analysis of three samples during 1912, which are averaged in the following table:

Table 7.—*Analysis of coal No. 5 in the La Salle region (Average of three samples from one mine)*

Condition	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	B. t. u.	Unit coal
"As received"	14.76	34.26	41.33	9.65	3.38	10,672	14,397
"Dry Coal"	.....	40.19	48.49	11.32	3.97	12,543	.....

The B. t. u. "as received" (10,672) is below the district average for coal No. 2 (10,980). The coal in this condition is slightly superior to the Springfield-Peoria coals. The "dry-coal" value of 12,543 is surpassed by that of all the other coals of the State except No. 5 of the Springfield region and No. 6 of the Belleville region. The moisture content of the coal where sampled is higher than that of the southern Illinois coals of Saline, Williamson, and Franklin counties, but evidently does not exceed that of coal No. 2 of the Longwall District. Ash and sulphur are both rather high in this coal if the samples collected are representative. The coal contains about the same proportion of ash and sulphur as No. 5 coal in Fulton County, but a greater amount than coal No. 2 except possibly the coal in Grundy County. In general, coal No. 5 seems to be slightly inferior to coal No. 2 of this district and to the southern Illinois coals No. 5 and No. 6, but to be slightly superior to the Springfield coal. Only a few analyses of coal No. 5 in this dis-

[2]Parr, S. W., the chemical composition of Illinois coal: Ill. State Geol. Survey, Bull. No. 16, 1910, p. 227.

trict are available, however, and therefore reliable conclusions for the entire area cannot be drawn.

Coal No. 7

Like coal No. 5, coal No. 7 in this district has been only slightly tested. The average of three analyses collected in 1912 are tabulated below.

Table 8.—*Analysis of coal No. 7 in the Longwall District (Average of three samples from one mine)*

Condition	Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	B. t. u.	Unit coal
"As received"	13.56	37.80	40.81	7.77	3.68	10,348	14,685
"Dry coal"	.....	43.73	47.28	8.99	4.26	13,127	.....

Coal No. 7 according to this analysis resembles coal No. 5. The coal is possibly not quite so good as No. 5 at La Salle. It has less moisture but more ash and sulphur than coal No. 2, and more moisture than the southern Illinois coals.

CHAPTER IV—WORKING DATA

INTRODUCTION

In the pages that follow, statistics of the coal production for the Longwall District since 1870 are presented by counties. A rough estimate is attempted also of the amount of coal still available in the district. Livingston and Woodford counties, lying for the most part outside of the Longwall District, are not considered in the summaries, and only the eastern part of Marshall County is considered. The figures for Bureau County are more or less unsatisfactory, because the early production of that county was from the higher coals in its western part beyond the Longwall District.

The available statistics before 1886 are those of the census of 1870 and 1880, production for the intervening years being estimated about the same. This gives rise to some error, but, inasmuch as the productions of those earlier years were relatively small as compared with the production of later years or with the total productions, the error is not large. For the dates since 1886 the figures given in the volumes of Mineral Resources published by the U. S. Geological Survey are used. These statistics are based on the calendar year, January 1 to December 31. In comparing the figures given in the following pages with the statistics presented by the State Mining Board, it should be borne in mind that the latter figures are based on the fiscal year running from July 1 to June 30.

In estimating the amount of the coal under a given area a weight of 1770 tons per acre-foot is assumed, Illinois coal having an average specific gravity of about 1.3.

The list of mines operating in each county includes only the active shipping mines during the present year (1914) in so far as we have been able to eliminate the others. Only those mines that lie within the Longwall District are included in the lists. The map of the area (Plate III) shows the locations and the names of all these mines and also of several local and abandoned mines that are either mentioned in the text or are of geographical importance. Appended to the list of the mines is information showing the location of the mine in the section, the name of the mine, the elevation of the surface, depth to the coal, the elevation of the top of the coal bed, and the thickness of the coal. Where available additional information regarding the depth, elevation, and thickness of the other coals in the section is given.

As little space as possible is given in the earlier parts of this report to data from drill records and sections. Such material forms a very important source of our information in regard to the geology of the Illinois coal fields because of the widespread glacial drift and the scarcity of outcrops. Therefore, it seems advisable to present a few records and sections showing the characteristic conditions in the different counties covered by this report. Reference has been made to most of these records in the first parts of the bulletin, and each is selected as being representative of that part of the county in which it is located. In some areas there was little opportunity for selection, as only one or two holes of sufficient depth to give a valuable record, had been drilled. This is especially true in Livingston County and in eastern La Salle and western Grundy counties. The best records available from those localities, except for the region around Cardiff, are not highly accurate. All the records have been interpreted geologically, so that the depths and thicknesses of the different formations can be readily determined. Most of the records have not been presented hitherto, the special exception being the old La Salle County generalized section by Freeman. This has been changed in some particulars. The record of the drilling at Streator appeared in the 17th Annual Report of the U. S. Geological Survey Part II, p. 798, and the record for the drilling at Depue in Bulletin 24, State Geological Survey, p. 48.

The reliability of the records varies. Those from deep wells primarily for artesian water are all obtained by churn drills, and the determinations of depth for the different strata are more or less inaccurate, especially those from wells drilled 25 or 30 years ago. Their general agreement with more recent determinations, however, increases their value. The records of coal test-holes are all from diamond drills, and most of them are more reliable than the churn-drill records, at least for the depth and thickness of the coal. Except with reference to coal the reliability of the diamond-drill record depends largely on the willingness of the driller to make careful observation. Too often the additional expense of drilling with a diamond drill is wasted because the core is not safeguarded and carefully interpreted. Those who contemplate prospecting with a diamond drill are urged to give proper attention to the intermediate strata between the coal beds, and if possible to store the core until it can be seen by a competent geologist. Especially should these cautions be observed in a new field, or where the structure is uncertain. The diamond-drill records presented in the following pages are possibly open to much criticism, but they represent out best data.

Several of the logs are of a confidential nature and for that reason either the location of the hole is given only in a general way or the confidential information is obscured in some other manner.

BUREAU COUNTY

STATISTICS

COAL NO. 2

Area of the county in the Longwall District originally underlain by coal No. 2, in square miles	300
Area underlain by workable coal, in square miles	120
Amount of coal available in tons, average thickness, 36 inches	407,808,000

COAL NO. 5

Area of the county in the Longwall District originally underlain by coal No. 5, in square miles	102
Area underlain by workable coal, in square miles	50
Amount of coal available in tons, average thickness, 36 inches	169,920,000

COAL NO. 7

Area of the county in the Longwall District originally underlain by coal No. 7, in square miles	73
Area underlain by workable coal, in square miles	40
Amount of coal available in tons, average thickness, 36 inches	135,936,000

TOTALS FOR COUNTY

Total tonnage originally available	713,664,000
Total tonnage produced by Bureau County between 1870 and the end of 1913, approximately	34,368,057
Percentage already used of total supply	3.4
Number of shipping mines in the Longwall District of Bureau County in 1913	7

Table 9 shows the output of coal for Bureau County in 1870 and 1880 and annually from 1886 to 1913, inclusive. The third column is the relative production of Bureau County as compared with the total State tonnage.

TABLE 9.—*Production of coal in Bureau County since 1870, and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	32,339	1.2	1899	1,400,908	5.7
1880	65,890	1.07	1900	1,318,784	5.1
1886	140,562	1.2	1901	1,594,803	5.8
1887	429,580	3.5	1902	1,769,643	5.3
1888	635,097	4.4	1903	1,846,642	4.9
1889	493,730	4.1	1904	1,821,867	4.9
1890	372,701	2.4	1905	1,701,255	4.4
1891	701,064	4.5	1906	1,580,085	3.8
1892	943,496	5.3	1907	2,010,762	3.9
1893	1,143,270	5.7	1908	1,512,971	3.1
1894	878,937	5.1	1909	1,612,452	3.1
1895	834,541	4.7	1910	973,346	2.1
1896	1,042,304	5.5	1911	1,628,688	3.0
1897	1,145,312	5.5	1912	1,677,317	2.8
1898	865,892	4.6	1913	1,639,208	2.6

TABLE 10.—*Names and locations of the shipping mines operating in the Longwall District of Bureau County, and the depths, thicknesses, and elevations of the coal beds*

