
GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

ON THE GEOLOGY

OF THE

REGION ADJACENT TO THE EASTERN BORDER

OF THE

WESTERN COAL FIELD,

FROM THE

LOUISVILLE, PADUCAH AND SOUTHWESTERN
RAILWAY TO THE OHIO RIVER.

BY P. N. MOORE.

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ON THE GEOLOGY OF THE REGION ADJACENT TO
THE EASTERN BORDER OF THE WESTERN
COAL FIELD, FROM THE LOUISVILLE,
PADUCAH AND SOUTHWESTERN
RAILWAY TO THE OHIO RIVER.

The work of tracing the eastern outline of the western coal field was performed by a party in charge of Mr. S. S. Lyon, in the year 1859, while the former Geological Survey of the State, under direction of Dr. D. D. Owen, was in progress, and a report was published in volume IV, first series Kentucky Geological Reports. A skeleton map, which was constructed at the same time, has, however, never been published, but has remained in the archives of the Survey to the present time.

The work by this party was, however, from necessity, done in so rapid a manner that it could not be detailed. Mr. Lyon himself states (vol. IV, p. 586) that a large portion of the margin of the coal measures was only approximately determined.

The topographical work was confined to mapping some of the principal roads near the coal field margin—some inside of it and some beyond. The geological observations seem likewise not to have extended over an area of any great width, nor to have embraced the country between the mapped roads.

For these reasons the Director of the Survey ordered the re-survey of this area during the past season, extending the examinations to the west within the coal field, in most cases beyond the point where the Sub-carboniferous rocks disappear beneath the drainage, and far enough to obtain some knowledge of the position and character of the coals which are near the margin.

The topographical party under Mr. W. B. Page extended its operations as far to the west as the geological examina-

tions, mapping all the roads and principal streams. It is owing to their work that the outline can be delineated with any detail.

In speaking of the outline of the coal field in the following pages, the word will be used to mean the line where the coal-measure rocks first present anything like a connected body, or beyond which they are the prevailing rocks.

The term must, of necessity, be used somewhat arbitrarily, for the edge of the coal field presents an extremely broken and irregular outline, being cut through by nearly every stream and ravine, so as frequently to isolate large areas, or leave them as tongues or outliers extending out over the Sub-carboniferous rocks.

The outline or margin of the coal field, from the point south of Leitchfield, Grayson county, whence it was followed south to Green river, in the report, part I, volume II, second series Kentucky Geological Reports, turns towards the west, crosses the Louisville, Paducah and Southwestern Railroad about three miles from Leitchfield; thence runs nearly parallel to the railroad, and not more than a half mile north of it, until a short distance beyond Caneyville, where it turns to the north. The Chester limestone is seen in the road about one half mile north of Caneyville, while a short distance beyond nothing but Sub-carboniferous rocks occur.

From Caneyville to the Falls of Rough creek the outline runs a little to the west of the Bowling Green and Cloverport road. Its distance from this road varies somewhat, but it does not cross the road, unless, perhaps, at one place on a high dividing ridge, and this even is not certain.

It is broken by the valley of Short creek, which runs entirely in Sub-carboniferous rocks from head to mouth, and again by Rough creek.

The triangular area between this road, Short and Rough creeks, is entirely detached and surrounded by Sub-carboniferous rocks; but it occurs in the direction of the principal line of outcrop, and, by position, belongs properly to the main body of the coal measures.

Near the Falls of Rough the coal measures cap the ridge to the west of, and but a short distance from, Pleasant run. Crossing Rough creek, they are first found in the Cloverport road, capping the ridge west of Rock Lick creek. From here the outline still follows closely the Cloverport road, crossing it occasionally, and often cut by the streams which the road crosses, until within a few miles of Cloverport, where it turns toward the northwest, crosses Tar Fork and a number of its branches, and reaches the Ohio river between Hawesville and Cloverport.

