TOPOGRAPHICAL GEOLOGICAL REPORT

OF THE PROGRESS OF THE

SURVEY OF KENTUCKY,

THROUGH

Hopkins, Crittenden, Caldwell, Greenup, and Carter Counties,

MADE DURING THE YEARS 1856 AND 1857,

BY

SIDNEY S. LYON,

TOPOGRAPHICAL ASSISTANT.

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INTRODUCTORY LETTER.

To DR. D. D. OWEN, *Principal Geologist:*

SIR: In obedience to your instructions, I herewith submit my report of the progress of the work intrusted to my direction, for the years 1856 and 1857.

The necessary instruments and outfit having been procured for camp No. 2, of the survey, this—the Western—corps was placed under the direction of Mr. Joseph S. Harris, late of the United States Coast Survey, who was dispatched to Hopkins county to resume the work of the late detailed survey at Mr. Watson's, near the line dividing Union and Hopkins counties, on the line of the Caseyville and Providence road.

Having accompanied this party to Hopkins county, a rapid reconnoissance was made of the district in which it had been proposed this corps should operate, meeting Mr. Harris from time to time, and directing his operations.

After having obtained a sufficient knowledge of the country, laid out the work for Mr. Harris during my absence, and left such instructions for the control of camp No. 2 as the requirements of the service seemed to warrant, I proceeded to organize corps No. 3, which was to enter upon the detailed survey of the Eastern Geological District.

For this purpose I repaired to headquarters for the necessary funds. On my return to Louisville I found the sub-assistant, on whom I had relied for the Eastern corps, prostrated by sickness, and unable to take the field. At the time, being unable to procure a proper assistant to supply his place, I was compelled, on this account, to postpone, for a time, the organization of camp No. 3, for the eastern division; meanwhile I concluded to make a reconnoisance of the country lying between Louisville and the margin of the Western Coal Field, in Hancock

county, and thence through the country adjacent to the base line, which was to be commenced by the Western corps, No. 2, during the summer. In this examination, having again intersected the line of operation of the Western corps, on Drake's creek, I made all the necessary arrangements with Mr. Harris for commencing the base line, and then proceeded into Crittenden and Livingston counties, to endeavor to determine whether the coal region of Livingston county was an outlier, or an extended peninsula of the Coal Measures connected with the coal field in Union or Hopkins county.

On my return, after consultation with the Principal Geologist, it was decided, as the season was so far advanced, and for the purpose of economizing the funds, to transfer the camp equipage and outfit of corps No. 1 for the use of corps No. 3.

This camp was ordered to Louisville by land, while I proceeded by rail to Cincinnati, for the necessary instruments, and the chronometers which had been sent to the care of Professor Mitchell, of the Astronomical Observatory, who had kindly undertaken to have them rated.

I returned to Louisville by rail, and sent forward, by a special messenger, the instruments for the use of the base line party. Owing to the extreme low stage of the Ohio river, the messenger was detained on the road, and did not join the party for three weeks, and that corps were compelled to begin operations with such outfit as it already had on hand.

The outfit having been completed for corps No. 3, the camp proceeded by land through Paris, Bourbon county, to Greenup county, shipping by the river being out of the question.

After having given the necessary directions for the guidance of corps No 3, to commence operations on Williams' creek, at the mouth of the tunnel of the Lexington and Big Sandy railroad, for carrying out the detailed survey of Greenup county, in the Eastern Coal Field, and having seen that they were making good progress, I then proceeded, in advance of the corps, to make a reconnoissance of the country, and learn the key of these *coal* and *iron* measures, leaving the Eastern corps in successful operation.

On the 12th day of October I left Greenup county and proceeded to join the base line party, in Hancock county.

On the 1st of November, the term of Mr. Harris' engagement hav-

ing expired, his corps was paid off, and the camp outfit, instruments, &c., were returned to headquarters.

On my return to Louisville I found it necessary to return to Greenup county to settle up the outstanding accounts of corps No. 3.

On my return home I made a rapid reconnoisasnce of the northern part of Greenup and Lewis counties, by the way of Springville and Vanceburg; thence by way of Clarksburg and Mt. Carmel to Flemingsburg, Fleming county; thence by Carlisle, in Nicholas county; thence to Paris, Bourbon county; thence to Georgetown, in Scott county; thence to Frankfort, in Franklin county; thence to Shelbyville, in Shelby county, to Louisville.

Here I engaged the assistance of Mr. Edward Mylotte to aid in making up the office work of the operations, in Greenup and Carter counties, which will be submitted as soon as completed.

I remain, &c.,

SIDNEY S. LYON,

Assistant Geological Survey of Kentucky.

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REPORT

OF

Observations in Hopkins, Crittenden, Livingston, Caldwell, Christian, and Henderson Counties.

In my former report it will be remembered that the out-crop of the lower coal measures, indicating the place of the Bell and Cook coals, which lie at the base of the first thousand feet of coal measures of Union and Crittenden counties, as exhibited on the map accompanying that report, was traced up the line of Tradewater river, until it had been run to the line of Hopkins county, and carried through sections 19 and 20, T. 5 S., R. 2 E. This line requires some modification since it crosses Tradewater river somewhere near the south boundary of section 19, T. 5 S., R. 2 E, and extends thence into Crittenden and Caldwell counties, making, near the corner of these counties, in the Hopkins county line, a long tongue of the coal measures, extending to the south and east of Tradewater. For the position of this tongue see plat of part of Union, Hopkins, Caldwell, and Christian counties, for 1856 and 1857.

The extension of the lower measures of the coal field, into the form above described, as to its outer boundary, has not produced a corresponding change in the line of out crop of the first, second, and third coals of the "Lower Coal Measures," which turn abruptly to the north and even north-westwardly, running in that direction from Providence, in Hopkins county, to the neigbourhood of Steuben's Lick, where the line marking these outcropping beds is deflected more eastwardly, and runs nearly with the line of the Hunting branch of Stuart's creek, to

its head, in Wright's ridge, when it takes a bend to the south, and probably crosses the ridge near the Box Mountain Springs, thence down the line of Flat creek, to the Rocky Gap, while the eastwardly boundary of the outcrop of the lower measures, have, by the flattening of the dip, and a succession of waves, faults, and breaks, been spread out on a horizontal surface from one and a half miles to ten or even fifteen miles. The lithological character of the measures has also experienced a change, not less noticeable, viz: the heavy masses of the Finnie Bluff, the Curlew, Ice-house, Little Vein, and the Anvil Rock.

The sandstones are much diminished, and some of them are entirely lost, so much that a section at Wright's ridge, and eastwardly to the outcrop of the lower beds, here known as the Campbell coal, equivalent of the Cook coal, Woldridge, and Terry beds, equivalent to the Bell coal, the associated measures, well developed at the Ohio river, are here very obscure, and though more recognizable at Providence, still it would be hardly possible that the key of these measures could be obtained, either in the line of Wright's ridge or Providence, without first having obtained the clue at the Ohio river, and then having followed the line of outcrop, in all its turnings, to Providence.

Having thus been enabled to identify the equivalent beds at that point, and having obtained a hint of the changes to be expected further to the north, to enable the observer to identify the equivalent beds at Wright's ridge.

At Providence the coals are much thicker and closer together than on the Ohio river, and the associated materials are more calcareous, and the angle of dip seems to be much flatter, since the first thousand feet has been spread out into a belt, ten miles wide, though the spaces between all the coals, where the quantities have been obtained, are less, indicating a positive thinning out of the materials separating the coals, and those materials are of a character indicating a different condition from that controlling the deposition of the equivalent beds, twenty miles to the northwest.

All the sandstones are thinner, and composed of finer grains, than those at the Ohio river; and in their stead we sometimes find limestone, black bituminous shales, and fine micaceous and shaly sandstones.

The same remarks, here made for that part of the coal basin at Providence, and eastwardly to its edge, will apply, with slight modification, to the equivalent measures from the head of the Hunting

branch to the edge of the measures, south and east to the margin of the coal-field, near the head of Casselbury and Drake's creeks, in Christian county; these changes are especially noticeable at Mr. Williams', on the Madisonville and Hopkinsville road, on a tributary of Drake's creek, and at the Campbell and Woolridge mines, five miles distant, on the waters of Casselbury creek.

In a line stretching nearly east from Providence, is a range of hills, cut through by various creeks, and which extends to and connects with a range of hills on the south east side of Tradewater river. This range is evidently an axis of elevation, and there are corresponding basins or troughs on the north and south side of this line. That on the south side lies in a line nearly southeast and northwest, beginning in the coal measures, and extending toward the outer edge of the basin, into Caldwell county. This trough is much narrower than that on the north side of the ridge, which covers all the space between its line and the base of Wright's ridge, on its southwest side. being from eighteen to nineteen miles wide in the line of its greatest developement.

This great extent of country, eighteen miles long, with the margin of the outcropping coals, and from ten to twelve miles wide, at right angles with this course, includes a district of country generally level and rich, intersected only by spurs of Wright's ridge, dividing the water courses; many of the valleys are flat and low. These spurs of the ridge may be regarded as the distant, feeble efforts of the mighty power that raised the surrounding margin of millstone grit, and the subcarboniferous limestone, which forms the rim.

Though the prolongation of the Bald hill disturbance is not so conspicuously marked, by high and abrupt ranges in Hopkins as in Union county, still the configuration of the country seems to warrant the opinion that one branch of this disturbance has been extended into Hopkins and Christian counties, and that the same dome-like method observed in Union county has also been exhibited along its course through Hopkins county, and to the margin of the coal field in Christian county.

The detailed surveys necessary to determine this question are not yet sufficiently extended; the subject will be left for further investigation.

The whole energy of the Topographical parties having been engaged in the Topography and Geology of the part of the country

which appeared to promise the earliest practical economical results, matters of strictly scientific interest have, for the present, been passed by, and those things only attended to which promised to give results of immediate practical value, except so far only as they were of prime necessity for the proper understanding and investigation necessary to those results.