Name of company	Name of mine	Location ¼	¼	Sec.	T. N.	R. E.	Elevation shaft	Depth to coal	Elev. of coal	Thickness of coal	No. of bed
							Feet	*Feet*	*Feet*	*Inches*	
Illinois Third Vein Coal Co.	Ladd	NW	SW	10	16	11	653	465	188	42	2
Marquette Third Vein Coal Co.	Marquette	NW	SE	31	16	11	466	282	184	42	2
Spring Valley Coal Co.	No. 1	SW	SW	35	16	11	470	336	134	42	2
				..	..	..	..	161	309	66	5
				..	..	..	..	111	359	48	7
Spring Valley Coal Co.	No. 3	SE	NW	33	16	11	598	453	145	42	2
Spring Valley Coal Co.	No. 4 (Seatonville)	SE	SW	18	16	11	585	389	196	42	2
Spring Valley Coal Co.	No. 5 (Dalzell)	SW	SW	24	16	11	568	418	150	42	2
				..	..	..	..	246	322	42	5
St. Paul Coal Co.	Cherry	SW	NW	27	17	11	694	486	208	42	2
				..	..	..	..	316	378	62	5
				..	..	..	..	271	423	44	7

Drill Records and Geological Sections From Bureau County

In the following pages are given four logs showing the succession of strata in Bureau County. The first record is the log of a boring through the drift where it nearly reaches its known maximum thickness in the county; the second record shows the Pennsylvania series where it has an unusual thickness for this county; the third shows the strata underlying the "Coal Measures" down to the Galena-Trenton limestone; and the fourth records shows the strata in the area west of Bureau, where the Pottsville is unusually thick.

Partial log of a drilling for coal in the NW.¼ SW.¼ sec. 10, T. 17 N., R. 10 E., Bureau County, showing the character of the drift

(Geologic interpretations by the author)

Plate IV, No. 13

Description of Strata	Thickness *Feet*	Depth *Feet*
Recent and Pleistocene series—		
Upper drift—		
Clay, yellow	18	18
Clay, gray	55	73
Gravel	2	75
Clay, brown	53	128
Gravel in clay	2	130
Sand, muddy	11	141
Clay, brown, and rotten wood	9	150
Middle drift—		
Clay, brown	3	153
Clay, gray	2	155
Clay, green	4	159
Sand, fine	5	164
Sand	4	168
Clay, pebbly	4	172
Sand	2	174
Clay, pebbly	2	176
Gravel, coarse	4	180
Sand	2	182
Gravel	6	188
Clay, pebbly	4	192
Sand	2	194
Gravel	4	198
Clay, brown sandy	3	201
Clay, green	6	207
Clay, brown, sandy	8	215
Clay, green	9	224
Clay, sandy	9	233
Sand and gravel	12	245
Sand	2	247
Gravel, coarse	1	248
Clay, sandy	10	258
Clay, sandy, with rotton wood	8	266

	Thickness	Depth
Lower drift (?)—	*Feet*	*Feet*
Sand with rotten wood	14	280
Sand, coarse	16	296
Sand, fine	8	304
Sand	4	308
Gravel	3	311
Sand, red	24	335
Gravel	8½	343½

Record[1] *of the shaft of Mine No. 5, Spring Valley Coal Co., Dalzell, Illinois, showing the "Coal Measures" in Bureau County down to coal No. 2*

(Geologic interpretations by the author)

Plate IV, No. 8

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pleistocene and recent series—				
Surface	8	6	8	6
Pennsylvanian series—				
McLeansboro and Carbondale formations—				
Limestone	6	..	14	6
Fire clay	5	..	19	6
Shale, red ("paint rock")	5	..	24	6
Shale ("soapstone")	3	6	28	..
Limestone	1	6	29	6
Stone, black	1	..	30	6
Rock, gray	2	2	32	8
"Soapstone"	4	6	37	2
Coal	..	4	37	6
"Soapstone"	2	..	39	6
Slate, blue	9	..	48	6
Limestone	14	..	62	6
Fire clay	8	..	70	6
"Soapstone"	4	..	74	6
Limestone	8	..	82	6
Rock, black	4	..	86	6
Fire clay	6	..	92	6
"Soapstone"	4	..	96	6
"Slate", black	8	..	104	6
Shale, gray	1	9	106	3
"Slate" and "soapstone"	1	2	107	5
"Soapstone", gray	8	..	115	5
Limestone	6	..	121	5
"Slate", gray	8	..	129	5
Shale, blue	8	..	137	5
"Soapstone"	7	..	144	5
Stone, green	8	..	152	5
"Soapstone"	11	3	163	8

[1]Record from F. D. Chadwick, Engineer, Spring Valley Coal Co.

Description of Strata	Thickness		Depth	
Pleistocene and recent series—	*Ft.*	*In.*	*Ft.*	*In.*
Sandstone	11	..	174	8
"Slate," black	12	6	187	2
Shale, black	8	9	195	11
Coal No. 7	3	2	199	1
"Soapstone"	12	2	211	3
"Soapstone"	8	..	219	3
Sandstone	6	..	225	3
Shale	10	9	236	..
"Slate", black	7	7	243	7
Coal No. 5	3	6	247	1
Shale, gray	1	..	248	1
Shale ("soapstone")	3	..	251	1
Sandstone	7	..	258	1
Shale	8	..	266	1
Sandstone	19	..	285	1
Shale, ("soapstone")	21	..	306	1
Sandstone and shale	13	..	319	1
Sandstone	11	4	330	5
Shale	13	..	343	5
"Slate", black	3	..	346	5
Shale	5	..	351	5
Sandstone	6	..	357	5
"Slate", black	3	..	360	5
Fire clay	7	..	367	5
Sandstone	8	..	375	5
Shale	23	..	398	5
"Slate", black	3	..	401	5
Shale ("soapstone")	15	..	416	5
Coal No. 2	3	5	419	10

Log[2] of artesian well No. 2 owned by the Mineral Point Zinc Co., Depue, Illinois, showing the character of the strata from surface to within the Galena-Trenton limestone

(Geologic interpretations by the author)

Description of Strata	Thickness		Depth	
Recent and Pleistocene series—	*Ft.*	*In.*	*Ft.*	*In.*
Clay, soft yellow	..	..	13	..
Gravel, coarse	22	..	35	..
Gravel, coarser	2	..	37	..
Gravel and sand, fine	16	..	53	..
Sand, clear	11	..	64	..
Gravel and sand	14	..	78	..
Pennsylvanian series— ..				
Shale, light and soft	12	..	90	..
Shale, dark, soft	10	..	100	..

[2]Log presented by the Mineral Point Zinc Co. See also Udden, J. A., Some deep borings in Illinois: Ill. State Geol. Survey, Bull. 24, p. 1914.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Shale, light, medium hardness	32	..	132	..
Shale, dark, medium hardness	50	..	182	..
Coal, very lean	2	6	184	6
Shale, dark, medium hardness	20	6	205	..
Shale, dark, harder	11	..	216	..
Shale, light, medium hardness	11	..	227	..
Shale, dark, medium hardness	45	..	272	..
Shale, dark, harder	3	..	275	..
Shale, light, medium hardness	17	..	292	..
Shale, darker, medium hardness	8	..	300	..
Shale, light, medium hardness	45	..	345	..
Shale, dark, medium hardness	11	..	356	..
Coal, indications of	4	..	360	..
Shale, light	11	..	371	..
Silurian series—				
Niagaran formation—				
Limestone, white soft	31	..	402	..
Limestone, white soft	133	..	535	..
Limestone, brown, medium hardness	45	..	580	..
Limestone, white, medium hardness	52	..	632	..
Limestone, darker, soft	71	..	703	..
Limestone, white, medium and hard	147	..	850	..
Ordovician series—				
Maquoketa formation—				
Shale, light, hard	78	..	928	..
Shale and limestone	22	..	950	..
Shale, light, hard	70	..	1020	..
Galena and Plattville formations—				
Limestone, white, hard	45	..	1065	..
Limestone, white, medium hardness	213	..	1278	..