There are a number of outliers a considerable distance to the east of the margin as just described, but they are mostly entirely isolated, and of small extent. They usually consist of detached knobs or high dividing ridges between streams, capped with a small thickness of wasted coal-measure rocks. They do not, so far as known, carry any coal, although a few of them apparently rise high enough to hold the lowest coal; but it is probable that, even if present, the coal will be found badly weathered and worthless, owing to the slight covering above it, and the effects of exposure on all sides.

Such outliers occur on the ridge between the waters of Tewells and Long Lick creeks, between the branches of Rough creek and Clover Fork, at Sand or Pine Knob, near Eskridge's Ferry, and also south of Rough creek, between that stream and Short creek.

The Sub-carboniferous rocks are found above drainage much further to the west than the outline above described. Nearly all of the principal streams shown in the accompanying map, by Mr. Page, except in the central and western portion of Hancock county, cut their channels in these rocks.

Near the Ohio river the Chester limestone is last seen immediately below, and in contact with, the Conglomerate sandstone, about one mile above Hawesville. Indian creek runs in Sub-carboniferous rocks from head to mouth; but Lead creek, which is next below, and not far distant, does not cut below the Conglomerate. The different branches of Tar Fork all run in the Sub-carboniferous rocks.

On Sulphur Fork of Blackford creek, at Patesville, it is stated that the Chester limestone was found a few feet below the bed of the creek, when digging a water-pit for a saw-mill; elsewhere it is not seen on this stream. It is found in all the head branches of Panther creek, and extends in the main stream nearly a mile west of the Cloverport and Fordsville road before it passes below the drainage.

Crossing the divide to the waters of Adams' Fork, a branch of Rough creek, the Chester limestone is found near the heads of the main branches, except Middle Fork, which does not cut it until within about one mile and a half of Fordsville, where the top of it is exposed. It is also seen just below Fordsville, but disappears again, and is not exposed for some distance.

No exposures of the Chester limestone have been found west of Fordsville and Middle Fork.

After its junction with the Middle Fork, the main branch of Adams' Fork runs in this limestone, to its mouth.

The branches of Rough creek from the north, and those emptying above Adams' Fork, all run in the Chester rocks nearly from head to mouth.

Rough creek itself has cut a wide valley in the Sub-carboniferous rocks for its whole length, in the region under discussion. This is owing to an anticlinal or uplift in the strata, by which the Chester rocks have been raised to the present surface far inside of the coal field. The axis of the anticlinal is followed pretty closely by Rough creek, within the area covered by this report, although occasionally the creek runs in the edge of the coal measures at one side of the Chester rocks exposed. This is due to the fact that the disturbed and folded rocks are most readily worn away by the action of running water, and thus afford the easiest channel for a stream to flow along. The anticlinal, therefore, has probably been the agent which has directed Rough creek into its present course.

This anticlinal is the most important geological disturbance of this region. It completely divides the region under discussion into two parts, as the coal-measure rocks at no point

extend across it. The rocks dip away from Rough creek in both directions, sometimes quite regularly and sometimes broken by small faults.

The writer is informed by Mr. Norwood that, shortly after passing to the west of this region, Rough creek leaves the line of the anticlinal, which extends westward through Ohio county some distance to the north of Rough creek, and finally crosses Green river into Webster county. For the particulars of its course the reader is referred to the report of Mr. Norwood upon the geology of Ohio county. Enough has been stated here to show that this is a geological feature of more than local interest, if not the most important disturbance in the western coal field.

South of Rough creek all of its branches, as far west as, and including, Caney creek, have cut down to the Chester rocks. Near the railroad, on Caney creek, the rocks are so covered that it is difficult to tell at what geological level it does run, but it is not far above the Chester limestone, if any; and before it reaches its mouth, Caney creek has cut nearly one hundred feet down into the Chester rocks. Along the railroad, as shown by Mr. Norwood's section in volume I, second series Kentucky Geological Reports, the Chester limestone is found a few feet above the creek, until beyond Caneyville.

Between the railroad and Rough creek, Caney creek and the Bowling Green and Cloverport road, the coal measures cap the ridge, and toward the railroad cover most of the surface; but on the Rough creek slope they extend only over a small area on the tops of the ridges.