While awaiting the return of the party who were operating in Muhlenburg county, during the latter part of August, I crossed into Crittenden county, with a determination to find whether there was any continuous connection between the *Union coal* of Livingston county, and those of the Tradewater country. In this excursion I passed by the old site of Bellville, where the counties of Union, Crittenden, and Caldwell corner in the Hopkins county line, and where the line of Hopkins county leaves Tradewater. Passing along the road from Bellville, through Caldwell county, in a southwest direction about three miles, the road then inclines more to the north. Then the intercalated limestones of the millstone grit make their appearance. Two and a half miles further the road makes a southwardly curve, and the Coal Measures re-appear five miles from Tradewater river, as shown in the borings for a well at Shady Grove, which have penetrated the rocks of the Coal Measures, and at a point one mile northeast, where a coal has been opened, said to be four feet thick. From one to one and a half miles from this a coal is to be observed, eighteen inches thick, wedged between heavy sandstones. East of Shady Grove coal has been opened by Mr. J. Land; this coal is said to be four feet thick also. The eighteen-inch coal is again found on the lands of Messrs. Terry and Campbell, and at Mr. Amos Singleton's, three-fourths of a mile east of the grove.

It is highly probable that the intercalated limestone of the millstone grit, before alluded to, near Bellville, has been brought to the surface by a fault.

From Bellville, distant seven and a half miles, in Crittenden county, on the farm of Dr. R. M. Hetherington, coal has been reached in a well; the person boring announced the coal to be one foot thick.

By the line traveled the country is very hilly from Dr. Hetherington's to Piney creek, the hills being caped with from fifty to one hun-

dred feet of the millstone grit, the deep ravines and valleys cutting into the sub-carboniferous limestones.

There are probably one or more faults between Shady Grove and Piney creek, that suddenly bring up the lower rocks, thrusting the Coal Measures forward and to the southwest. Six and a half miles to the northeast of Marion, the county seat of Crittenden county, the upper intercalated limestones of the millstone grit rises to the tops of the hills, being overlaid by a thin capping of from twenty-five to fifty feet, of the debris of the sandstones, which are penetrated by sinking wells, the water being found on top of the limestones. Five miles east of Marion the road crosses a branch of Piney, called Flat creek, which flows in a trough scooped into the masses of the lower interculated limestone.

On passing westwardly from Marion, about five miles, the sub-carboniferous limestone makes its appearance, coming up the dry fork of Livingston creek, here connecting with the same rocks, which are cut into by the waters of the Paroquet fork of Hurricane creek. Where these creeks interlock the sandstones of the millstone grit series are severed, and now all the Coal Measures lying to the west, northwest, and southwest of this point are completely disconnected from the great body of the coal field of western Kentucky.

On the Ohio river the beds of the sub-carboniferous limestone is the surface rock, from a short distance below Crooked creek, in Crittenden county, to the mouth of Deer creek, which enters the Ohio river a short distance above the Union coal mines, in Livingston county. These rocks, as before stated, also form the surface-rock, at the head of Paroquet creek, and from this point extends to the Ohio river; the eastern boundary lies nearly in a north and south direction line. The western limits have not yet been completely traced, it however extends to the north-west from the head of Paroquet creek, for about two miles, forming the beds of the creeks, minor streams, and valleys, the neighboring hills being capped by the lower masses of the millstone grit; then more westwardly, by a great curve, to the mouth of Deer creek, including an area of fifty or sixty square miles of sub-carboniferous limestone country with all the marking characteristics, viz: sink-holes, bold springs, &c.

The belt of millstone grit country lying to the eastward, and between the sub-carboniferous limestone country of Crittenden county, and the productive coal measures on Tradewater river, in the same county, is about twelve miles wide, being very broken from Crooked creek to that river; the dividing ridge between Crooked and Big Hurricane creeks is also capped by the lower masses of the millstone grit and the intercalated limestones, rising rapidly from the Ohio river at the mouth of Crooked creek, into a high table land, with occasional high hills rising above it. The belt of millstone grit, above alluded to, exhibits the evidence of having been much disturbed, the masses having been broken into fissures and cracks, locally much elevated. Places are frequently to be observed where the lower mass of the millstone grit forms the bed of a branch, where it lies in a position nearly horizontal, while the next hills, four or five hundred feet above the level of the stream, have the same rock forming their summits, where it is seen dipping at an angle of ten, fifteen, or even twenty degrees to the southeast, northeast, or northwest, as the case may be, varying with different localities. These remarks are especially applicable to the country north of Piney creek; north of that creek, and eastwardly, to the Caldwell county line, and for some distance into that county, the surface does not present breaks and disturbances on quite so grand a scale. Near the Caldwell county line the measures of the millstone grit at once pass under the rocks of the true coal measures, making the belt of country possesing the remarkable characteristics of the millstone grit country, much narrower in Caldwell and Christian than in Muhlenburg, Butler, and Breckinridge counties, where the same country has been observed. The same remark will apply, with equal force, to Hardin and Pope counties, Illinois, and Perry and Crawford counties, Indiana.

It being established that the coal beds of Livingston county are an outlier, being cut off from the main body of the coal field of which they once formed a part.

It is also worthy of notice, that the upheaving force which has been instrumental in these changes has also brought up the ores of iron, lead, and zinc. It is along the anticlinal axis of this greatest disturbance, which has cut through the millstone grit at the head of and along the line of Paroquet and Big Hurricane creeks, that are to be found the fissures filled with Galena, Fluor spar, and other minerals.

I would, therefore, respectfully suggest that at some convenient time part of the force of the survey be detailed, to investigate the strip of country lying along the axis of this disturbance, extending from the Ohio to the Cumberland river.

Some years since an effort was made to prove the Lead Lodes of Crittenden and Livingston counties; the works were not carried to any considerable extent before they were discontinued, without any profitable result.

The detailed surveys have only been carried to the margin of the coal field bordering on Crittenden, Caldwell, and Christian counties.

The foregoing facts have been obtained, incidentally, in reconnoisance made by myself, for the purpose of obtaining such information as would enable me to direct the operations of the field parties, according to the tenor and spirit of my instructions.

Party No. 2, of the Geological Survey, having begun their operations at the edge of Union county, under favorable circumstances, but the whole party having no previous knowledge of the topography of the country, or its geological features, my operations were restricted mostly to the vicinity of the field-party, thus, by covering but a limited space, I was enabled to make a most critical examination of all the known outcrops of coal, and by pursuing this plan I have, while carrying forward the lineal Survey, discovered many new outcrops of coal, and connected these with my previous observations.

The first line run by party No. 2, this season, was begun at Whitesides' creek, and run northward, and connected with the line dividing the counties of Hopkins and Union, and the work of the previous season. From the point of departure thus obtained, at the termination of the work of Union county, the detailed work of Hopkins county was begun.

After conducting the party a few days, the reconnoisance was carried further. A synopsis of the field notes made, and the facts obtained during these reconnoisances, may aid in arriving at just conclusions as to the structure and value of the Western Coal-field of Kentucky, in Hopkins, Christian, and Caldwell counties.

I shall endeavor to set forth these facts, and the method by which they were obtained, and the impressions they produced on my own mind.

The field-work of the topographical parties not being fully made up, the courses and distances estimated will, for the present, be deduced, from the very imperfect map of Kentucky which I have.

The identification of the different beds of coal, wherever observed, has been made a matter of prime importance, and all coals, spoken of in Hopkins and Christian counties, are referred to their equivalent beds, by the same names by which they are known at the Ohio river.

The first camp pitched on Whitesides' creek, in Hopkins county, was found, on examination, to be on the mass of rocks known at the Ohio river as the rocks covering the three feet or "*Little vein*," and the four-feet coal lying first below it. Neither of these beds, at present, are open here. The "Little vein" has, however, been penetrated, several years since, in digging a well, near the Caseyville and Providence road, within a few yards of the old school house, on Whitesides' creek. About a mile from this the equivalent of the second coal under the Anvil rock has been worked by Mr. Watson, on the southwest side of the ridge, and by Mr. Llewellen, on the northeast side of the same ridge, only a few rods apart.

The following section was taken at the opening into the coal at the "Llewellen bank," on the north side of the ridge, which here is the dividing line between the waters of Tradewater, above the mouth of Crab Orchard creek, of Union county, and Slover creek.

Here the dividing ridge has entirely lost its capping of the "Anvil Rock," there being only about forty feet of materials between the top of the coal and the top of the ridge.

Section of the Llewellen Coal.

Heighth.	Thickness.	
39.6	30.0	Sloping ground.
9.6	4.0	Loose pieces of limestone projecting from the surface.
5.6	.6	Black bituminous shale varying from 6 inches to 1 foot.
5.1	.11	*Coal.*
4.2	.1	Parting clay.
4.1	2.6	*Coal.*
1.7	.2	Parting clay.
1.5	1.5	*Coal.*
	.0	Top of under-clay, thickness not satisfactorily seen.

Thickness of the bed is five feet one inch. In this locality there is, therefore, four feet ten inches, in all, of workable coal.

The under-clay was not seen at this place, but the following section of the same coal bed, from the "Watson bank," on the other side of the same ridge, and only a few rods distant, will probably be satisfactory as to the thickness of the under-clay.

Section of Watson's bank, southwest side of ridge, and equivalent of the second coal under the Anvil Rock.

Heighth.	*Thickness.*	
70.9	30.0	Covered space.
40.9	16·0	Limestone in several beds, much affected by exposure.
34.9	.6	Six inches to one foot of black bituminous shale.
34.3	1.0	*Coal.*
33.3	.3	Parting clay.
33.0	2.6	*Coal.*
30.6	.2	Parting.
30.4	1.8	Coal.
28.8	1.0	Under-clay.
27.8	10.0	Ten to twelve feet of drab colored limestone.
17.8	7.8	Covered space with coal.
10.0	10.0	Sandy shale.

Thickness of workable coal, in Watson's bed, five feet two inches.

The section heretofore given of the Watson and Llewellen coal, equivalent of the second coal of the lower series, may be further extended by the aid of a partial section obtained about one hundred yards to the east of the opening made on Watson's land.