Log of drilling in the vicinity of Bureau, T. 15 N., R. 10 E.
Elevation of the surface 488 feet above sea level

(Geologic interpretations by the author)

Plate IV, No. 11

Description of Strata	Depth		Thickness	
	Ft.	*In.*	*Ft.*	*In.*
Pleistocene and recent series—				
Sand and gravel—				
Clay and quicksand	135	...	135	..
Pennsylvanian series—				
McLeansboro and Carbondale formation—				
Shale, gray	8	..	143	..
Shale, gray and black	4	..	147	..
Shale, black	3	..	150	..
Shale, gray	8	..	158	..
Limestone	2	..	160	..
Shale, blue	4	..	164	..
Limestone	1	..	165	..
Shale, blue	8	..	173	..
Shale, sandy, blue	6	..	179	..
Shale, blue and gray	28	..	207	..
Shale, black	3	..	210	..
Shale, gray	4	..	214	..
Coal No. 2	3	6	217	6
Pottsville formation—				
Fire clay	..	6	218	..
Shale, gray	15	..	233	..
Shale, sandy	2	..	235	..
Shale, gray	10	..	245	..
Shale, black	1	..	246	..
Shale, blue	2	..	249	..
Coal (No. 1 ?)	1	4	250	4
Shale, black and blue	13	8	264	..
Coal (No. 1 ?)	1	..	265	..
Shale	5	6	270	..
Shale, black, and coal	1	6	272	..
Shale, sandy	22	6	294	..
Shale, black	..	6	294	..
Shale, sandy	13	..	308	..
Silurian System (Devonian ?)—				
Niagaran formation—				
Limestone	5	..	315	..
Limestone, porous and wet	56	..	369	..

GRUNDY COUNTY

Statistics

COAL NO. 2

Area of the county originally underlain by coal No. 2, in square miles..	370
Area of available coal, in square miles..............................	300
Amount available in tons, average thickness 30 inches............	849,600,000

COAL NO. 5

Area of the county underlain by coal No. 5 in square miles, negligible	0

COAL NO. 7

Area of the county underlain by coal No. 7 in square miles..........	15
Amount available, negligible....................................	0

TOTALS FOR COUNTY

Total tonnage originally available................................	849,600,000
Total amount mined to date probably between 30,000,000 and 35,000,000 tons representing 40,000,000 tons in the ground.	
Percentage already used of total supply..........................	4.7
Number of shipping mines operating in Grundy County in 1913......	5

The shipping mines for Grundy County are listed in Table II, page 122.

Table 12 shows the output of coal of Grundy County in 1870 and 1880 and annually from 1886 to 1913 inclusive. The third column is the relative production of Bureau County as compared with the total State tonnage.

Table 12.—*Production of coal in Grundy County since 1870, and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	51,375	1.9	1899	1,257,092	5.1
1880	103,812	1.6	1900	1,315,688	5.1
1886	776,625	6.9	1901	1,269,741	4.6
1887	792,954	6.3	1902	1,414,479	4.2
1888	862,860	6.0	1903	1,392,427	3.7
1889	698,033	5.7	1904	1,334,422	3.6
1890	654,017	4.3	1905	1,310,892	3.4
1891	921,907	5.8	1906	1,162,019	2.8
1892	1,108,419	6.2	1907	1,327,321	2.5
1893	1,186,919	5.9	1908	1,091,442	2.2
1894	1,130,420	6.6	1909	1,114,101	2.1
1895	1,261,838	7.1	1910	600,281	1.3
1896	1,247,394	6.3	1911	776,800	1.4
1897	1,077,576	5.3	1912	540,787	.9
1898	796,249	4.2	1913	401,527	.6

Drill Records and Geological Sections From Grundy County

Two records of drilling in Grundy County are given. Both of these are of artesian wells and show the strata below the Pennsylvanian in some detail. The first record is from the southern part of the county where the Maquoketa shale underlies the "Coal Measures" and the other is from the northeast part of the county where the Galena-Trenton limestone lies under the Pennsylvanian strata.

Log[3] of well sunk on the farm of Ed Walker 2 miles south, 1 mile west of Mazon, Grundy County, Illinois, in the SW.¼ sec. 28, T. 31 N., R. 7 E.

(Geologic interpretations by the author)

Description of Strata		
Recent and Pleistocene series—	*Feet*	*Feet*
Soil	6	6
Clay, blue	160	166
Pennsylvanian series—		
Shale ("soapstone"), slate, black, 4 feet	40	206
Sandstone, blue	18	224
Shale ("soapstone")	34	258
Ordovician series—		
Maquoketa formation—		
Shale ("soapstone")	46	304
Slate, black	12	316
Shale (hardpan)	16	332
Galena-Trenton formation—		
Limestone, hard	216	548
Limestone, soft	60	608
Limestone, hard	12	620
St. Peter formation—		
Sandstone, white	87	707

[3]Well drilled and record furnished by C. W. Johnson, Seneca, Ill.

Record of an artesian well on the farm of Abe Hoge in the NW. ¼ NW. ¼ sec. 25, T. 34 N., R. 6 E., Grundy County. Well drilled in 1875

(Geologic interpretations by the author)

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pleistocene and recent series—				
Soil	5	..	5	..
Pennsylvanian series—				
Shale and sandstone	70	..	75	..
Ordovician system—				
Galena-Trenton—				
Limestone	200	..	275	..
Shale	2	..	277	..
St. Peter sandstone—				
Sandstone	200	..	477	..
"Cement" and shale	8	..	485	..
Sandstone (St. Peter ?)	60	..	545	..
Lower Magnesian formation—				
Limestone, white	185	..	730	..
Sandstone, white	93	..	823	..
Limestone, white	326	..	1149	..
Cambrian (?) system—				
Sandstone, red	166	..	1315	..
Limestone, gray	30	..	1345	..
Sandstone	317	..	1662	..
Limestone, gray	43	..	1705	..
Sandstone	163	6	1868	6

KANKAKEE COUNTY

Statistics

COAL NO. 2

Area of the county originally underlain by coal No. 2, in square miles	33
Area underlain by available coal, in square miles....................	30
Amount originally available in tons, average thickness 30 inches....	84,960,000

COAL NO. 5

Area of the county underlain by coal No. 5........................	0

COAL NO. 7

Area of the county underlain by coal No. 7, in square miles..........	9
Area of the county underlain by available coal in square miles (negligible)	0

TOTALS FOR COUNTY

Total tonnage originally available.................................. 84,960,000

Total tonnage mined approximately 2,000,000 representing 3,000,000 in the ground.

Percentage already mined.. 3.5

Table 13 shows the output of coal of Kankakee County in 1870 and 1880 and annually from 1886 to 1913 inclusive. The third column shows the relative production of the county as compared with the total tonnage of the State.

Table 13.—*Production of coal in Kankakee County since 1870, and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	.....	..	1899	129,262	.5
1880	.....	..	1900	109,129	.4
1886	73,678	.6	1901	67,195	.2
1887	97,000	.7	1902	48,439	.1
1888	82,000	.5	1903	74,226	.2
1889	67,380	.5	1904	.....	..
1890	62,460	.4	1905	700	.01
1891	90,908	.5	1906	39,499	.09
1892	92,158	.5	1907	26,704	.05
1893	88,700	.4	1908	30,994	.06
1894	57,883	.3	1909	25,000	.04
1895	83,513	.4	1910	......	..
1896	72,395	.3	1911	......	..
1897	180,683	.9	1912	......	..
1898	84,632	.4	1913	......	..

During 1913 there were no commercial mines operating in Kankakee County. There has been no production reported from this county since 1910.

TABLE 11.—*Names and locations of the shipping mines operating in Grundy County in 1913, and the depths, thicknesses, and elevations of the coal beds*

Name of company	Name of mine	Location ¼	Location ¼	Location Sec.	Location T. N.	Location R. E.	Elevation shaft	Depth to coal	Elev. of coal	Thickness of coal	No. of bed
							Feet	*Feet*	*Feet*	*Inches*	
Big Four Wilmington Coal Co.	No. 5	SE	NE	33	33	8	565 ap	114	451	36	2
Wilmington Star Coal Co.	No. 5	NW	SE	3	32	8	562 ap	69	493	36	2
Wilmington Star Coal Co.	No. 6	SE	NE	4	32	8	562 ap	126	436	40	2
Chicago, Wilmington & Vermilion Coal Co.	No. 3	Centre	..	23	31	8	590 ap	185	405	39	2
Chicago, Wilmington & Vermilion Coal Co.	No. 1	Centre NW	NE	14	31	8	580 ap	190	390	39	2

TABLE 14.—*Names and locations of the shipping mines operating in La Salle County in 1913, and the depths, thicknesses, and elevations of the coal beds*