GENERAL GEOLOGY.

In the region under consideration there are exposed only the rocks of the Carboniferous system, including:

Carboniferous,	-	-	{	Coal Measures.
Sub-carboniferous,	-	-	{	Chester Group.
				St. Louis Group.

The characteristics of these different divisions have been so fully and recently described in the reports of the Geological Survey, that it is not considered necessary here to repeat them. They will be discussed here in an ascending order.

THE ST. LOUIS GROUP.

The limestone of this group, called by Mr. Lyon, in his report (volume IV, first series Kentucky Geological Reports), "the cavernous member of the Sub-carboniferous limestone," is exposed only in the eastern portion of the region under discussion, where it is cut into by the streams, but not to any great depth. It is seen on Little Clifty creek and on Rough creek, near the mouth of Little Clifty. It also probably occurs on Short creek, its presence being indicated by the topography; but the region has not yet been examined in sufficient detail to determine with certainty if this be the case.

North of Rough creek, and as far west as the Falls of Rough, most of the streams and their branches run in the upper part of the St. Louis limestone. This is also true of the creeks flowing into the Ohio river as far west as Clover and Tar Forks, which empty at Cloverport.

In none of these cases, as already stated, is a considerable thickness of the rocks of the St. Louis Group exposed, so that it is practically of small importance. But a short distance to the east, in Breckinridge county, the St. Louis limestone is the most prominent member of the rock series.

The thickness exposed in the region covered by this report is so small, that, from natural sections alone, little could be known in regard to this limestone; but in the vicinity of Cloverport, during the oil excitement some twelve years since, numerous wells were sunk in search of oil, which penetrated deep into the St. Louis rocks. Of these, unfortunately, the records of only two have been obtained. It has been impossible, though diligent efforts have been made, to find any trace of the others, as the individuals who sank the wells and kept the records, if any were taken, have left the

region, and no trace of them can be found. This is greatly to be regretted, as the records of all these wells would furnish valuable information in regard to the stratification below the present drainage surface of the country, which can be obtained in no other way.

Sections obtained by boring, unless made for the express purpose of ascertaining the character of the rocks, are always liable to a certain amount of error from the difficulty of recognizing the material passed through by the drill. This liability to error is greatest where passing through thin strata, as the line of transition from one to the other is not easily determined, owing to the mixing of the pulverized material by the drill. When these allowances are made, however, these records are of great value.

The two following sections are the records of wells sunk by the Breckinridge Petroleum Company, and were kindly furnished for publication by Mr. E. D. Tyler, of Louisville. They were both sunk in Breckinridge county, on the waters of Tar Fork, and the starting point in both cases was near the base of the Chester Group. The records are given as reported, although in some cases slightly altered in phraseology, and abbreviated. The remarks in parentheses are by the writer:

THE NEWTON WELL, HONEY LOCUST BRANCH OF TAR FORK.

	Thickness, feet.	Total depth.
Soil	7	7
Sandstone	2	9
Limestone	10	19
Shales and thin sandstones	30	49
Sandstone	24	73
Limestone	9	82
"Slate and soapstone" (shale)	41	123
Limestone	33	156
"Slate and soapstone" (shale)	23	179
Limestone	15	194
Sandstone	3	197

It is stated by Mr. J. T. Goff, of Cloverport, that this well was afterwards sunk to a total depth of nearly 300 feet; but no records of it have been found, other than as above given.

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THE GABBERT WELL, TAR FORK, ABOUT ONE MILE BELOW TAR
SPRINGS.