Providence lies in an eastwardly direction from the Llewellen and Watson Coal Banks, about two and a half miles. By an observation of the map of Union county, in the first Geological Report, it will be seen that the outcrop lines of the coals of the Mulford series will be found running eastwardly across section 4, T. 5 S., R. 2 E. After the line has entered section 3 of the same township, it runs south and southwest, to the southeast corner of section 9, when it again curves to the east. The line again curves abruptly to the north, soon after entering section 10. This is probably the centre of a valley of depression in the Coal Measures, which being prelonged extends into Crittenden and Caldwell counties, crossing Tradewater river at or near Bellville. Crossing this valley, as before stated, in section 10, the outcrop line runs northwardly along the eastern edge of the valley to a point near Providence, when the line is again deflected to the south and east, by an elevated fold of the Coal Measures that begins at Providence and runs in a line nearly parallel with the Providence and Princeton road, and on the south side of it, to the outer margin of the Coal Field, near the mouth of Dollison's creek, in Caldwell county. A nameless branch, which rises in section eighteen of the same township, runs northeastwardly into section eight. Out of this section it passes into section seventeen, where it has its bed in the soft materials associated with the fourth coal, under the Anvil Rock, or the "*Four-foot Coal*" of the Lower Coal Measures

Heighth.	*Thickness.*	
49.11	45.0	Covered space, with limestones near the coal.
4.11	1.00	Coal.
3.11	.3	Parting clay.
3.8	2.6	Coal.
1.2	.2	Parting clay.
1.00	1.0	Coal.

On the north side of the ridge, containing the Llewellen and Watson coal openings, there is evidence of fractures in the masses of the coal measures covering this bed. The drainage having taken the lines of fracture has, by denudation, exposed these beds on the south side of the spurs of the main ridge, and the coal may be entered and worked, on the north of the ridge; with a dip to the north and northwest, carrying these coals under a level country bordering Slover creek.

These beds of the Coal Measures, at Providence, have experienced some slight modifications, the limestones are more ferruginous; there are also beds of chert intercalated in the limestone mass, which is thicker. The dip is greater, and to the northwest. The limestone beds are highly fossiliferous.*

If these beds are entered north of the main dividing ridge, the produce of the mines may reach the Ohio river, by a railroad which may be made almost by a naturally graded road bed. By laying the line of the road down the valley of Slover creek, to the Pond Fork; thence up that valley, and on the southwest side of that creek, to the gap between Poplar ridge and Coal hill; thence along the valley of Cypress creek, to a point near the mouth of Pearson's branch; then either up Cypress, and reach the Ohio river by the valley of Hine's creek, or by the Bookham valley pass, through the gap, at the head of the Little vein branch, and thus reach the Ohio; or from Pearson's branch, by the Henry valley pass, through the gap at Winstead's, in section 24, T. 3 S., R. 2 W. For a coal road, with very light grades, I am acquainted with no country where a road, with a better allignment, or lighter grades, could be had, for the same amount of graduation, for a road of this length; while along the line of the road, and at very short distances from it, the best stone for bridges and culverts could be had; since, near by, along its entire length, the heaviest coal beds in this part of Kentucky find their outcrop, the main trunk road would receive numberless branches from numerous coal mines, that must be opened along the entire length of the line, and only a short distance from it, many of them within from fifty to two thousand yards of the main road. In this connection, I may be permitted to state that a *good* railroad is the only reliable means by which these vast beds of fossil fuel can, with certainty, reach a market. It has been in contemplation to lock and dam Tradewater river for the purpose of forwarding these coals; my opinion is, that Tradewater river, if dammed, and its waters were spread over the surface, as they would be by dams sufficientiy high to obtain the head required, would not, during the dry season of the year, afford a sufficient supply to keep up the pools, much less the water necessary for lockage. The evaporation would probably largely exceed the supply afforded by the river should this be the case, as it most probably is; Tradewater river, therefore, as a means of transporting coal to market, is absolutely useless.

*See specimens "*from Providence*"

There being no difficulty in the way, the outcropping bench of the Llewellen and Watson coal was easily traced to the equivalent bed opened at Providence. The following section will serve to illustrate, in some degree, the arrangement of the Providence beds. The land holdings here being in very small lots, two banks having different names are included in one section.

These banks are on nearly the same level, and the thickness of the separating material is probably somewhat greater than the work on the ground made them.

Section of the Lofland Coal Bank.

Heighth.	*Thickness.*	
60.2	30.0	Yellow-grey shales, (place of Anvil Rock?)
30.2	3.0	Black bituminous shale.
27.2	1.3	Slaty coal.
25.11	.5	Parting clay.
25 6	1.0	Coal, (in large blocks.)
24.6	1.4	Parting clay.
23.2	2.9	Coal.
	1.9	Under clay.
20.5		

Section of Dorris Bank.

18.8	12.0	Twelve to fifteen feet limestone.
6.8	1.3	Calcareous marly shales, 15 to 20 inches thick.
5.5	.4	Black bituminous shale.
5.1	4.0	Coal, fine quality, mining in fine blocks.
1.1	.1	Parting clay.
1.0	1.0	Coal to top of underclay.

The following section is from the Dollison bank, equivalent to Dorris bank:

Heighth.	*Thickness.*	
18.2	10.0	Ten to sixteen feet limestone.
8.2	2.2	Grey and black calcareous shale; lower part argillaceous shale.
6.0	3.6	Coal.
2.6	.1½	Parting clay.
2.4½	1.4½	Coal.
1.0	.1	One to two feet ferruginous limestone.

A number of sections of these beds could be given, but this will be unnecessary, as they would be a repetition of those already given.

It may be possible that the last section given is of an intercalated coal, between the equivalent of the Mulford bed and the "middle coal;" the

Lofland section is probably the equivalent of the "Anvil Rock," or first coal which has again increased in thickness.

It will be recollected, that at Thompson's mines, in Union county, the Anvil Rock bed had thinned down to fifteen or eighteen inches.

The Lofland, Dorris, and Dollison banks, being three distinct beds of coal, would make the Dollison the third coal under the "Anvil Rock," and equivalent to the Mulford coal, provided there be no new intercalated coal here over the Mulford. This seems to be confirmed by the fact that a coal was opened, partially at my request, on the farm of Mr. Samuel Montgomery, near the eastern edge of section ten, T. 5 S., R. 2 E., which has the characteristic covering and associated shaly materials of the Mulford coal; if this be the equivalent of that coal it will be undoubtedly fall the fourth coal in the series here.

Three-fourths of a mile to the southeast of the last coal alluded to, in the direction across a narrow trough in the measures, a coal is seen in the bank of a small branch, known here as Hunter's bank." The equivalent of this bed is also to be seen on the farm of Mr. Samuel Montgomery, distant about half a mile from the equivalent of the Mulford coal opened on his farm; this last coal is known as the Montgomery coal.

Section of Montgomery coal.

Heighth.	*Thickness.*	
31.00	10.00	Covered space to top of point.
21.00	10.	Thin bedded sandy shale.
11.0	8.	Black bituminous shale.
3.0	3.	Coal.

The pit being partially filled with water, neither the bottom of the coal nor clay was seen.

Section of Hunter's bank.

Heighth.	*Thickness.*	
43.6	15.0	Covered space.
28.6	10.	Greyish-yellow sandy shale.
18.6	8.0	Black bituminous shale.
10.6	3.9	Coal.
6.9	.9	Parting clay.
6.0	.7	Coal.
5·5	.6	Under clay.
5.0	5.0	Sandy shales.
	.0	Bed of branch.

Mr. Alfred Towns had this coal opened, and the parting clay dug through, in doing which the workman discovered the seven inches of coal between the under and the parting clay. When the lowest coal was cut through an abundant spring of water burst forth. When I visited the bank the water had settled, and the spring was flowing in a beautifully clear stream. The day being warm, and being very thirsty, I laid down for a drink, but one mouthful of such water was sufficient—the water being very acid, and largely charged with alum.

In my report for 1855 the map shows the line of the lower coals south of Mr. Imboden's house, section 24, T. 5 S., R. 1 E.

The Winn hill was set down as the equivalent of the "Finnie bluff," or the sandstone mass covering the Bell coal. After the survey was made, in 1855, Mr. Winn dug at the foot of the hill near his house, at the base of the equivalent of the "Finnie bluff," and found a good coal at the place indicated in the report.

Taking the road from Providence to Princeton, the first creek crossed has, at this place, its bed on the soft shale under the Providence coals or over the Mulford coal.

There is evidently a sinking of all the beds for a short distance on the line of this road, when they rise again immediately west of it, while on the right of the same line they lie quite level for two or three miles, as there is only one ridge intervening, made by the members over the Hunter or "Little Vein" coal. On the northwest side of Clear creek the mass of the Curlew hill crosses the road in a low ridge between Clear creek and Mr. Barnhill's house. The mass of the "Ice-house," and its accompanying measures, is probably the northwest bank of the flats of the creek itself, and it is repeated between the forks of the creek. The masses equivalent of the Finnie Bluff extend from the bank of Tradewater river for two or three miles toward Providence, and must be repeated or lie very level.

At two miles beyond Tradewater the millstone grit sets in, and the rocks are raised into high hills. About four miles to the southwest of the road the millstone grit runs up to the river, and the sub-carboniferous limestone forms the hills. The lower masses of the millstone grit still has one, if not both, of the intercalated limestones; the upper mass of this limestone is hard, and broken into polygonal blocks from the size of marbles up to pieces of five hundred pounds weight. The usual buff belt is found less earthy, more solid and compact than at

the Ohio, and nearly destitute of fossils. The key obtained by the study of the various members of the coal measures, in Union county, from the millstone grit to the Mobley, has been of the greatest service in identifying the corresponding beds elsewhere; nevertheless, in consequence of some important modifications in the formations in their extension through Hopkins county, it is often necessary, in order to convince ourself positively of identity, to follow out any given bed in all its meanders from its known position in Union county to the locality elsewhere to be established. The changes of lithological character are always accompanied by a corresponding change in the character of of the soil and the growth upon it; this aids greatly in following the outcrops, when the rocks themselves are concealed; indeed, without observing which one would be entirely at a loss.