Name of company	Name of mine	Location ¼	Location ¼	Location Sec.	Location T. N.	Location R. E.	Elevation shaft	Depth to coal	Elev. of coal	Thickness of coal	No. of bed
La Salle-Minonk field—							*Feet*	*Feet*	*Feet*	*Inches*	
Cahill Coal Co.	Cahill	SE	SW	16	33	1	463	347	116	42	2
La Salle County Carbon C. Co.	La Salle	SE	SE	15	33	1	495	395	100	42	2
La Salle County Carbon C. Co.	Union	NE	SE	16	33	1	503	386	117	48	2
La Salle County Carbon C. Co.	No. 5 (Cedar Point)	SW	SW	4	32	1	653	542	111	42	2
Oglesby Coal Co.	Oglesby	NE	SW	25	33	1	562	457	105	42	2
				..	..	..	..	300	262	60	5
				..	..	..	..	246	316	42	7
Rutland Coal Co.	Rutland	NE	SW	18	29	2	713 ap	517	196	36	2
Ottawa-Morris field—											
Gray & Jones Coal Co.		SE	NE	23	33	5	520 ap	125	395	36	2
Streator field—											
Chicago, Wilmington & Vermilion Coal Co.	No. 2	NW	SW	19	31	4	632	246	386	48	2
Chicago, Wilmington & Vermilion Coal Co.	No. 3	SW	NW	24	31	3	637	215	422	36	2
Harrison Coal Co.		SW	SW	31	31	4	625	..	..	..	2

LA SALLE COUNTY

Statistics

COAL NO. 2

Area of the county originally underlain by coal No. 2 in square miles	590
Area of available coal, in square miles..........................	300
Amount available in tons, average thickness, 36 inches............	1,019,520,000

COAL NO. 5

Area of the county originally underlain by coal No. 5, in square miles	200
Area of available coal, in square miles..........................	150
Amount available in tons, average thickness 36 inches.............	509,760,000

COAL NO. 7

Area of the county originally underlain by coal No. 7, in square miles	275
Area of available coal, in square miles..........................	225
Amount available in tons, average thickness 36 inches.............	764,640,000

TOTALS FOR COUNTY

Total available original tonnage..................................	2,293,920,000
Total already mined between 45,000,000 and 50,000,000 tons representing possibly 75,000,000,000 tons in the ground.	
Percentage already mined..	3.2

Table 15 shows the output of coal of La Salle County in 1870 and 1880 and annually from 1886 to 1913, inclusive. The third column shows the production of La Salle County as compared with the total State tonnage.

Table 15.—*Production of coal in La Salle County since 1870 and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	173,864	...	1899	2,015,304	8.2
1880	716,487	...	1900	2,022,462	7.8
1886	980,382	8.7	1901	1,751,758	6.4
1887	1,125,235	8.9	1902	1,846,236	5.6
1888	1,090,435	7.7	1903	1,882,589	5.0
1889	1,039,703	8.5	1904	1,542,518	4.2
1890	926,214	6.0	1905	1,772,988	4.6
1891	1,378,168	7.2	1906	1,467,672	3.5
1892	1,544,311	8.6	1907	1,667,990	3.2
1893	1,494,826	7.5	1908	1,557,173	3.2
1894	1,134,097	6.6	1909	1,686,391	3.3
1895	1,084,552	6.1	1910	1,178,885	2.5
1896	1,409,085	7.1	1911	1,610,470	3.0
1897	1,508,833	7.5	1912	1,537,591	2.5
1898	1,165,490	6.2	1913	1,564,459	2.5

Drill Records and Geological Sections From La Salle County

One geological section and three drilling records from La Salle County are presented in the following pages. The section is an adaptation of that presented by H. C. Freeman in his chapter on the Geology of La Salle County in Geological Survey of Illinois, Vol. III. Some additions have been made to this section both at the top and at the bottom. The first drilling record is that of the artesian well recently sunk by the Chicago Portland Cement Co. at Oglesby, which shows the character of the strata underlying the Pennsylvanian at La Salle. The second record is that of a deep well at Streator, and the third that of a deep well east of Marseilles, which penetrates strata older than any other well in the district.

Section of the Pennsylvanian series in La Salle County (after Freeman[4] with amendations and additions by the author)

Plate IV, No. 7

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pennsylvanian Series—				
McLeansboro formation—				
Peru clays—				
Shale, reddish to bluish laminated, containing limestone nodules at the top	8	..	8	..
Clay, yellowish	8	..	16	..
Clay, blue and shaly	8	..	24	..
Coal, soft and rotten	1	..	25	..
Clay, shaly, dark, olive colored, some ocherous	11	..	36	
Limestone, argillaceous, slightly shaly	1	8	37	8
Limestone, fossiliferous and argillaceous, solid	1	6	39	2
Shale, olive black, bituminous, grayish	1	8	40	10
Limestone, marly	2	8	43	6
Coal	1	..	44	6
Fire clay	..	3	44	9
Shale, blue and brown	15	3	60	..
Shale, blue	2	..	62	..
Shale, brown	8	..	70	..
La Salle limestone—				
Limestone, gray, 7-9	9	..	79	..
Shale, blue and grayish	3	6	81	6
Limestone, gray 7-12	12	6	93	6
Shale	5	..	98	6

[4]Freeman, H. C., La Salle County: Geological Survey of Illinois, Vol. III, Chap. XIV, pp. 264-266, 1868.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Limestone, blue	5	..	103	6
Black slate	7	..	110	6
Coal	..	6	111	..
Shale, blue	9	6	120	6
Limestone, blue	1	7	122	1
Shale, blue	9	3	131	4
Limestone, blue	3	5	134	9
Coal	..	1	134	10
Fire clay	..	3	135	1
Shale, blue	17	1	152	2
Limestone, gray	3	6	155	8
Shale, blue	9	6	165	2
Limestone, gray	2	6	167	8
Shale, blue	12	..	179	8
Limestone	2	..	181	8
Shale, blue	1	..	182	8
Shale, black, fissile	2	6	185	2
Shale, blue	13	..	198	2
Limestone, "marble-streaked". Lonsdale limestone (?)	4	..	202	2
Shale, blue	2	8	204	10
Limestone, blue	..	6	205	4
Shales, brownish red	2	..	207	4
Limestone	..	4	207	8
Shale, brownish red and brown	14	6	222	2
Sandstone	18	..	240	2
Shale, siliceous	19	..	259	2
Shale, slaty	11	4	270	6
Shale, black fissile	6	..	276	6
Coal No. 7, 4½ to 5 feet	4	6	281	..
Fire clay	6	..	287	..
Shale, dark colored, brownish	15	9	302	9
Sandstone	34	..	336	9
Carbondale formation—				
Shale, black, fissile	10	..	346	9
Coal No. 5, 3 and 9 feet, average 6 feet	6	..	352	9
Fire clay 2 to 4 feet	4	..	356	9
Shale, siliceous and argillaceous	30	..	386	9
Sandstone, 15′ increasing in the south and southwest part of the county to 35′ or more (Vermilionville sandstone)	35	..	421	9
Shale, blue, brown and black	9	..	430	9
Shale, black, fissile	2	..	432	9
Clay, black and greenish	1	..	433	9
Limestone, argillaceous	2	6	436	3
Shales, brown, and olive, with limestone	2	..	438	3

Description of Strata	Thickness		Depth	
	Ft.	In.	Ft.	In.
Limestone, black, argillaceous..	..	4	438	7
Shale, black, in places blocky and carbonaceous like cannel coal	2	9	441	4
Fire clay	5	..	446	4
Shale, blue	6	..	452	4
Limestone, argillaceous	1	..	453	4
Shale, with bands of nodules...	22	..	475	4
Shale, black	1	4	476	8
Sandstone, argillaceous and calcareous	1	9	478	5
Shale, dark, septaria at the bottom	8	6	486	11
Shale, black, fissile, with nodules, spherical and oval	2	9	489	8
Shale, gray "soapstone"	15	..	504	8
Coal No. 2	4	..	508	8
Pottsville formation—				
Fire clay, thin, sandy, 6 to 10 in.	..	10	509	6
Sandstone 3 to 6 feet	6	..	515	6
Shale,[5] dark gray	14	6	520	..
Shale, gray	110	..	640	..
Sandstone, white	40	..	680	..
Shale, light gray	36	..	716	..
Sandstone, gray, very fine	10	..	726	..
Sandstone, fine, argillaceous	10	..	736	..
Shale, bluish to greenish, sandy	25	..	761	..
Silurian system—				
Niagaran series—				
Dolomite	+	..	...	..

Log of an artesian well at Oglesby, Illinois

Well drilled in 1912 for the Chicago Portland Cement Co.

(Samples examined and interpreted by T. E. Savage)

Plate IV, No. 6

Description of Strata	Thickness Feet	Depth Feet
Pennsylvanian series—		
Shales, sandstones, limestones, coal	580	580
Silurian series—		
Niagaran formation—		
Limestone, gray, mixed with a small amount of drab shale and quartz sand	20	600
Limestone, gray, mixed with gray to dark shale	25	625
Limestone, gray, mixed with dark shale	5	630
Limestone, gray, slightly sandy, or sandstone, calcareous, fine	5	635

[5]Rest of the log from the record of artesian well drilled at Cedar Point.