	Thickness, feet.	Total depth.
Limestone	10	10
Shale	3	13
Limestone	42	55
Shale	50	105
Limestone	37	142
"Red sandstone"	10	152
Hard shale	15	167
Limestone	23	190
Hard shale	15	205
Limestone	30	235
Shale	10	245
Limestone	87	332
Sandstone	2	334
Limestone	21	355
Shale	5	360
Limestone	11	371
Shale	7	378
Limestone	13	391
Shale	1	392
Limestone	4	396
Shale	3	399
Limestone	91	490
"Hard grey granite?" (This is evidently a mistake. It is prob- ably a stratum of flinty limestone)	10	500
Limestone	38	538
"Limestone and sandstone"	47	585
Limestone	16	601
Shale	6	607
Sandstone	7	614
Limestone	3	617
Sandstone	7	624
Limestone	6	630
Sandstone	2	632
Limestone	5	637
Sandstone	2	639
Limestone	38	677
Sandstone	1	678
Limestone	7	685
Sandstone	3	688
Limestone	13	701
Shale	27	728
Limestone	9	737
Shale	30	767

In the above record there is evidently a serious mistake in the stratum recorded as "granite," for there is certainly no such rock in this region. It is probable that it is a stratum of unusually hard limestone, which the person in charge of the well dignified with the name of granite.

If the above records are to be depended upon, they prove that the St. Louis Group, instead of showing massive, homo-

geneous character, which it possesses further south and south-east, is here formed of limestones interstratified with numerous thin beds of shale and sandstone, and nowhere shows an unbroken limestone of more than 150 feet thickness. For the present, and until this group can be studied in more detail in Breckinridge and Meade counties, to the east of this region, this conclusion must be regarded as tentative, as it indicates a marked change from the character of the group as known at other places. Dr. Owen, however, in volume II, first series Kentucky Geological Reports, page 92, calls attention to this same feature in Breckinridge and Meade counties.

THE CHESTER GROUP.

This group retains throughout the characteristics described in the previous reports of the Geological Survey by Mr. Norwood and the writer.

It consists of sandstones, limestones, shales, and marly shales in great variety, both as to thickness and order or position. The strata which compose it are very changeable and uncertain in their occurrence—no one stratum, except perhaps the Big Clifty sandstone, which marks the base of the series, seeming to be persistent over any wide area.

For this reason no general section of the members of this group can be given which will be more than locally accurate, and none has been attempted. In a general way the rocks retain the character shown in the sections of Mr. Norwood's report along the railroad, and in the sections for the region south of Leitchfield and Grayson Springs. (Part II, volume II, second series Kentucky Geological Reports.) There is a great prevalence, especially toward the upper part of the series, of thin-bedded and shaly rocks, differing from the more massive character which the members of this group present further south, on Green river.

In the southern part of this region, along the railroad and for a short distance to the north, the sections above referred to, which have heretofore been published, illustrate the character of the stratification. The shales, marly shales, and

marls are the most abundant rocks. Further north, in the valley of Rough creek, on both sides of that stream, these rocks are not so conspicuous, and where present are thin; and we have a greater prevalence of thin limestones and sandstones.

Still further north, in the immediate drainage of the Ohio river, the shales and marly shales are again found abundant, and of considerable thickness; in fact, they are the most conspicuous members of the series in this vicinity.

The following section, near the Bowling Green road, just after the crossing of Tar Fork south of Cloverport, is fairly typical of the upper portion of the Chester Group, and shows the great abundance of these shaly rocks:

SECTION.

Top of hill.	
Covered space; wasted coal-measure sandstones?	50 feet.
Limestone	25 "
Shale	15 "
Thin limestone	1 "
Shale, upper part marly.	8 "
Limestone, very silicious	10 "
Dark shale	11 "
Limestone	4 "
Shale	6 "
Green marly shale	14 "
Shale	25 "
Covered space	20 "
Sandstone	25 "
Covered (probably sandstone)	15 "
Limestone.	25 "
Covered, limestone seen at intervals	45 "
Red and green marly shale	4 "
Covered space	25 "
Tar Fork.	

High water mark of the Ohio river will probably come within a few feet of the last exposure of marly shale in the above section.