The first line of country passed over, lying between Providence and Wright's ridge, was through the woods and farms, and by no regular road. Leaving Providence, the route lay to the south of east, crossing Wyer's creek about a mile from its mouth. On the northwest side of the flats of this creek the outcropping sandstones over the "Little Vein" are in sight; beyond this a stretch of bottom land extends for a mile; then a low flat point was crossed, before entering the valley of Clear creek, not far from a pond called "Jenney's hole;" from this point, up the valley of the creek, there is no low water bed for a distance of over two and a half miles, by the path through a flat swampy land, with a succession of small lakes called "holes," with most fanciful names. Pond creek was crossed in the valley of Clear creek, and the route now lay up the southeast side of Clear creek to Lamb's creek, one of its small tributaries. A coal was seen in the hills that bound the south side of Clear creek, near Lamb's creek. From the character of the associated rocks I took it to be either the Ice-house coal, or one of the lower small beds of the Curlew Hill Measures. I am inclined to the opinion that it is the former coal, which has thickened up to four feet four inches, of excellent quality.

It should be mentioned that the ridge on the northwest side of Pond creek, near its mouth, is probably the equivalent of the masses covering the four feet and "Little vein" at the Ohio river. When it was crossed it was about seventy five feet high above the surrounding flat lands. The ridge on the south side of Clear creek, in which the Kirkwood branch takes its rise, is the coal before alluded to, on the

south side of the creek; it is opened on the N. W. side of the hill. At the opening the dip is N. 10° W.; the rate of dip is two and a half degrees. In all probability there is a reverse dip somewhere under the flats of Clear creek, or at least a much flatter dip. The rate of dip would bring in the rocks of the "Little Vein" much nearer to this opening than they are, if there were not some decided modification of dip. A limestone is said to exist in the hills over this coal, but it was not seen by myself; there are, however, evidently limestones or else calcareous shales. The sugar-tree, which I consider an invariable sign of the presence of calcareous beds, in the Coal Measures, is quite abundant.

Continuing up the south side of Clear creek, immediately after crossing Lamb's creek, a sharp ridge rises, called Bobb's ridge, probably the equivalent of the ridge at the last coal; this ridge soon receives an additional height, and is capped by another sandstone very like in lithological character to the upper part of the sandstone at Curlew hill. This ridge divides the waters of Richland and Lamb's creeks, and has an elevation of about two hundred and fifty feet above the surrounding flat land. The ridge appears to be the dividing line marking the east side of the great trough extending from Providence to this point, and brings us to the edge of the undulations, marking the character of the measures of Wright's ridge, and the ridge running between Lamb's creek and Richland creek, coming up in the way it does through the direction of the strike line, in a sharp curve to the southeast, then southwardly and southwestwardly to the waters of Cane creek, at least twelve miles south from the mouth of Lamb's creek; so that the productive Coal Measures extend in a tongue twelve to fifteen miles outside of the nearest edge, or smaller diameter, of a regularly shaped basin. The prolongation of the basin, which passes southeast of Bellville, is a depressed fold, while that southeast of Lamb's creek is an axis of elevation, extending on either side of the line of Wright's ridge for several miles; it is, however, most extensive on the westwardly side, also including the body and spurs of the ridge, so that the greatest body of coal, of the Western Coal-field of Kentucky, crops out along this line of elevation. No less than ten beds of coal are here presented to view varying, from three (3) to eight (8) feet in thickness. Five of these are five (5), and two over four (4) feet.

To the eye these coals are not inferior to the best Pittsburgh coal; their true value can however only be determined by analyses.

The road traveled from Richland creek lay up that stream for two or three miles, to the intersection of the Princeton and Madisonville road, near the Sulphur spring; thence up the dividing ridge between Richland and Sugar creeks, crossing Wright's ridge at a point near the head branches of Sugar and Stuart's creeks, where the ridge is nearly severed by a gap lying in a line nearly east and west.

In order to establish the exact geological position of the Coal Measures of Wright's ridge, I determined to trace the measures along the line of the Madisonville and Hopkinsville road, from the thick coal at the Rocky Gap to where the sub-carboniferous limestone is cut through south of the head waters of Drake's creek. From thence, the sub-carboniferous limestone, millstone grit, and the upper intercalated limestone, to the Buttermilk road.

The line of the road from Madisonville to Hopkinsville runs nearly south, crossing the Crab Orchard Fork of Drake's creek, approaching the valley of the latter creek nearly east of the point where the line of Christian and Hopkins counties leaves that creek. Three marked ridges cross this road between the Rocky Gap and the confines of the productive Coal Measures, on the south.

These examinations showed that the eight feet coal, at the Gap opened by Price, Johnson & Co., is the equivalent of the beds on the Hunting branch and Stuart's creek, only the materials separating the two beds, which in some instances amounts to a thickness of several feet, have here diminished to two and a half inches; and for all practical purposes the two beds are here united into one.

On the same horizontal plan, on the west side of the gap, only about five hundred feet distant, there is another bed totally unlike any coal bed which I have had an opportunity of witnessing. The following section will serve to show this bed, which is also on the property of Price, Johnson & Co.

Section of coal bed at Rocky Gap, north side.

Heighth.	*Thickness.*	
57.03½	22.0	Massive sandstone.
35.03½	15.0	Covered space.
20.03½	5.0	Clay shale. whitish.
15.03½	5.0	Clay shale, yellowish.
10.03½	3.0	Clay shale, grey.
7.03½	2.4	Clay shale, grey.
4.11½	.7	Black bituminous shale.
4.4½	2.4	Black bituminous shale.
2.0½	2.0½	Cannel coal.

Under clay not measured.

The masses given above are each in distinct beds, with a regular parting between them. The black shale is very hard, black, and rich in bituminous matter. The coal is hard, and in its general appearance much like the finest block mineral at the Breckinridge mines.

The section of the thick coal, on the east side of the gap, is as follows:

Section of Eight-foot coal at Rocky Gap.

Heighth.	*Thickness.*	
157.11½	50.00	Rounded hill top.
119.11½	20.00	Bench probably sandstone.
89.11½	16.00	Top of slope and foot of bench.
73.11½	19.00	Bench; some sandstone in sight.
54.11½	45.00	Top of covered space.
9.11½	1.6	Blue marly shale.
8.5½	3.1	Coal; soft from exposure.
5.2½	0.2½	Marly shale parting.
		Beds of coal.
5.0	5.0	Coal with 2 small streaks of clay near the center of mass.

The lower, or five-feet mass of coal appears bright and good. The upper mass will probably be found as good as the lower when the coal has been followed under solid cover.

Starting, as before stated, at these beds at the Rocky Gap, three distinct, different masses of sandstone are passed over, by the line of this road, before the margin of the Coal Field is reached—the distance being about seven miles. The spurs of Wright's ridge, which runs in a line nearly parallel with it, are thrown off at right angles to the road, and are doubtless the sandstones of the "Little Vein," Curlew hill, and Finnie Bluff. There being no repetition of these masses, the inference is that the amount of dip is not greater than two degrees, for a large part of the distance; for suddenly the dip, south of Drake's

creek, carries the equivalent of the Cook and Bell coals from the top of the high hills, from two hundred to two hundred and fifty feet high, on the south of the creek, down to the bed of the stream, where the equivalent, probably of the Cook coal, has been mined in the bed of the creek near Mr. Williams.' The covering to this coal being very similar to the covering of the coal mined by Mr. Campbell, on Casselbury creek, five miles to the west, which is certainly the equivalent of the Cook coal of Union and Crittenden counties.

Crossing Drake's creek to the south, and ascending a hill two hundred feet high, which is capped by a sandstone equivalent to the Finnie bluff, a coal outcrop is seen at a place called "Isinglass Glade." On the southwest side of the Glade is the following section:

Section at Isinglass Glade.

Heighth. Ft. In.	*Thickness.* Ft. In.	
58.	5.00	Top of hill at glade.
53.	2 00	Black bituminous shale.
51.	2.6	Coal.
48.6	3.10	Under-clay.
44.8	5.4	Shales.
39 4	5.4	Belt of carbonate of iron, three inches thick, regular and continuous as far as exposed, in a bed of grey shale.
34 0	2.0	Bed micaceous sandstone.
32.0	6.0	Sandstone.
26.0	5.0	Blue shale.
21.0	21.0	Sandy shale.
	.0	Top of covered space.

In the under-clay of this coal are a great number of finely formed crystals of gypsum, especially where the coal has disappeared and left the under-clay disturbed; doubtless produced by the abundance of sulphuric acid set free by the wasting pyritiferous coal, which has combined with the lime filtered from the limestone hereafter mentioned; a similar phenomenon was observed at Johnson's, under the equivalent of the Llewellen coal, near Providence, where lime must have been carried from above the coal down to the *acid*.

Above the coal at the Isinglass Glade are two thin beds of carbonate of iron. Between the Glade and the Croft, or Williams' farm, an additional member comes in above the coal, composed of alternations of sandy shale and beds of flag-stones.

At Petersburg, westwardly from the Glade, the coal measures are flattened, probably by a slip or fault at the south foot of the Glade hill; which has carried down the measures. The hill itself is flattened out to the east and northeast into a high table land. Three miles to the southeast Mr. Lacy has worked a coal bed, which is said to be four feet thick. The workings having been abandoned I did not visit them. About three miles to the west of Petersburg, the dividing ridge between the waters of Tradewater and Pond rivers has its summit, in which interlock the branches of Casselbury creek, the longest branch of Tradewater, and the head branches of McFarland's creek, the longest westwardly branch of Pond river.

On the waters of Drake's creek the coals and associated rocks are much bent and disturbed. One of the lowest of these coals, at Mr. P. W. Cabel's, is either the equivalent of the Cook or the Battery Rock coal. From the character of the rocks associated with this coal I incline to the opinion, that it is the former of these coals. At another opening in this coal, which is seen half a mile further down the branch, the dip was N. 40° E.; the rate of dip was not satisfactorily obtained. The coal is hard and firm around the old pits, although the diggings have not been worked for seven or eight years. The coal is covered with aluminous earth. The top of the hill over this coal is covered by a loose-textured soft sandstone, massive in its character. The sandstone at Chalk-level is probably identical with the sandstone here, and both are probably the equivalent of the sandstone near the base of the Finnie Bluff.