Description of Strata	Thickness Feet	Depth Feet
Limestone, gray, finely grained	5	640
Limestone, gray, with a little sand	5	645
Limestone, gray, mixed with fragments of dark shale	5	650
Limestone, gray, mixed with dark colored fragments	30	680
Limestone, gray, fine grained	5	685
Limestone, gray, fine grained	5	690
Limestone, gray	10	700
Limestone, gray, with fragments of darker shale	5	705
Limestone, gray	5	710
Limestone, light gray, slightly dolomitic	5	715
Limestone, light gray, mixed with fragments of darker shale	10	725
Limestone, light gray	10	735
Limestone, gray, fine grained	5	740
Limestone, gray, very fine grained	75	815
Limestone, gray, subcrystalline, dolomitic	5	820
Limestone, light gray, fine grained	10	830
Limestone, white, fine grained	5	845
Limestone, gray, fine grained	5	850
Limestone, white, fine grained	15	865
Limestone, white, fine grained, subcrystalline, dolomitic	5	870
Dolomite, gray, fine grained	15	885
Dolomite, gray, subcrystalline	10	895
Dolomite, pink to red, subcrystalline	10	905
Dolomite, gray, subcrystalline	25	930
Dolomite, gray, subcrystalline, cherty	40	970
Dolomite, greenish gray	5	975
Dolomite, gray, subcrystalline	10	985
Ordovician series—		
Maquoketa formation—		
Shale, gray, calcareous	5	990
Limestone, gray, somewhat shaly	10	1000
Limestone, gray, subcrystalline	20	1020
Limestone, gray to bluish, subcrystalline (Maquoketa)	20	1040
Shale, gray, rather soft	20	1060
Dolomite, gray, subcrystalline, with fragments of shale and coal	25	1085
Dolomite, gray, subcrystalline	25	1110
Limestone, gray, subcrystalline	15	1125
Shale, gray, slightly calcareous	15	1140
Shale, gray, calcareous	10	1150
Galena-Trenton formation—		
Dolomite, gray, subcrystalline	35	1185
Limestone, gray, dolomitic	40	1225
Limestone, gray, subcrystalline, slightly dolomitic	85	1310

Description of Strata	Thickness Feet	Depth Feet
Limestone, gray, subcrystalline, non-dolomitic	55	1365
Limestone, gray, very fine grained	20	1485
Limestone, drab to gray, very fine grained	10	1495
Limestone, gray, fine grained	25	1520
Sandstone, gray (acid action slight)	10	1530
St. Peter sandstone—		
Sandstone, gray	5	1535
Sandstone, gray, round grains	10	1545
Sandstone, white, round grains	25	1570

Record of an artesian well boring at Streator, Illinois

Altitude of the surface at the well 623 feet above sea level

(Geologic interpretations by the author)

Description of Strata	Thickness Feet	Depth Feet
Pleistocene and recent series—		
Drift	30	30
Pennsylvanian series —		
Shales, limestone, sandstone, and coal	211	241
Ordovician system—		
Galena-Trenton formation—		
Limestone	203	444
St. Peter sandstone	225	669
Lower Magnesian formation—		
Limestone, white	90	759
Sandstone, white	133	892
Limestone, white	211	1103
Sandstone, white	37	1140
Limestone, dark gray	50	1190
Sandstone, fine, reddish (contained magnetic iron grains)	15	1205
Limestone, dark gray	13	1218
Sandstone, white and brown, mixed	1	1219
Limestone, gray	18	1237
Sandstone, white with some brown	168	1405
Cambrian system—		
Shale, blue	100	1505
Limestone, dark	73	1578
Sandstone, dirty brown	21	1599
Sandstone, limy and shaly	2	1601
Sandstone, buff	35	1636
Sandstone, white to buff	77	1713
Sandstone, white	25	1738
Sandstone, red (grains of magnetic iron)	10	1748
Sandstone, dirty brown (10% mag. iron)	17	1765
Lime, soft	60	1825
Shale, blue	13	1838
Shale, brown, sandy, hard	30	1868
Shale, blue, soft	20	1888

Shale, pink	95	1983
Sandstone, dark red	80	2063
Shale, blue	50	2113
Limestone, bluish	50	2163
Cambrian system—		
Potsdam sandstone—		
Sandstone, dark drab	15	2179
Sandstone, reddish buff	35	2213
Sandstone, white	283	2496

Reord of an artesian well drilled on the farm of R. N. Peddicord in the SW.¼ NE. ¼ sec. 32, T. 34 N., R. 5 E., near Marseilles, La Salle County

Elevation of the surface about 710 feet above sea level

(Geologic interpretations by the author)

Description of Strata	Thickness *Feet*	Depth *Feet*
Pleistocene and recent—		
Soil and drift	165	165
Pennsylvanian series—		
Shale (till ?)	9	174
Sandstone	8	182
Shale	10	192
Shale, hard	7	199
Sandstone (sand and gravel)	70	269
Shale	65	334
Ordovician system—		
Trenton limestone	25	359
St. Peter sandstone	195	554
Lower Magnesian formation—		
Sandstone, calciferous	50	604
Sandstone	45	649
Limestone	265	914
Sandstone, calciferous	25	939
Limestone	72	1011
Sandstone, hard	15	1026
Limestone	95	1121
Shale, blue	73	1194
Limestone	34	1228
Shale	3	1231
Limestone	20	1251
Cambrian system—		
Sandstone	15	1266
Sandstone, white	265	1531
Limestone	152	1683
Shale, blue	50	1733
Shale, red	5	1738
Shale, blue	60	1798
"Slate"	112	1910
Shale	9	1919
Limestone	20	1939
Sandstone	214	2153
Limestone	5	2158
Sandstone	125	2283

LIVINGSTON COUNTY

STATISTICS

No attempt has been made to estimate the amount of surface underlain by coal in that part of Livingston County lying within the Longwall District because of the very uncertain character of the distribution of the coal.

There were no commercial mines operating in 1913 in that part of Livingston County that lies in the Longwall District.

Table 16 shows the output of coal of Livingston County in 1870 and 1880 and annually from 1886 to 1913, inclusive. The third column shows the production of Livingston County as compared with the total tonnage of the State.

TABLE 16.—*Production of coal in Livingston County since 1870 and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	49,360	1.8	1899	129,484	.5
1880	118,230	1.9	1900	236,872	.9
1886	208,545	1.8	1901	307,267	1.1
1887	387,600	3.1	1902	395,083	1.1
1888	495,388	3.4	1903	122,773	.3
1889	383,965	3.1	1904	186,688	.5
1890	372,504	2.4	1905	284,984	.7
1891	404,491	2.5	1906	273,831	.6
1892	532,667	2.9	1907	303,497	.5
1893	542,516	2.7	1908	265,666	.5
1894	342,127	1.9	1909	246,031	.4
1895	267,133	1.5	1910	162,898	.3
1896	218,953	1.1	1911	89,423	.1
1897	145,206	.7	1912	65,774	.1
1898	122,087	.6	1913	63,877	.1

DRILL RECORDS FROM LIVINGSTON COUNTY

Two records of drilling from Livingston County are given. The first is that of a diamond drill record in the vicinity of Cardiff penetrating the underlying Silurian, the second is that of an artesian well at Dwight, showing Pennsylvanian, Silurian, and Ordovician strata.

Record of a diamond drill boring in the vicinity of Cardiff, Illinois

Elevation about 635 feet above sea level. Drilled in 1898

(Geologic interpretations by the author)

Plate IV, No. 3

Description of Strata	Thickness		Depth	
Pleistocene and recent series—	*Ft.*	*In.*	*Ft.*	*In.*
Soil, black	2	..	2	
Clay, sandy	5	..	7	..
Clay, pebbly	7	..	14	..
Clay, blue, full small gravel	46	..	60	..
Sand and gravel	3	..	63	..
Sand and gravel	2	..	65	..
Clay, blue	6	..	71	..
Gravel	2	..	73	..
Clay, hard, blue	9	..	82	..
Sand and gravel	1	..	83	..
Blue clay and gravel	2	..	85	..
Limestone boulder	..	5	85	5
Hardpan	1	7	87	..
Hardpan	8	..	95	..
Sand	3	..	98	..
Clay	1	..	99	..
Sand and gravel	13	..	112	..
Sand and gravel	15	..	127	..
Sand and gravel	4	..	131	..
Pennsylvanian series—				
McLeansboro and Carbondale formations—				
Shale, soft, blue	6	..	137	..
Shale, blue	1	6	138	6
Shale, black	2	..	140	6
Fire clay	6	..	146	6
Fire clay	6	6	153	..
Shale, black	2	6	155	6
Shale, soft, light	..	7	156	1
Coal	..	10	156	11
Shale, dark	1	1	158	..
Fire clay	9	..	167	..
Shale, sand	24	..	191	..
Shale, dark sand	10	..	201	..
Shale, gray	20	..	221	..
Shale, hard, dark blue	9	..	230	..
Coal, good	1	10	231	10
Shale, black, mixed with coal	1	2	233	..
Shale, light	..	4	233	4
Slate, black, mixed with coal	1	..	234	4
Fire clay	2	8	237	..
Shale, dark, soft	2	..	239	..
Shale, light, soft	3	..	242	..