The heavy sandstone at the base of the Chester series, which has been called by Mr. Norwood the Big Clifty sandstone, is persistent throughout this region; more so apparently than any other stratum of the group. It is found from 40 to 100 feet in thickness, and is generally exposed wherever the streams have cut into the lower part of the series. It is called by Mr. Lyon the "Lower Tar Spring Sandstone." It is noted for the great number of tar springs which issue

from its base. It is the sandstone which occurs in such imposing exposures at the Tar Springs south of Cloverport, in Breckinridge county. It is also the sandstone which is seen on the Ohio river below Cloverport. It is here an excellent building stone, and has, in former times, been extensively quarried and shipped away. Part of the rock for the locks on Green river was obtained here.

The great prevalence of tar springs issuing from this sandstone gave encouragement to the idea that oil would be found in this region in large quantities; but beyond this single fact there was nothing which points to any such conclusion.

THE LEITCHFIELD MARLS.

The green and red marly shales, containing a considerable per centage of potash, which are found in the upper part of the Chester Group, and which occur in such abundance in the vicinity of Leitchfield, Grayson county, that they have been called by the Director of the Survey the Leitchfield Marls, extend over a large part of this region. They may be said to follow the distribution of the shaly and thin-bedded strata as already given. Near the railroad they are abundant. In the central part of this region, on Rough creek and its tributaries, they have not been so frequently seen, and where they do occur, they are thin. Toward the Ohio river, they are again abundant and of great thickness. On nearly all of the branches of Tar and Clover Forks they are frequently exposed. The section just given shows them occurring at several different levels.

At a locality in the edge of Hancock county, about three miles from Cloverport, known as the Buffalo Wallow, there is a remarkable natural exposure of these marly shales, showing a thickness of thirty feet or more. These shales are reported to extend several miles to the south of this locality, still retaining this thickness.

There is, therefore, in the aggregate, in this region, an enormous quantity of these marly shales, lying close to the surface, and very accessible. It is greatly to be hoped that

some economical process will ere long be discovered, by which the potash, their valuable fertilizing ingredient, can be rendered soluble, and therefore immediately available. When this can be cheaply accomplished, these beds will be of the greatest value to this country as a source from which to draw the fertilizers which shall renew the worn tobacco lands. They exist in such quantities, and are so accessible, that they will cost but a trifle; and the only expenses attending their use will be the transportation and preparation.

THE CHESTER COAL.

The thin coal in the Chester rocks, which is so generally found in the region south of this, is also quite persistent here. It has been seen at a number of places, and is reported at many more.

Dr. Owen and Mr. Lesquereux, in volumes II and III, first series Kentucky Geological Reports, refer to two coals in the Sub-carboniferous rocks, and state that they are sometimes as much as ten inches in thickness; but the writer has seen none of more than three inches.

Although nowhere of economic value, very many attempts have been made to work these coals, and even yet time and money are occasionally wasted in digging into them at newly-discovered out crops, in the vain hope of finding them of workable thickness—a hope which, it is unnecessary to repeat, will never be realized. It is useless to search for workable coal in the Chester rocks.

THE COAL MEASURES.

Within the area covered by this report, not including Hancock county, which will be discussed in a report devoted to the whole county, we have shown a total of about 180 feet thickness of coal measures, or perhaps 200 feet in some of the highest knobs. A thickness of 150 to 180 feet is only attained in the western part of this region, while to the east it gradually decreases until only the tops of the hills are covered with a thin cap of wasted coal measures.

The rocks vary so greatly in thickness, are so uncertain in occurrence, and, withal, are so rarely well exposed, that it is difficult to give a general section which will hold true over any considerable area. Nevertheless, with the qualification that it only shows the stratification in a very general way, the following section is given:

GENERAL SECTION.

1. Covered space, probably shales.	30 to 60 feet.	
2. Coal	1 to 4 "	
3. Covered space, probably shale	50 "	
4. Coal		4 to 18 inches.
5. Sandstone	10 to 30 "	
6. Shale	0 to 20 "	
7. Coal		0 to 4 "
8. Shale	15 "	
9. Coal		12 to 26 "
10. Sandstone and shale	0 to 30 "	
Top of Chester limestone.		

The plate of sections accompanying this report shows more accurately the position and changes of these rocks.