Mr. Felix Bourland, (seventeen miles from Madisonville,) opened the coal last alluded to. Mr. Bourland says the coal is three feet four inches thick. The thickness of the coal is probably over estimated.

At Mr. Brashears' is a coal covered by argillaceous shale; this bed is doubtless the equivalent of the "Cook coal;" and the coal at the Isinglass Glade is the equivalent of the "Bell coal" (?).

The materials between these coals are generally soft and argillaceous, while the mass covering them has decidedly the character of the Finnie Bluff; here, however, it is quite soft in its lower part, while the main sandstone mass is only represented by a few feet* of sandstone,

*About 18 or 20 feet.

flagstones, and sandy shales, the whole mass being about fifty to sixty feet thick.

At Petersburgh* limestone was found at the bottom of a well, which I take to be the equivalent of the limestone afterwards seen, lying above the coal at Mr Campbell's, and at the Wooldridge "old mine." On the west side of the dividing ridge, this limestone lies at those places thirty-five feet above the coal, equivalent to the Cook coal.

The first mass of the millstone grit seen containing pebbles was near the farm of Mrs. Elizabeth Brashear's, eighteen miles south of Madisonville. This mass forms here the dividing ridge between the waters of Casselbury and Drake's creeks. Limestone, intercalated with sandstone of the millstone grit series, are first met with one and a fourth miles south of Mrs. Brashear's, or nineteen and a fourth miles south of Madisonville.

From information obtained, I infer that there must be a number of openings in the equivalent of the Bell and Cook coals, with perhaps one or two places where the equivalent of the Battery Rock coal is worked, southwest and west of the road.

At Mrs. Brashears' and Mr. Williams', when the intercalated limestones before alluded to were seen, there is much irregularity in the dip, both in quantity and direction, being in most cases conformable to the contour of the hill on which it is observed; the rocks here are generally softer than these equivalent beds of Union and Crittenden counties, and, so far as I have been able to obtain measurements, the rocks are found to be thinner.

At Mr. Williams' I listened to one of the legends of the country, which appears to be fully credited by the people. This story, as related to me, details, with much apparent accuracy, the direction, size, and condition of certain great lodes of lead, not yet worked in this part of the country; also, of certain mines of silver, said to exist near the margin of the coal field. The relator of this information informed me that nothing but his great age and ill health prevented him from opening and operating the mines, whose existence he had communicated to me. Nothing, however, that I was able to observe at these localities, would warrant me in giving any encouragement to these fancies, but rather to discourage any hope of these visions of wealth

*Petersburgh is station No. 1002 of the Nashville and Henderson railroad.

being realized. There may be all that the mineral witches declare there is, of lead and silver, but the Mineralogical and Geological signs do not accompany them here, as they do at localities, where lead and silver are found, elsewhere.

From where the millstone grit and sub-carboniferous limestone cross the road, near Mr. William's house, in Christian county, the margin of the former was traced to the Buttermilk road.

Along the great dividing ridge between the head branches of Pond and Tradewater rivers, its east side is abrupt and precipitous, while on the west side the spurs of the main ridge are thrown off flatter, except on the west side of the head of Tradewater, where the hills are also rough, produced either by lines of drainage ploughed into them, or original lines of abrupt bending, and irregular folding of the uplifted heavy masses of the millstone grit.

On crossing the first hill formed by the masses of the conglomerate, between Mrs. Brazier's and Mr. Williams', you descend into a valley of one of the branches of McFarland's creek. On the east side of the road the conglomerate caps the hill from seventy-five to eighty feet thick, with one hundred to one hundred and fifty feet of soft argillaceous shales immediately underlying it.

On the first branch east of Mrs. Brazier's at a short distance north of the road, is to be seen a fine evidence of a fault; the heavy masses of the millstone grit having sunk down. Along a line, on the east side, are the shale beds before alluded to, while on the west is the solid wall of the masses of millstone grit. Near the junction of these measures there bursts from the sandstone side of the fault a bold cold spring of most excellent chalybeate water.

The rocks of the millstone grit, form the bed of Casselbury creek, where it is crossed by the Buttermilk road, near Mr. Alexander Brazier's; on the south side of whose house, and near the *school-house*, is a fine example of the upper intercalated limestone, but no satisfactory section could be obtained. These limestones present the usual "*glady*" appearance. These rocks here dip toward Casselbury creek, i. e., to the north, and sink under the millstone grit. On descending the creek, on a line nearly east and west, the spurs of the hills are crossed at right angles with their length, and are found to be waves formed of solid masses of rocks and shales, from fifty to one hundred feet high from the top of the wave to the bottom of the intervening trough,

here represented by the valleys between the spurs. The band of limestone before alluded to crosses the spurs in a rising line, one wave descending into the succeeding valley or trough, and again mounting and descending. The bending of the strata, by the original force forming these hills, has thrown the limestone up and down with the folds forming these spurs, and on a given line the limestone crosses them like a ribbon resting on their surface. The greatest lie on the axes of the ridges; the least in the valleys between them. On the top of the ridges the dip equals twenty-five to thirty degrees; in the valleys from five to twenty degrees. The buff limestone is here associated with this bed, and is about thirty feet thick; the whole mass of limestone is probably one hundred feet thick. From the base of the intercalated limestone, to the great mass of the sub-carboniferous limestone (?,) the distance is about sixty-five feet, filled with thin bedded sandy shale and flagstones.

In a branch of Casselbury the sub-carboniferous limestone was seen, where it was broken into heavy square and oblong blocks.

The margin of the coal field is deflected very rapidly to the north, from the crossing of Casselbury creek.

I visited the coal bank worked by Mr. Campbell, on the southwest side of the Buttermilk road, where the direction of the dip is north twenty degrees east; the rate two to two and a half degrees; the coal is two feet seven inches thick, the roofing being "grey metal, i. e., grey micaceous shale. This coal rests on a bed of thin under-clay, four to six inches thick; this on hard thin-bedded sandstone. The bank is worked by stripping. The coal is the undoubted equivalent of the Cook coal.

The old Wooldridge bank is an opening into the same bed; it is over this coal that is found the limestone spoken of as being found in the well at Petersburg.

I learned of Mr. Campbell that a bed of thin coal exists on Casselbury creek, one mile to the south of his mine; this is probably the equivalent of the Battery coal; it is said to be one foot thick.

Mr. Wooldridge is now opening another bank, on the east side of a small ridge, about half a mile from the old "*diggings;*" this new opening is in a coal above the limestone, which lies above the coal at the old diggings, but owing to the curving arrangement of the beds I thought it useless, with the Lock level, and the time at command, to

undertake to determine the thickness of the beds intervening between the two beds of coal.

The coal mined at the new opening is of superior quality; the bed presents a face, where seen, three feet high; it is hard, bright, shining, black.* No sulphur ("*or brass*") was observed in the coals at this opening, which is covered by dark sandy shale ("*grey metal.*") This bed is the equivalent of the Bell coal.

Two and a half miles to the northwest the same bed has been worked by Mr. Patrick Hamby; here the greatest thickness observed was four feet four inches; the coal is covered by argillaceous and sandy shale, probably the counterpart of the shale beds observed at the Wooldridge new mine. The difference in the appearance of the covering materials at the two mines is owing, doubtless, to the wasted condition of those at the Hamby mine. It may not be improper here to state that, all the banks mined here, with one exception, (the Terry mine,) are stripped at the tail of the bed, and no regular pits or slopes are made. The materials associated with these beds are very soft, and sections above and below the coals could not be obtained. The only section as yet seen, north of the millstone grit, on this line, was obtained at the Wooldridge old mine, which gave thirty feet from the top of the Campbell (Cook) coal up to the base of the limestone above it—the space being filled with sandy shale. At Mr. Campbell's the limestone was found to be twelve feet thick and upwards. At both places it contains many fragments of entrochites and spirifer. The shales weather to a yellow-grey color. The Hamby bank is not now worked, the stripping having become very heavy. It is situated one-fourth of a mile from, and on the west side of, the Buttermilk road, and eighteen miles from Madisonville, and about a quarter of a mile from the line dividing Hopkins and Christian counties; it lies in the latter county. In the branch which runs through the bed of coal at the workings, the dip of the beds under the coal was ascertained to be to the northwest; the under-clay here is four inches thick, resting on lumpy irregular bedded sandstone. The bed of the coal is wavy and irregular. This coal has also been worked by Mr. George Terry.

About one mile further, to the north, the coal is entered at the north face of a low ridge, where it lies at a much higher level than at the Hamby bank. The same bed is opened in the bed of the branch, one

*See specimens labeled Wooldridge coal, Christian county.

hundred and fifty yards up the stream, from the Terry opening; the coals in the bed of the branch have been stripped, and some coal has been removed; the dip here was north seventy degrees west, at the rate of four or five degrees. On tracing the covering rock down the branch, on the north side of the stream, the coal was traced to a point opposite the Terry opening, on the west side of the road; the coal on this side of the stream having been carried down by the dip thirty feet below the bottom of that exposed in the Terry opening. On the south side of the branch the coal may be traced to the Terry bed, which is entered by the usual form of slope entry, which enters with an ascending dip rising to the south or with the direction of the entry, and the coals are at the entry dipping to the north. A little below the opening on the north side of the branch, sugar-trees, the usual accompanyment of limestone in these measures, are to be found in great abundance. From the data here obtained it is inferred that the limestone is twenty-five feet below the coal, and that the distance between the coals, equivalent to the Cook and Bell coals, is fifty five feet. Hence there appears to be a thinning of the member between these coals, with the insertion of a limestone mass in some localities, as at Mr. Campbell's, from ten to twelve feet thick. The Terry coal mine is on a branch of Buffalo creek. On the left of the road, near Terry's mine, Buffalo creek receives a small branch on the north side. One fourth of a mile up this branch from its mouth is to be seen the following section, which is illustrative of the measures of Wright's ridge. At the locality of this section the end of a ridge is worn off by the action of the waters of the branch, producing an escarpment one hundred feet long and thirty feet high, rising above the surface of the pool at its foot. The face of the escarpment stands in a line nearly north and south, and presents a remarkable stratification, dipping from the centre of the bed, to the north and south, and burying the top of the coal under the water at both ends of the pool.