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Limestone	2	..	244	..
Shale, dark	2	..	246	..
Coal stone (coal No. 2)	..	8	246	8
Shaly coal	..	4	247	..
Soapstone	..	8	247	8
Coal	..	2	247	10
Pottsville formation—				
Shale, brown	1	2	249	..
Limestone, sandy	2	..	251	..
Limestone	2	..	253	..
Sandstone	3	..	256	..
Rock, hard, dark	1	..	257	..
Shale, light	17	..	274	..
Shale, black	4	..	278	..
Coal	..	5	278	5
Shale, light sand	2	7	281	..
Limestone	2	..	283	..
Shale, light sand	1	..	284	..
Conglomerate	3	..	287	..
Silurian system—				
Niagara (?) limestone—				
Limestone	23	..	310	..

Record of an artesian well at Dwight, Ill., bored in 1912

Well owned by Leslie Keely

(Geologic interpretation by author)

Plate IV, No. 4

Description of Strata	Thickness *Feet*	Depth *Feet*
Pleistocene and recent series—		
Gravel, clay and sand	157	157
Pennsylvanian series—		
Shale	44	201
Limestone	3	204
Shale	36	240
Coal (and shale ?) coal No. 2 (?)	10	250
Shale	45	295
Silurian and Ordovician systems—		
Niagaran or Maquoketa limestone	53	348
Maquoketa shale	61	409
Galena-Trenton limestone	386	795
St. Peter formation—		
Sandstone	251	1046
Shale	9	1055
Lower Magnesian limestone	22	1077

MARSHALL COUNTY (EAST OF ILLINOIS RIVER)

Statistics

COAL NO. 2

Area of the county originally underlain by coal No. 2, in square miles	240
Area of available coal, in square miles	240
Amount available in tons, average thickness 36 inches	815,616,000

COAL NO. 5

Area of the county originally underlain by coal No. 5, in square miles	115
Area of available coal, in square miles	60
Amount available in tons, average thickness 36 inches	203,904,000

COAL NO. 7

Area of the county originally underlain by coal No. 7, in square miles	90
Area of available coal, in square miles	60
Amount of available coal in tons, average thickness, 36 inches	203,904,000

TOTALS FOR COUNTY

Total tonnage originally available	1,223,424,000
Total amount mined east of Illinois River is the product of two mines, practically negligible, less than	0.1

Table 17 shows the production of coal in Marshall County in 1870 and 1880 and annually from 1886 to 1913, inclusive. The third column shows the relative production of the county as compared with the total State tonnage.

Table 17—*Production of coal in Marshall County in 1870, and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	17,330	.6	1899	350,732	1.4
1880	9,536	.4	1900	396,087	1.5
1886	56,174	.5	1901	417,444	1.5
1887	73,928	.5	1902	448,186	1.3
1888	87,013	.6	1903	479,641	1.2
1889	59,784	.4	1904	467,724	1.2
1890	56,574	.3	1905	499,672	1.3
1891	65,219	.4	1906	418,904	1.0
1892	78,576	.4	1907	482,796	.9
1893	92,144	.4	1908	393,281	.8
1894	134,696	.7	1909	295,812	.5
1895	346,281	1.9	1910	267,447	.5
1896	389,429	1.9	1911	423,984	.7
1897	339,820	1.6	1912	449,660	.7
1898	286,365	1.5	1913	426,490	.6

Drill Records From Marshall County

Three drill records from Marshall County are presented. The first shows especially the Pottsville and some of the underlying strata

TABLE 18.—*Names and locations of the shipping mines operating in Marshall County in 1913, and the depths, thicknesses, and elevations of the coal beds*

Name of company	Name of mine	Location ¼	Location ¼	Location Sec.	Location T. N.	Location R. E.	Elevation shaft	Depth to coal	Elev. of coal	Thickness of coal	No. of bed
							Feet	*Feet*	*Feet*	*Inches*	
Wenona Coal Co.		..	NE	13	30	1	696 ap	567	129	40	2
		..	..	..	..	..	..	absent	..	..	5
		..	..	..	..	..	..	332	364	40	7
Toluca Coal Co.	No. 2	E½	NE	8	29	1	702 ap	507	195	34	2
		..	..	..	..	..	..	450	352 ap	24	5
		..	..	..	..	..	..	410	392 ap	38	7

TABLE 19.—*Names and locations of the shipping mines operating in Putnam County in 1913, and the depths, thicknesses, and elevations of the coal beds*

Name of company	Name of mine	Location ¼	Location ¼	Location Sec.	Location T. N.	Location R.W.	Elevation shaft	Depth to coal	Elev. of coal	Thickness of coal	No. of bed
							Feet	*Feet*	*Feet*	*Inches*	
B. F. Berry Coal Co.	Standard	SE	SE	11	32	1	680	497	183	36	2
		..	..	..	..	..	ap	321	359	6	5
		..	..	..	..	..	..	284	396	36	7
St. Paul Coal Co.	Granville	NW	NE	8	32	1	678	454	224	36	2
		..	..	..	..	..	..	260	418	36	5
		..	..	..	..	..	..	225	453	42	7

TABLE 22.—*Names and locations of the shipping mine operating in Woodford County in 1913, and the depths, thicknesses, and elevations of the coal beds*

Name of company	Name of mine	Location ¼	Location ¼	Location Sec.	Location T. N.	Location R. E.	Elevation shaft	Depth to coal	Elev. of coal	Thickness of coal	No. of bed
		..	..				Feet	*Feet*	*Feet*	*Inches*	
Minonk Coal Co.	No. 2	NE	NW	7	28	1	751 ap	537	214	36	2
		..	..	..	..	..	..	..	..	..	5
		..	..	..	..	..	..	370	381	2	7

on the east side of Illinois River opposite Henry. This is followed by the record of a boring near Toluca that shows the strata down to the fire clay below coal No. 2. The third shows the character of the strata near Sparland, down to a coal, possibly No. 2.

Record of drilling in T. 30 N., R. 2 W., Marshall County, across the Illinois River from Henry

Elevation of surface 458 feet above sea level.

Details above coal No. 2, obscured

(Geologic interpretation by the author)

Plate IV, No. 12

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Pleistocene and recent series—				
Soil and drift	73	..	73	..
Pennsylvanian series—				
Carbondale formation—				
Shale, limestone and coal (No. 2)	98	4	171	4
Pottsville formation—				
Fire clay	4	..	175	4
Shale, blue	25	8	201	..
Shale, sandy	9	..	210	..
Sandstone	23	..	233	..
Slate, black	..	6	233	6
Fire clay	2	..	235	6
Shale, light	15	6	251	..
Slate, black	..	8	251	8
Coal No. 1 (?)	..	10	252	6
Fire clay	1	6	254	..
Shale, light	5	..	259	..
Slate, dark	6	6	265	6
Slate, black	..	6	266	..
Fire clay	3	..	269	..
Shale, sandy	2	..	271	..
Sandstone	8	..	279	..
Devonian system (?)—				
Shale, brown	36	..	315	..
Shale, lime	2	..	317	..
Shale, brown	20	..	337	..
Shale blue	5	..	342	..
Shale, dark	4	..	346	..
Shale, blue	1	..	347	..
Silurian system (?)—				
Niagaran formation—				
Limestone, gray and hard	11	..	358	..
Limestone, soft	19	..	377	..
Shale, light	1	6	378	6
Limestone, hard	1	6	380	..