It will be noted that no reference is made to the Conglomerate in the above general section. This rock is not recognized in this region until near the Ohio river, in Hancock county. At some places it seems to be represented by a coarse, friable, micaceous sandstone; at others it is entirely wanting; and we have the lowest coal resting almost immediately upon the Chester limestone.

In the region to the south of this, which was embraced in the report, part II, vol. II, second series Kentucky Geological Reports, there is no rock which can be certainly identified as the Conglomerate for a distance of several miles south of the railroad. Its disappearance is nearly coincident with the occurrence of the frequent small disturbances in, and the sudden rise of, the Chester rocks toward the railroad. It is possible that this may be due to the fact that, where the Conglomerate is present, the faults and disturbances are not noticed; but the fact remains. The Conglomerate is, therefore, wanting over nearly all the area in which the Chester rocks are known to be considerably disturbed. Whether this has any bearing upon the question of the age of these disturbances, it is difficult to state. It certainly indicates a

cessation, over a large district, of the disturbed waters and rushing currents which accompanied the deposition of the Conglomerate, and a prevalence of more quiet conditions; but whether this was accompanied by a greater submersion, or a previous elevation of this region, is not yet certain.

This region, as is also true of other portions of the margin of the western coal field, shows a decided thinning of the coals toward the margin. With perhaps one or two very limited exceptions, the lowest coal is not found workable near the edge of the field. The most prominent exception to this rule is the Breckinridge cannel coal, which will be referred to in another place. The coal in the upper part of the general section is not found until some miles within the coal fields, and then it is not always workable; while the coals between are nowhere workable within the present field under discussion.

This fact has an important bearing upon the question of the former connection of the eastern and western coal fields, in that it indicates the original termination of the coal field by a natural thinning out of the strata along a line probably to the east of the present margin, which has retreated to its present position under the influence of erosion.

It is the prevalent opinion among many western geologists, at the present time, that if the eastern and western coal fields ever were connected at all, it must have been around the southern end of the Cincinnati anticlinal.* At present the least distance between the two fields is about 60 miles—from the outliers of the western coal field in Edmonson and Hart counties to those of the eastern field in Clinton and Wayne counties. The character and position of the strata in Edmonson county, at the extreme southeastern corner of the western coal field, more closely resemble the rocks of a similar horizon in the eastern field than at any other point on the margin of the western field. In fact,

*While this is indeed the prevailing opinion among geologists, I have no longer any doubt that it is entirely an error, and that the eastern and western coal measures were once connected over a large part, if not the whole, of the Cincinnati axis. The evidence will be given in the third volume of this series of reports and in the second volume of Memoirs.

going toward the Ohio river, the character of the section changes rapidly, until it bears hardly the slightest resemblance to the rocks at the margin of the eastern field.

COAL.

It will be observed that there are four seams of coal included in the general section; but one of these, at No. 7 of the section, is so thin, and so rarely occurs, that it was a question whether it was worth a place in the general section, and it was only admitted after considerable hesitation. It will not be numbered.

The coal at No. 4 of the general section has been seen at few places, but it has been reported at a number of others, so that finally it was considered best to give it a place in the section. It is of no economic importance, as it has never been reported of more than eighteen inches thickness, and has been seen as thin as four inches.

The coals at the base and at the top of the general section are the most regular in their occurrence and position.

The equivalency of these coals with the seams of other parts of Western Kentucky has not been conclusively determined; for this section does not closely resemble any of the heretofore published sections of Western Kentucky coals. It is indeed doubtful if any true equivalency over a large area can be asserted. It sometimes happens that a few coal seams are persistent, and hold the same positions with reference to each other for long distances; but this is rarely true for the majority of the coal seams of any one region. Increasing acquaintance with the coal measures of the State only strengthens the conclusion that the most trustworthy of coal seams are subject to great changes of position and character, and that continental equivalencies, such as were thought to be traced between the coals of Western Kentucky and Pennsylvania, by members of the former Geological Survey of this State, are as yet unproved.