Section on branch of Buffalo creek, near the Buttermilk road.

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
31.5	12.	Light colored yellow-grey sandstone.
19.5	11.	Grey metal.
8.5	4.	Coal.
4.5	.9	Under-clay.
3.6	3.6	Grey metal.
	.0	Surface of pool.

This coal is the equivalent of the Terry coal.

Ascending the branch, toward the north, several waves are apparent in the measures, gradually rising with the ascending valley. Near the head of the valley, the measures of the section are lost to view under the hill; at the base of which, on the west side, Mr. Croft made an opening into, and has taken coal from, the bed equivalent to the Terry bed, which here lies at a much greater elevation than at that mine. The opening is near the summit of one of the many waves into which the measures are thrown in this part of the coal field. This bed rising and falling with the measures until it disappears under the south side of the first great hill south of Caney creek, and is finally lost to view on the line of this road.

The top of the hill south of Caney creek is evidently capped with the equivalent of the Ice-house, and the lower part of the Curlew hill measures. This hill is separated from the southern prolongation of Wright's ridge by a deep valley, through which a trial line has been run for the Nashville and Henderson railroad, and it was stated to me that a road, with a maximum grade of forty feet to the mile, can be made through this gap, by a cut of sixteen feet at the deepest part, and a fill of twenty-five feet for the valley of Caney creek.

Near the mouth of Cane run, on Caney creek, two miles west of the Buttermilk road, there is an outcrop of coal under black bituminous shales, and over these eighteen to twenty feet of grey metal, which is covered by loose blocks of heavy sandstones, none of which were seen in place; this is probably the equivalent of the Bell coal.

In a northeast direction from the mouth of Cane Run, new and superior members begin to appear.

It now became apparent that the line traveled had been nearly parallel with the strike line; also, that the dip conformed largely to the external surface of the country, and that few of the hills are raised to a sufficient heighth, above the equivalent of the Bell coal, to contain the next superior bed; until I had reached the first hill south of Caney creek, around whose sides might be traced the denuded edges of the superior measures.

Overlying the coal seen at the mouth of Cane run, near Mr. Joseph Woodruff's, on the Princeton and Greenville road, are to be seen the measures lying first above that coal. The line of the following section lies from Cane run, along the road toward Mr. Woodruff's house.

Section near Mr. Woodruff's, in the valley of Cane run.

Heighth. Ft. In.	*Thickness.* Ft. In.	
45.00	15.00	Thin bedded fine sharp grit sandstone.
32.	3.2	Sandy shale.
28.10	2.6	Coal.
26.4	1.2	Under-clay.
25.2	1.6	Clay filled with limonite ore.
32.8	.8	Black bituminous shale.
23.0	2.4	Coal.
20.8	.8	Under-clay.
20.0	20.0	Covered space.
.0	0.	Bed of Cane run.

There are many blocks of limestone associated with the above section; their bed could not, however, be certainly traced in place; these blocks of limestone have been used to repair the public road in the vicinity of the coal outcrop, as they can be found in the washes and water-worn gullies cut into the soft part of the mass, and are buried in the debris of the coal and clay, both above and below both beds of coal. A more extensive opening on this bed would easily determine the place of the limestone.

This bed, at this point, dips to the northeast at the rate of ten to fifteen degrees.

On the north side of Mr. Woodruff's house, four hundred yards distant from the point of the foregoing section, black bituminous shales are seen in the bed of a branch; these beds are much bent and curved, having been disturbed by a great number of waves, but they have much less dip than the measures of the preceding section. They are covered by the soil and clay of the valley of Cane run, but are no doubt connected with, and are part of a bed of shales seen on Caney creek, at the mouth of Cane run, about three-fourths of a mile distant, to the southeast.

Some segregations of bituminous carbonate of iron are seen here. No decided dip could be obtained.

Half a mile eastwardly lies the foot of "Dozier" hill; here is presented the next member succeeding the section last given. The Princeton and Greenville road has laid bare a bed of sandy micaceous shale, near the "Christian Privilege" meeting-house. The bed of shale forms the body of the point on which the meeting-house stands, rising about fifty-five feet above the ravine, on the northwest side of it.

In this ravine, and probably at the base of the shale beds above, are to be seen several blocks of ferruginous limestone, which could not be traced to any regular bed. Irregularly disseminated in the shale bed, above the limestone, are a number of thin broken bands of clay ironstone.

Having now arrived at the base of the great hills, which are here known under many specific names, they will, for the sake of clearness, be treated of under the general appelation of Wright's ridge.

The ridge is prolonged towards the west, in a high range on the north side of Caney creek, presenting, on its south face, a bold front deeply indented by narrow and nearly parallel ravines, from which flow, during the wet season of the year, Cane, Buck, Fox, and Pigeon runs, besides a number of nameless drains, all entering Caney creek on the north side of that stream—the longest of these runs being about five miles, by a direct course from the head to the mouth of the stream, all nearly south—some of the steepest of the steep hill sides presenting, along their length, the outcrop of four different beds of coal—the same beds being repeated on all of these branches with more or less modification.

Flowing towards the west, from the ridge, are first: Richland creek, with a number of small tributaries, still further north; Sugar creek, and its branches, on the north slope of the range; and from its folds and wrinkles, Stuart's creek, and its branches, descend nearly due north.

The equivalent of the first, second, third, and frequently the fourth coals of Union county, under the Anvil Rock, appear in natural outcrop at numerous places on those creeks, from Caney creek to the Hunting branch. What is here said of the west side of the ridge is true of the east side, also, with certain modifications. Flat creek and Pleasant run rise in the ridge and flow toward the east. Between these streams the ridge is prolonged nearly to the mouth of Drake's creek. In many places, however, nearly surrounded by deep valleys, called gaps, which cross its line.

Ten miles north of Caney creek the Hunting branch and Stuart's creek join their waters, and form Clear creek—the Hunting branch flowing from the east, and joining Stuart's creek, which flows from the south, forming nearly a right angle with Clear creek, which flows to the southwest.

A territory here, with its southern boundary on Caney creek, with a breadth six of miles from the mouth of Cane run, extending to the north ten miles, covering about fifty-four thousand acres, presents probably as many natural outcroppings of six different beds of fine workable coal, as are to be found in a district of like size in any coal field, if not more.

The facts here exhibited may be explained on the hypothesis that the axis of Wright's ridge, which has a general course north and south, is crossed nearly at right angles by a series of waves, elevating and depressing the measures composing the ridge.

These waves carrying the same measure, from the anticlinal to the synclinal axes, upward and downward, from fifty to one hundred and fifty feet, with a distance from north to south, of from a half to three-fourths of a mile, from the summit of the wave to the summit of the succeeding one, gradually sinking deeper and deeper below the horizon of the last preceding wave. At the same time there is an axis of elevation rising from the flat land on the east side of the ridge attaining the greatest elevation, near the longitudinal axis of the ridge; then again dipping toward the flat lands of Richland and Clear creeks. The amount of this elevation and depression crossing the ridge varying, in different places, from seventy to two hundred and twenty feet.

On the south face of the spur of the ridge lying parallel with Caney creek, and near the Christian Privilege meeting-house before alluded to, is an out-crop of coal, known as the Charles Woodruff bank. The coal has been stripped, and a small amount taken from the tail of the bed, which is four feet seven inches high. The dip here is south, or a little west of south, at the rate of two or three degrees. There is some doubt as to the precise direction of the dip, but the coal certainly dips from the axis of the hill. This is the first bed on the south side of the basin, in this district, that exhibits calcareous spar in the fractures of the coal. The coal is hard and firm, and not unfrequently breaks with a choncoidal fracture. The roof of the coal is very black bituminous shale, from five to six feet thick.

There is no heavy sandstone to be seen here, but about one hundred feet above the coal, and one-fourth of a mile to the west, is a bluff of solid sandstone, weathering into rock houses, resting on fifteen feet of blue argillaceous shale. The sandstone, measured in a favorable place, is nineteen feet thick: its upper exposed surface is

eighty-five feet below the top of the hill, mostly of soft materials. About forty-one feet above the rock, is a belt of calcareous material, some fifteen or twenty feet wide, which seems to result from the waste of a limestone; its out-crop does not show on the surface at this place, but was found afterwards in place fifteen to sixteen feet thick.

Further west the equivalent of the Charles Woodruff coal outcrops in the bed of a small branch, at about the same horizontal level as that coal. Descending this branch to Cane run I examined the several out-crops on the land of Mr. John Davis.

The following section, taken from one of these out-crops of the bed here exposed to view, will give its general character, although it is variously modified at every different locality.

Section on Cane run, from one of the so-called beds of black band ore.

Heighth. Ft. In.	*Thickness.* Ft. In.	
17.4	10.0	Black shales, top of exposure.
7.4	.6	Pyritiferous shales and coal.
6.10	.4	Hard black shale.
6.6	2.0	Pyritiferous shales, eighteen to twenty-four inches.
4.6	.6	Irregular sandstone.
4.00	2.6	Pyritiferous argillaceous shale.
1.6	1.6	Sandy shale.
	.0	Coal in bed of creek from three inches to two feet thick.

At one of the points on Cane run, where the foregoing section was made, a six-inch coal rests on a bed of sandy micaceous shales, full of fine specimens of stigmaria, in a good state of preservation. They are generally flattened, or partially crushed, and sometimes eleven feet in length, but too delicate to preserve entire* with the means then at my disposal.

By a section obtained near here of strata, exposed forty-five feet above the last section, no openings having been made, I am not able to say whether there is a workable coal or not. I am rather led to believe it is only a thin band of black bituminous shales, covered by bluish argillaceous shale, and thin micaceous sandy shale. It is highly probable that the former bed has been thrown up, and that this out-crop is only a part of the upper members of the last cited section.