Log of diamond drilling for coal in the NE. ¼ NE. ¼ sec. 5, T. 29 N., R. 1 W. near Toluca, Marshall County, Illinois

Hole drilled in 1892

(Geologic interpretation by author)

Plate IV, No. 10

Description of Strata	Thickness		Depth	
Pleistocene and recent series—	*Ft.*	*In.*	*Ft.*	*In.*
Soil	1	..	...	..
Boulder clay	5	..	6	..
Gray	39	..	44	..
Sand (water)	12	..	51	..
Gravel (water)	5	..	56	..
Gravel and sand	3	..	59	..
Gray clay	3	..	62	..
Gravel and clay	5	..	67	..
Gravel and sand	12	..	79	..
Gravel and clay	12	..	91	..
Sand and gravel	8	..	99	..
Gravel and clay	15	..	114	..
Pennsylvanian series—				
McLeansboro and Carbondale formations—				
Shale, gray	16	..	130	..
Limestone	5	..	135	..
Clay, red	3	..	138	..
Shale, dark	4	..	142	..
Clay	3	..	145	..
Clay, red	3	..	148	..
Clay, gray	2	..	150	..
Clay, dark	3	..	153	..
Fire clay	4	..	157	..
Shale, dark	2	..	159	..
Shale, light	6	..	165	..
Clay, gray	2	..	167	..
Shale, light	4	..	171	..
Shale, gray	5	..	176	..
Shale, dark	2	..	178	..
Clay	1	..	179	..
Shale, light gray	10	6	189	6
Sandstone	48	6	238	..
Shale	15	..	253	..
Shale, dark	25	..	278	..
Slate, black	..	6	278	6
Shale	9	6	288	..
Coal No. 7	3	6	291	6
Clay	7	6	299	..
Sandstone	14	..	313	..
Shale	5	..	318	..
Limestone	3	..	321	..

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Slate, black	10	..	331	..
Coal No. 5	1	6	332	6
Clay	5	6	338	..
Sandstone	8	..	346	..
Shale, sand	15	..	361	..
Shale, sandy	34	..	395	..
Shale, dark	6	..	401	..
Shale, black	3	6	404	6
Limestone	3	6	408	..
Shale, dark	16	..	424	..
Shale, black	4	..	428	..
Coal	1	..	429	..
Fire clay	6	..	435	..
Shale, sandy	16	..	451	..
Shale, gray	2	..	453	..
Shale, dark	3	..	456	..
Sandstone	13	..	469	..
Shale (?)	32	6	501	6
Coal, No. 2	2	6	504	..
Clay	2	6	506	6

Record[6] of a drilling for coal near Sparland, Marshall County, in sec. 22 T. 12 N., R. 9 E.

Drilled, August, 1910

(Geologic interpretations by the author)

Description of Strata	Thickness		Depth	
Pleistocene and recent series—	*Ft.*	*In.*	*Ft.*	*In.*
Clay	17	..	17	..
Gravel, sand, and till	51	4	68	4
Gravel	4	..	72	4
Till, blue	3	..	75	4
Sand and gravel	5	..	80	4
Pennsylvanian series—				
McLeansboro formation—				
Shale, light gray	23	4	103	8
Sandstone	1	3	104	11
Shale, light gray	2	3	107	2
Shale, dark gray	15	1	122	3
Sandstone	2	..	124	3
Shale, dark gray	21	7	145	10
Shale, black	2	4	148	2
Coal, soft, dirty (No. 7 ?)	2	6	150	8
Clay	2	9	153	5
Shale, lime	2	10	156	3
Sandstone	7	1	163	4

[6]Log presented by the Barr Coal, Lumber, and Power Co.

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Sandshale, limy	9	..	172	4
Shale, dark	..	8	173	..
Carbondale and Pottsville formations—				
Coal No. 6	2	4	175	4
Clay	..	4	175	8
Coal	..	11	176	7
Clay	2	..	178	7
Shale, light	14	2	192	9
Shale, gray sand	14	.	206	9
Shale, light sand	3	2	210	11
Shale, dark gray	33	1	244	..
Shale, gray	..	6	244	6
Shale, black	2	.	246	6
Slate, black	2	9	249	3
Coal	..	5	249	8
Clay	1	6	251	2
Shale, light	3	1	254	3
Shale, dark	2	6	256	9
Shale, light	5	..	261	9
Sandstone	1	6	263	3
Shale, light gray	8	10	272	1
Sandstone	9	..	281	1
Shale, light gray	1	2	282	3
Sandstone	3	1	285	4
Shale, light	10	8	296	..
Sandstone	3	..	299	..
Shale, gray sand	4	2	303	2
Shale, gray	13	..	316	2
Shale, light gray	28	..	344	2
Shale, blue	10	..	354	2
Shale, light gray	6	10	361	..
Shale, black (No. 2 ?)	2	4	363	4
Shale, light gray	12	8	375	..
Shale, light	21	..	396	..

PUTNAM COUNTY

Statistics

COAL NO. 2	Approximate
Area of the county originally underlain by coal No. 2, in square miles	172
Area of available coal, in square miles	132
Amount available in tons, average thickness 36 inches	448,588,000

COAL NO. 5	
Area of the county originally underlain by coal No. 5, in square miles	84
Area of available coal, in square miles	40
Amount available in tons, average thickness 36 inches	135,936,000

COAL NO. 7	
Area of the county originally underlain by coal No. 7, in square miles	72
Area of available coal, in square miles	50
Amount available in tons, average thickness 36 inches	169,920,000

TOTALS FOR COUNTY	
Total tonnage originally available	754,444,000
Total tonnage already mined (1913)	3,441,414
Percentage already mined	.45

A list of mines for Putnam County is given in Table 19, page 134.

Table 20 shows the output of coal for Putnam County since the beginning of production in 1906 to 1913, inclusive. The third column shows the relative production of the county as compared with the total State tonnage.

TABLE 20.—*Production of coal in Putnam County since 1906, and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1906	156,928	.3	1910	364,882	.7
1907	362,858	.7	1911	772,976	1.4
1908	466,019	.9	1912	720,048	1.2
1909	597,703	1.1	1913	......	...

Drill Records From Putnam County

Only one record of drilling from Putnam County is given, the log of the B. F. Berry Coal Co. shaft, at Standard, Illinois.

Record of the shaft of the B. F. Berry Coal Co., Standard, Putnam County, Illinois

Surface elevation about 680 feet above sea level

(Geologic interpretations by the author)

Plate IV, No. 9

Description of Strata	Thickness		Depth	
	Ft.	*In.*	*Ft.*	*In.*
Previous drilling	84	..	84	..
Pleistocene and recent series—				
Clay, red	5	..	89	..
Clay, red mixed with sand	6	5	95	5
Silt, light green, mixed with sand	3	11	99	4
Pennsylvanian series—				
McLeansboro and Carbondale formations—				
Shale, lime	9	3	108	7
Limestone	5	..	113	7
Shale, black	4	..	117	7
Shale, gray	2	7½	120	2½
Fire clay with a little coal	3	9½	124	..
Fire clay	4	..	128	..
Fire clay and hardpan	2	6	130	6
Shale, lime, with streaks of hardpan	7	6	138	..
Shale, blue, and lime	2	..	140	..
Limestone and gray shale	3	..	143	..
Shale, gray	7	..	150	..
Shale, lime, and boulders	4	..	154	..
Shale, blue	4	..	158	..
Conglomerate	4	..	162	..
Shale, blue	2	8	164	8
Clay, hard	9	8	174	4
Shale, blue	4	..	178	4
Shale, gray	4	6	182	10
Shale, gray and blue	10	6	193	4
Fire clay	6	..	199	4
Shale, lime	2	..	201	4
Lime rock	2	..	203	4
Conglomerate	2	..	205	4
Shale	3	..	208	4
Clay, hard	8	6	216	10
Conglomerate	1	..	217	10
Sand-shale	13	10	231	8
Conglomerate	2	..	233	8

Description of Strata	Depth		Thickness	
	Ft.	*In.*	*Ft.*	*In.*
Sandstone	4	2	237	10
Sand and shale, blue	3	..	240	10
Sand-shale	12	6	253	4
Shale, light	9	7	262	11
Shale, gray	2	1	265	..
Shale, dark	19	..	284	..
Coal No. 7	3	..	287	..
Fire clay	11	4	298	4
Sand-shale	15	8	314	..
Limestone, blue shale, and slate, black	7	4	321	4
Coal No. 5	..	6	321	10
Fire clay	3	4	325	2
Sandstone	12	4	337	6
Sand-shale	16	6	354	..
Sand-shale mixed with gray	34	10	388	10
Shale, gray	12	4	401	2
Shale, blue	3	10	405	..
Shale, black	9	..	414	..
Shale, light	4	10	418	10
Shale, dark, and ironstone	3	..	421	10
Hardstone, mixed with lime	4	..	425	10
Shale, dark	4	2	430	..
Shale, lime, and boulders	4	..	434	..
Fire clay and boulders	2	..	436	..
Sandstone	6	8	442	8
Shale, sand	12	4	455	..
Shale, gray	12	3	467	3
Shale, gray with sulphur balls	8	9	476	..
Shale, black, and "niggerheads"	5	..	481	..
Shale, light	16	7¾	497	7¾
Coal, No. 2	3	..	500	7¾
Pottsville formation—				
Fire clay	1	3	501	10¾
Sandstone	4	..	505	10¾
"Soapstone"	10	..	515	10¾