Nevertheless, it is desirable to identify the coals over as large an area as possible. Using the temporary method of

designating the coals by letters, suggested by Mr. Norwood, and referring to his general section of the coals of the western field along the line of the railroad, part VI, vol. I, second series Kentucky Geological Reports, the probable equivalencies of the coals in this region are as follows:

No. 2 of the general section, coal H.

No. 4 of the general section, coal K.

No. 9 of the general section, coal L.

Of these, coals L and K correspond very well with the sections published by Mr. Norwood, while coal H is much nearer to the Chester limestone than in his section, but is probably the same coal.

Coal L covers, of course, by far the largest area of any in this region; but it is usually too thin to be worked profitably, as it ranges in thickness from one to two and one half feet, the latter thickness being decidedly the exception. The position of this coal is shown by the sections of the accompanying plate. It is sometimes found resting almost immediately upon the Chester limestone, with only its fire-clay between, while at other places a thickness of thirty feet of sandstone or shale intervenes. In the central part of this region, in the valley of Rough creek, the distance of the coal above the limestone is usually less than fifteen feet, while toward the railroad and the Ohio river it is greater. It has been opened at many places for local blacksmith's use; but the openings have mostly fallen in, so that good exposures of the full thickness of the seam are rare, and in a majority of cases the thickness has been taken as reported; but as this is a matter in which the tendency of reports is not to underrate the thickness, and as in none of these places has the coal proved thick enough for profitable underground working, it is believed that the value of this coal has not been underestimated.

The character and thickness of this coal along the railroad have been stated in Mr. Norwood's report, before referred to, so that it is unnecessary here to say anything further in regard to it. From Caneyville east, as indicated already in the statement of the position of the margin of the coal field,

this coal will only be found a very short distance north of the railroad.

Between the railroad and Rough creek very little is seen of this coal. It is opened by a drift near the Falls of Rough, at what is known as the Smith or Allen bank, on land belonging to Mr. L. Green, where it shows a thickness of 25 inches, without parting, of coal rather too soft, but quite free from sulphur.

The following analysis, by Dr. Peter and Mr. Talbutt, shows the character of this coal:

Moisture	6.50	} Coke 63.46
Volatile combustible matter	30.04	
Fixed carbon	55.54	
Ash	7.92	
Total	100.00	
Sulphur	1.972	
Specific gravity	1.343	

The exact distance of this coal above the Chester limestone was not determined, for it lies in a position near the top of the ridge, and at a considerable distance from any outcrop of the limestone; but it is probably not far above. The ridge in which the coal occurs rarely rises more than 75 feet above the Chester limestone.

Between Rough creek and the Ohio river coal L has been seen at many places, a number of which are shown in the plate of sections accompanying this report. Near the margin of the field it is 20 to 30 feet above the Chester limestone, but to the west it is nearer. It has been opened on Pipe run, at the Shreve bank, and at a number of places in the ridge at the head of that stream. Its thickness was not shown at any of these places, but it is not reported at more than two feet. On Pond run it has also been found at many places. Here it is nearer the limestone, being rarely more than fifteen feet above it, and sometimes not more than five. The thickness is reported from one to two feet. On Adams' Fork, below Fordsville, the coal is found resting almost immediately

upon the Chester limestone, with nothing but a thin fire-clay intervening. The coal is here reported one foot thick. Toward the head of Adams' Fork, and across the dividing ridge, on the head branches of Panther creek, this coal is not so well known. On the branch of Adams' Fork, above Fordsville, it is found close to the limestone in two or three places, and toward the head of this branch, near Mr. J. Newton's, a cannel coal or cannel shale seems to occupy this level. The exposure at this place was very imperfect, so that little could be learned as to either quality or thickness. It is probable that this is near the beginning of the field of the cannel coal, which, on Tar Fork, at the Breckinridge mines, undoubtedly occupies the horizon of coal L.

Coal K, as already stated, is usually so thin that it is of no economic importance. Along the railroad it is thicker than in any other portion of this region. At other places it is not known of more than eighteen inches. Very few exposures of it have been seen, so that nothing is known as to its quality.