All the materials in this particular locality are very soft. The hills

*See specimens collected, marked Cane run, Hopkins county.

and points are round and smooth; the ravines are deep, and cut through the clay down to the soft argillaceous or sandy shales.

At all the points observed on Cane run, the dip was in either the south, southeast, or southwest direction. No rocks were observed dipping at the northward, except at Mr. Joseph Woodruff's.

On one of the head branches of Cane run, which runs from the east toward the west on the northside of the spur of Wright's ridge, called "*Dozier*," is to be observed the equivalent of the Charles Woodruff coal. This last out-crop is on the land of Mrs. Nancy Morgan, and the bed is here known as the "Nancy Morgan coal."

The ravine in which the branch has its course being one of denudation, the out-cropping coal bed is seen on both sides of it. The dip is from one to two degrees to the southwest.

Crossing a spur of "*Dozier*" to the head of Fox river, in an eastwardly direction, I visited, on the run, two exposures of one of the most distinctly marked beds of coal in this region. One of these exposures is near the water level of the run; the other lies about one hundred yards further to the east, i. e., down the run.

This last exposure gives the following section:

Section of Fox Run coal, on the lands of the "Hopkins Mastodon coal company."

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
44.0	15.0	Covered space.
29.0	8.0	Bituminous shale.
21.0	4.0	Coal.
17.0	1.6	Under-clay.
15·6	3.3	Sandy shale.
12.3	2.3	Rough ferruginous limestone.
10.0	10.0	Micaceous and sandy shale.
	.0	Bed of Fox run.

This is bright and hard, exhibiting very little sulphur. A small quantity having been mined three years before my visit, was found lying near the outcrop; it was very bright, and is evidently a good coal to resist the destroying effects of exposure.

At this point the measures dip eastwardly; nearly south the bed has fallen to a lower level by a dip in that direction, and at forty feet from the place of the section, on the north side of it, the measures are falling toward the north. Here is probably the summit of one of the waves before alluded to, as crossing Wright's ridge.

On a branch of Flat creek, on the east side of Wright's ridge, four miles north of Caney creek, and near the "*Mitchell Old Field*," is an out-crop of the equivalent of the bed of the John Davis section on Cane run.

From the locality, at the *Mitchell Old Field*, the bench covering the next coal above this horizon, may be traced up a drain coming into Flat creek from the south side, to the place of the section which will be hereafter given. From which place, the heavy mass before alluded to, as covering the coal, may be traced down Flat creek to the crossing of the Madisonville and Hopkinsville road, where the coal also out-crops; at seventy-five feet above the equivalent bed, at the *Mitchell Old Field* locality; it is also seen out-cropping in the bed of the drain leading from the tunnel of the Nashville and Henderson rail-road to Flat creek, showing the upper part of the "Black Band Bed."

The same coal bed may also be traced, by the covering mass of sandstone, up Flat creek to the Box Mountain springs. Up the right hand, or north branch, the Black Band may be traced through the gap across the ridge, to the headwaters of Stuart's creek, while up the south, or left hand branch, the coal above it is easily traced, by the sandstone before alluded to, to the very source of the stream, there being many places, on both sides of the branch, when the coal is itself exposed in outcrop. Some of these exposures have been slightly opened.

There is great difficulty in obtaining the thickness of the rocks, or the interval between the coal beds, which arises from the uncertainty as to the direction of the dip for any considerable distance, and from the fact that the dip so generally conforming, in some considerable degree, to the sloping hill sides, the thickness is almost certain to be made too great by a quantity equal to the amount of the dip, and the data for the correction of this error cannot be obtained with any degree of certainty.

All the localities of the so-called Black Band ore, on Cane run, Stuart's, Richland, and Flat creeks, are no doubt the out-crop of the same bed, and although there is great difference in the character of the bed, in different localities, but from the relation this bed bears to the next succeeding measure in an ascending order, (which is so distinctly marked as to be unmistakeable,) I have no hesitation in placing all the Black Band localities in the same Geological horizon.

The differences to be found in sections taken of this bed, at a distance of three or four miles asunder, are not greater than of those at the same out-crop, within a few feet of each other. The last remark will apply with great force to the localities on Cane run.

The following section taken across one of the spurs of Wright's ridge, called "*Barney's ridge,*" is probably the most reliable section—reaching from one coal bed to another—obtained in the ridge country. The line of the section being very short, and measured nearly with the direction of the strike line, while the vertical distance differs from the horizontal dent about as three to one.

Section at Barney's Ridge, half a mile south of the Mitchell's old field.

Heighth. Ft. In.	*Thickness.* Ft. In.	
166.	20.0	Covered space to top of ridge.
146.	14.0	Sandstone?
		Coal?*
132.2	37.4	Steep bank, partly covered and partly sandy shale.
95.0	26.0	Steep face of bluff, principally thick bedded sandstones.
69.0	12.00	Hard mass of sandstone.
57.0	16.0	Steep bank, covered with loose sandstones.
41.0	4.0	Black bituminous shale. This mass probably extends higher.
37.0	5.0	Coal.
		No under-clay.
32.0	2.6	Pyritiferous sandy shale.
29.6	4.0	Top of limestone, loose blocks.
	25.0	Base of rough blocks limestone; covered space mostly sandy.
7.0		Shales, seven feet in sight, at
	.0	Bed of branch.

At the head of the south fork of Flat creek, one and a half miles from the Box mountain springs, the out-crop of the coal, placed at one hundred and thirty-two feet in the last section, is to be seen in out-crop, in a notch in the hills at the heads of that and Richland creek, at the very summit of the ridge dividing these two streams. The coal, at the base of the section before given, having been traced the entire length of the valley. Here the ridge is much wasted by denudation, which has cut out the upper coal immediately at the notch, on either side of which the hills are much higher than at the notch itself.

*This bed was afterwards seen in place; it is the equivalent of the Bear Wallow coal, &c.

The following section, taken on the southeast side of the notch, includes the upper part of last section:

Section at Bear Wallow, head of Richland and Flat creeks.

Heighth. Ft. In.	*Thickness.* Ft. In.	
69.	18.0	Covered space above sandstone, composed of waste of sandy shale.
51.6	10.0	Heavy sandstone.
41.6	1.6	Black bituminous shale.
40.00	2.0	Coal.
38.0	1.0	Under-clay.
37.0	37.0	Sandy and argillaceous shale, near the base of which are several thin, broken bands of carbonate of iron, from half an inch to two inches thick.
.0	0.0	Base of shales at covered space.

The bed of shale, and the carbonates at the base of the above section, strikingly resemble the covering mass at the "*Gordon coal*" bank, on the south east side of the ridge.

The coal at the Bear Wallow is seen in out-crop on both sides of the notch, descending by a rapid dip towards it; conforming, in a great degree, to the surface of the ridge. On the south side of the notch the dip is to the north; while on the north side the dip is south. The Bear Wallow is evidently situated upon, or near a line of fracture which runs up the south branch of Flat creek, crossing the ridge at the Bear Wallow. It may also be traced for some distance down the valley of Richland creek; a similar line of fracture also crosses the ridge by the line of the north branch of Flat creek, and is finally lost to sight in the valley of Stuart's creek.

From the top of the ridge, near the Bear Wallow, an extensive prospect is opened to the south and west, extending from the ridge across the flats of Richland, Clear creek, and Tradewater river, to the margin of the coal field; around which extends a barrier of hills, formed by the upturned edges of the beds of millstone grit and sub-carboniferous limestone; taking in at one view the line of hills from the headwaters of Casselbury creek, the longest branch of Tradewater river, to the hills at the mouth of Piney creek. Thus exhibiting, at one view, the line of the margin of the coal field extending through Christian and Caldwell into Crittenden county, a line seventy-five or eighty miles in length, varying in distance, from the observer, from twelve to thirty miles.

On the south side of Clear creek, near the Madisonville and Princeton road, is to be seen an opening into a coal, here known as the *Barret bank*. This opening is situated on the north face of the hill, about seventy-five feet from the bed of the creek.

This bank gave the following section:

Section of the Barrett coal bank.

Heighth. Ft. In.	*Thickness.* Ft. In.	
185.0½	100.0	Covered space to top of hill.
83.0½	2.4	Marly shales, grey and dove colored, with segregations of iron stones.
82.8½	.4	Black marly shale.
82.4½	.8	Black marly shale with segregations of limestone.
81.8½	.4	Black bituminous shales.
81.4½	4.5	Coal.
76.11½	.2	Parting clay.
76.9½	1.9½	Coal.
75.0	75.0	Covered space.
	0.0	Bed of creek.

The same bed of coal was visited, where it had been worked by Mr. P. M. Robinson, on the south side of Clear creek. The coal lies near the level of the creek, and gives the following section:

Section of P. M. Robinson's coal bank.

Heighth. Ft. In	*Thickness.* Ft. In.	
89.2	70.0	Space covered by soft materials.
19.2	1.0	Shale in sight, at foot of covered space.
18.2	3.4	Coal.
14.10	.4	Coal rust.
14.6	1.2	Parting clay.
13.4	1.5	Sandy shale.
11.11	3.0	Limestone.
8.11	.8	Marly shales.
8.3	1.7	Black bituminous shale.
6.8	4.2	Coal.
2.6	.2½	Parting clay.
2.3½	2.3½	Coal.
	.0	Top of under-clay, the thickness not seen.

The coal is soft, iridescent, much marked with pyritiferous matter. The beds, at the opening, are dipping to the northeast at one or one and a half degrees. The beds again come to the light near the bed of the creek, about half a mile above the Robinson bank. No good

section could be obtained here. The bed has the same limestone covering, which lies much nearer to the lower coal here than at the Robinson bank.

The dip observed at this bank was six degrees, in a direction north fifteen degrees west. Still further up the creek, an opening has been made into a coal called the *Marston* Hall bank. A section of all the materials, at the openings, could not be obtained, I am, therefore, unable to identify this as the equivalent of any of the beds heretofore seen. The distance from this to the last *bank* is about half a mile. About fifty yards to the northwest the bed of the creek is a pyritiferous limestone?