WILL COUNTY

Statistics (Approximate)

COAL NO. 2

Area of the county originally underlain by coal No. 2, in square miles	27
Area of available coal, in square miles	20
Amount available in tons, average thickness 30 inches	56,640,000

COAL NO. 5

Area of the county underlain by coal No. 5, in square miles	0

COAL NO. 7

Area of the county underlain by coal No. 7, in square miles	0

TOTALS FOR COUNTY

Total tonnage originally available	56,640,000
Total tonnage mined between 7,000,000 and 8,000,000, representing 10,000,000 tons in the ground.	
Percentage already mined	17.6

The coal produced in Will County during 1913 was from three small mines operated by the following companies:

Murphy, Linsky & Kasher Coal Co. (Murphy mine).

Oswald & Young (No. 1 mine).

Wilmington Coal Mining and Manufacturing Co. (Diamond No. 6).

Table 21 shows the output of coal of Will County in 1870 and 1880 and annually from 1886 to 1913 inclusive. The third column shows the relative production of the county as compared with the total State tonnage.

Table 21.—*Production of coal in Will County since 1870, and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	228,000	8.6	1899	42,275	.1
1880	984,908	16.1	1900	55,323	.2
1886	287,512	2.5	1901	56,646	.2
1887	284,040	2.2	1902	40,792	.1
1888	347,105	2.4	1903	49,240	.1
1889	342,372	2.8	1904	76,538	.2
1890	288,131	1.8	1905	137,957	.3
1891	233,613	1.5	1906	154,955	.3
1892	113,847	.6	1907	183,985	.3
1893	81,725	.4	1908	162,239	.3
1894	20,717	.1	1909	162,307	.3
1895	38,675	.2	1910	124,652	.2
1896	86,950	.4	1911	178,397	.3
1897	25,682	.2	1912	130,806	.2
1898	40,904	.2	1913	149,926	.2

Drill Records From Will County

The record of the well at Braidwood is selected as representative of the Will County section.

Record of artesian well at Braidwood, Will County, Illinois, drilled in 1889
(Geologic interpretations in part by the author)

Plate IV, No. 1

Description of Strata	Thickness		Depth.	
Pleistocene and recent series—	*Ft.*	*In.*	*Ft.*	*In.*
Sand	15	..	15	..
Clay, (hardpan)	6	6	21	6
Clay and boulders	12(?)	6	34	..
Pennsylvanian series—				
Carbondale formation—				
Shale, clay	3	..	37	..
Sandstone	10	..	47	..
Shale (slate)	4	..	51	..
Shale	29	..	80	..
Coal No. 2	2	9	82	9
Pottsville formation—				
Fire clay	3	3	86	..
Sandstone	6	..	92	..
Shale ("slate")	1	..	93	..
Coal	..	6	93	6
Shale	13	6	107	..
Sandstone	8	6	115	6
Shale, bituminous	6	..	116	6
Fire clay	2	..	118	..
Fire clay, nodular	2	..	120	..
Shale	3	..	123	..
Coal	..	6	123	6
Fire clay	1	6	125	..
Shale, sandy	12	..	140	..
Silurian series—				
Niagaran (?) limestone	46	..	186	..
Ordovician series—				
Cincinnatian limestone and shale—				
Shale	2	..	188	..
Limestone	35	..	223	..
Limestone and shale	10	..	233	..
Shale, gray	20	..	253	..
Shale, hard and soft	15	..	268	..
Galena-Trenton limestone	377	..	645	..
St. Peter sandstone	208	..	853	..
Lower Magnesian limestone—				
Limestone	5	..	858	..
Sandstone	2	..	860	..
Limestone	40	..	900	..

WOODFORD COUNTY

The shipping mine of Woodford County is given in Table 22, page 134.

Table 23 shows the output of coal in Woodford County in 1870 and 1880 and annually from 1887 to 1913, inclusive. The third column shows the relative production of the county as compared with the total State tonnage.

TABLE 23.—*Production of coal in Woodford County since 1870 and a comparison with the total output of the State*

Calendar Year	Quantity Tons	Percentage of State Production	Calendar Year	Quantity Tons	Percentage of State Production
1870	4,000	.1	1899	179,024	.7
1880	175,000	2.8	1900	192,135	.7
1886	......	...	1901	142,219	.5
1887	122,445	.9	1902	101,567	.3
1888	154,500	1.1	1903	123,501	.3
1889	169,600	1.4	1904	105,185	.2
1890	129,724	.8	1905	348,707	.9
1891	140,820	.7	1906	717,566	1.7
1892	158,041	.8	1907	158,742	.3
1893	180,131	.9	1908	174,031	.3
1894	156,665	.9	1909	194,410	.3
1895	131,557	.7	1910	125,823	.2
1896	162,790	.8	1911	164,001	.3
1897	148,829	.7	1912	185,499	.3
1898	145,840	.7	1913	......	...

SUMMARY FOR LONGWALL DISTRICT

Table 24 presents a summary of preceding pages and shows the estimated original coal and the total extraction and wastage.

TABLE 24.—*Coal supplies in the counties of the Longwall District and the total amount of coal mined to date*

	Original Coal supply *Tons*	Coal mined or made unavailable by mining *Tons*
Bureau	713,664,000	25,000,000
Grundy	849,600,000	40,000,000
Kankakee	84,960,000	3,000,000
La Salle	2,293,920,000	75,000,000
Livingston	....	....
Marshall	1,223,424,000	7,000,000
Putnam	754,444,000	4,000,000
Will	56,640,000	8,000,000
Woodford	....	....
Total	5,976,652,000	
Total (2.7% of supply)		162,000,000

Total production of State (1913), 61,618,744 tons.

INDEX

PUBLICATIONS OF THE ILLINOIS COAL MINING INVESTIGATIONS

Bulletin 1. Preliminary Report on Organization and Method of Investigations, 1913.

Bulletin 2. Coal Mining Practice in District VIII (Danville), by S. O. Andros, 1914.

Bulletin 3. A Chemical Study of Illinois Coals, by Prof. S. W. Parr, (in press).

Bulletin 4. Coal Mining Practice in District VII (Mines in bed 6 in Bond, Clinton, Christian, Macoupin, Madison, Marion, Montgomery, Moultrie, Perry, Randolph, St. Clair, Sangamon, Shelby, and Washington counties), by S. O. Andros, 1914.

Bulletin 5. Coal Mining Practice in District I (Longwall), by S. O. Andros, 1914.

Bulletin 6. Coal Mining Practice in District V (Mines in bed 5 in Saline and Gallatin counties), by S. O. Andros, 1914.

Bulletin 7. Coal Mining Practice in District II (Mines in bed 2 in Jackson county), by S. O. Andros, 1914.

Bulletin 8. Coal Mining Practice in District VI (Mines in bed 6 in Franklin, Jackson, Perry, and Williamson counties), by S. O. Andros, 1914.

Bulletin 9. Coal Mining Practice in District III (Mines in beds 1 and 2 in Brown, Calhoun, Cass, Fulton, Greene, Hancock, Henry, Jersey, Knox, McDonough, Mercer, Morgan, Rock Island, Schuyler, Scott, and Warren Counties), by S. O. Andros, 1915.

Bulletin 10. Coal Resources of District I (Longwall), by G. H. Cady, 1915.

Bulletin 11. Coal Resources of District VII (Counties listed in Bulletin 4), by Fred H. Kay, 1915.

*Bulletin 72. U. S. Bureau of Mines, Occurrence of Explosive Gases in Coal Mines, by N. H. Darton, 1915.

*Bulletin 83. U. S. Bureau of Mines, The Humidity of Mine Air, with Especial Reference to Coal Mines in Illinois, by R. Y. Williams, 1914.

* Copies of these bulletins may be obtained by addressing the Director, U. S. Bureau of Mines, Washington, D. C.