Coal H, at the top of the general section, is the highest near the margin of the coal field. Its position is from one hundred to one hundred and twenty feet above the Chester limestone, in the vicinity of Fordsville, where it is best known; but south of Rough creek, near the railroad, this distance is greater. This coal is only found in the western part of this region, where the Chester limestone is near or below the drainage. Its thickness varies from one to four feet; but it is more often a fine workable seam than any other of this region.

Between Rough creek and the railroad this coal has been seen at few places. It has been opened at many, but these openings have fallen in, so that little could be learned as to thickness or quality. This is probably the coal at Laban Wright's, near Rosine Station. Here it was imperfectly seen, but a total thickness of three feet six inches was reported. It has also been opened at a few localities in the ridge on both sides of Caney creek. It will not be found far to the

east of that stream; but there is reason to expect that it will be found, whenever sought at its proper level, in the ridge to the west.

North of Rough creek, for several miles, its most easterly limit is the ridge between the branches of Adams' Fork, Rocky Fork, and Pond run. Toward the head of Pond run the hills do not rise as fast as the rocks, and they are soon too low to carry this coal; but we find it in the next ridge to the west, between the east and middle branches of Adams' Fork. It also is found in the ridges between the forks of Panther creek and between that stream and Tar Fork, south of the Breckinridge mines. In general terms it may be said that its eastern limit here is from one to two miles east of the Cloverport and Fordsville road.

This coal is seen at its best at the Gaines bank, near Fordsville. It here is 51 inches thick, including 3 inches of slate. At places the coal measures less than this, but it will average nearly 4 feet in thickness. Its quality is shown by the following analysis, by Dr. Peter and Mr. Talbutt, from a sample collected by the writer:

Moisture	6.10	} Coke 56.40.
Volatile combustible matter.	37.50	
Fixed carbon	50.46	
Ash	5.94	
Total	100.00	
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Sulphur	3.002	
Specific gravity	1.310	

This coal is also known at other places near Fordsville, where it has been formerly worked, but is not now well shown at any of them. It is reported between three and four feet thick. Toward the east, in the last ridge where it is found, it is thin. To the west, near the Hawesville and Hartford road, which is as far as the present observations extend, it is also thinner. The dip of the coal is here decidedly to the west, and it is much lower than near Fordsville. It has

been opened by Mr. Reynolds near Zion Church, and is the upper of two coals once opened near Brooks' Mill.

North of Fordsville, in the ridge just east of the Fordsville and Cloverport road, the coal was formerly worked, and is reported of a good thickness; but nothing can now be seen of it. On the head of Panther creek, near the road, the coal was seen by the writer nineteen inches thick. It is also reported in the ridge between Tar Fork and Panther creek, south of the Breckinridge cannel mines.

IRON ORES.

In general this region does not seem to be so rich in the iron ores, near the base of the coal measures, as that further south. They have been occasionally seen, but are usually so thin and silicious as to be of little value. The only places worthy of notice occur in the road south of Cloverport. One of these, known as the "Iron Ore Hill," about five miles from Cloverport, is a high knob covered with an abundance of sandy limonite, which, however, is so silicious as to be of no value. The other occurs about five miles from the Falls of Rough, near Mr. Howard's. There is here in the road an exposure of limonite which is of very good quality, but seems to be deficient in quantity. It is possible that a more detailed and thorough examination than could be given to it at this time would prove it to be more extensive than now supposed; but the indications are that it is limited in its horizontal range.

LEAD ORES.

In many localities throughout this region, especially in the Chester rocks, small specimens of galena, or sulphide of lead, are found. They are generally found in the clay, but sometimes in thin seams in the Chester limestone. The quantity, however, is never sufficient to offer any encouragement whatever to the theory that the ore will prove abundant enough for profitable working. The reverse of this is true; and it is not probable that the quantity is at any place sufficient to render it valuable, and all time and money expended in searching for and developing these deposits will be wasted.