A section from the bed of the creek up to the coal is as follows:

Section on Clear creek which includes the Marston Hall coal.

Heighth. Ft. In.	*Thickness.* Ft. In.	
98.0	20.0	Covered space to top of point.
78.0	3.0	Black bituminous shale.
75.0	4.6	Coal. The whole bed was not seen.
70.6	55.0	Covered space up to bottom of exposed coal.
15.6	2.6	Sandy shale and flagstones.
13.0	12.0	Sandy shale with ironstones.
1.0	1.0	Limestone?
.0	.0	Bed of Clear creek.

Dip to northwest; rate one degree.

The two last localities observed are separated by the valley of a branch entering Clear creek from the south. On the line of this valley is to be observed great irregularity, both in the amount and direction of the dip. Near this last branch, called Stuart's creek, and high in the hills, an examination was made of a coal opened by Mr. Hiram Oldham. The following arrangement was presented here:

Section of the Hiram Oldham coal bank.

Heighth. Ft. In.	*Thickness.* Ft. In.	
9.10	2.6	Black bituminous shale.
7.4	0.5	Marly shales with segregations of limestone.
6.11	1.3	Rotten or partially decayed coal.
5.8	3.2	Solid coal; good quality.
2.6	.2	Parting clay.
2.4	2.4	Coal.

The under-clay is not exposed, except at its upper surface.

The belt of calcareous shales presented at this opening a lenticular mass, fifteen feet in length, and one foot thick in its thickest part, gradually thinning away to a line at either end.

It is probable the limestone at the Barrett and Robinson banks are here represented by this mass of marly material.

No bed of coal was discovered in the ravine below the Oldham coal. This coal lies from one hundred and fifty to two hundred and fifty feet above the bed of Clear creek, about three-fourths of a mile ot the southeast of the Robinson bank.

Before closing my report on the Wright's ridge country I will add a few remarks, to those already made, on the subject of the so-called bed of Black Band. All the known exposures of this bed in the country having been visited, the following section on the headwaters of Stuart's creek, will be added.

Section of so-called Black Band bed at head of Stuart's creek.*

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
1.9	.6	Black bituminous shale.
1.3	.1	Black *band*, (productive?)
1.2	.1	Black shale.
1.1	.1	Black *band*, (productive?)
1.0	.3	Black shale.
.9	.1	Black band, (productive?)
.8	.3	Black shale.
.5	.1	Black band, (productive?)
.4	.2	Black shale.
.2	.2	Black band, (productive?)
	.6	Shale.
	1.0	One to two feet bluish clay.

Segregations of limestone, probably part of a bed of limestone.

It may be also added that no two localties ever furnish the same section of ore or separating masses. The average of many localities may be set down at eight inches, and that all the out-crops of the Black Band are in the same Geological horizon. It will also be necessary that special examination be made of the ores of each locality to determine their value.

Northwardly of the head of Flat creek, and on the east branches of Stuart's creek, several out-croppings of the coals appear near the

* See analysis of specimen, No. 132, page 337, report 1854–55.

road from Madisonville to Hopkinsville—one known as the Arnold bank.

An entry has been driven into the coal about sixty yards, in a direction south fifteen degrees east, which direction lies across a spur of a hill.

The coal descends from the mouth of the entry for a short distance, with a slight dip; then it runs level for a short distance, descending again, with step like grades, at the rate of about six inches in twenty-five feet.

The section of the Arnold bank, east fork of Stuart's creek, is as follows:

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
22.8½	14.00	Covered space, including yellow micaceous shale.
8.8½	1.6	Black shale.
7.2½	4.9	Coal.
2.5½	.2	Parting clay.
2.3½	2.3½	Coal.
	.0	Top of under-clay.

Down the same branch, northwestwardly from the Arnold bank, is to be seen the Bart. Sisk bank; here the direction of the dip is north fifty degrees east, and the rate two and a half to three degrees, being greatest at the most westwardly exposure. This bank gives the following section:

Section of the Bart. Sisk bank.

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
19.4	4.0	Black bituminous shale.
15.4	2.0	Coal.
13.4	1.0	Under-clay.
12.4	1.6	Marly shale.
10.10	4.6	Shale with segregations of bituminous limestone.
6.4	4.3	Coal.
2.1	.2	Parting-clay.
1.11	1.11	Coal.
	.0	Top of under-clay, thickness not ascertained.

On the opposite side, a little further down the same branch, to the west and southwest, the same bed has been opened. On the north side of the branch the coal soon disappears, under the bed of the branch as you descend it, or to the west, where the upper bed of coal

in the foregoing section is covered by a massive sandstone, twelve to fifteen feet thick.

Northwardly, for two and a half miles, no out-crop is seen, until immediately in the vicinity of Madisonville, where a limestone is exposed resting on a bed of argillaceous shale. Under this limestone is an abundance of water; springs break forth wherever it is worn through. From Madisonville the limestone dips westwardly for some distance, at the rate of about sixty feet to the mile.

Continuing northwardly from Madisonville and Ashbysburg road, I passed over a country mostly composed of soft materials. Thin bedded micaceous sandy shales were observed in the road two miles north of the town. The country is gently undulating, with high lands three and a half to four miles to the northwest. At the deep cut the line of the Henderson and Nashville railroad was intersected, where is a bed of loose textured sandstone, forty feet thick; it rests on a mass of blue pyritiferous shale; the dip is northeast, and the cut exposes many lines of fracture in the mass. The line of the railroad was followed until it crosses the Asbysburg road, at a distance of three miles from the deep cut. As the road lies in the valley of a branch there are no good Geological sections here. The boundary of the valley consists of low hills and undulating land.

The Ashbysburg road leads off to the west and northwest, crossing the head branches of Deer creek, and intersecting the Madisonville and Henderson road near Mr. Orr's. There are said to be some coal openings on the branches of Deer creek, which I was unable to visit.

Near the intersection of the Madisonville and Henderson road with the road from Morganfield to Madisonville, the country begins to exhibit protrusions of the millstone grit, extending from the disturbances; at which are situated, two and a half miles distant to the northwest, bold and constant springs of limestone water (?) The wasted and worn condition of the farms along the road mark the area of the underlying millstone grit, brought up by the extension of the Bald Hill fault.

The transition on the east side of the road here is probably from the millstone grit to the Coal Measures, equivalent to the Jerusalem school-house range, of Union county, which lie high in the series between the "Blue" (Bonharbour?) and the Newburgh beds. It would be exceedingly interesting to settle these opinions, by an examination of the country here in detail. This being on the northeast side of the

fault (?) it is probable that a different state of case may exist on the southwest side of it; it is probable that the *lower coals* may be found out-cropping on the slopes of this great ridge on the south and southwest side, duplicating the coals of the Coal Measures, as at Chalybeate and Bald hill. Having, as yet, made only three hurried journeys through this district, I am not prepared to give any precise information of the country lying between the surveyed part of Union and Hopkins counties.

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CHAPTER II.

OBSERVATIONS IN

Greenup and Carter, and incidentally in Bourbon, Bath, Fleming, and Lewis counties.

Before proceeding to report on the progress of the surveys in Greenup and Carter counties I shall make a few remarks on observations made in a few other counties along the line of travel into these counties.

All the rocks observed westwardly of Owingsville, in Bath county, belong to the Lower Silurian division, as indicated by the contained fossils, viz: *Leptæna alternata, Orthis occidentalis, Orthis (spirifer) lyra, Murchisonia bicincta?*

The disintegrated rocks around Paris produce a reddish-brown soil, increasing in depth of color, with local exceptions, to within four miles of Mt. Sterling, where it gradually becomes less red as you go northeastwardly toward Owingsville, beyond this the soil is of a dirty lemon-yellow color, with locally strips of whitish clay (crawfish) lands. Near Mr. Jackson's, four miles from the Licking river, towards Owingsville, the surface gives some indications of iron ore.

The top of the hill east of Owingsville is capped with a yellow earthy calcareous stone, containing a few entrochites. This yellow member was first noticed at this locality; from observations made on this formation in December I should estimate its thickness to be from seven hundred to one thousand feet. From Slate creek to near the mouth of Triplet's creek the road runs over this member, which is the principal rock of the first range of Knobs, first seen in the distance toward the southeast, after leaving Mt. Sterling.

A short distance, after crossing the main fork of Licking river, the Devonian Black Slate was first observed on the line of this road. Near the mouth of Triplet's creek, on the south side of the road, the Black Devonian Slate presents bold bluffs, about fifty feet high, with a slope of an equal heighth above the bluff, evidently the wasted materials of the same formation, which is at least as thick, if not thicker, here than it is in the vicinity of the falls of the Ohio.

On either side of the valley of Triplet's creek, along which the road runs, the hills are based on the slate, and are capped with the same knob sandstones which form the Salt river hills in Bullitt county.

Triplet's creek has its course along a fracture or valley of this formation, nearly parallel with the strike line, and its waters flow upon it for twenty miles. The dividing ridge at the head of Triplet's creek, and between it and the waters of Tygert's creek, rises from four to five hundred feet high, above the waters of the mouth of Triplet's creek, and are composed of the knob-stone.

Three miles from the mouth of Triplet's creek the knob-stone is surmounted by masses of chert breccia. I am not certain whether these masses belong to the upper or lower division of the sub-carboniferous group, as I have not yet observed any fossils in it.

The general dip of the rocks on Triplet creek is with the line of the drainage, and towards the stream itself, which flows in an original sloping valley, whose contour is not produced, as one might at first suppose, altogether by denudation.

After descending six miles from the dividing ridge at the head of Triplet's creek, down a branch of Tygert's creek, the road then leaves the branch, and turning to the left crosses a heavy hill two hundred and fifty to three hundred and fifty feet high, above the valley on either side of it. Towards the top a bed of limestone ten or twelve feet thick, is in place above the road, which, on the northeast side, continues to traverse the knob-stone until within a short distance of Olive Hill P. O., where the limestones of the sub-carboniferous limestone set in. One mile further northeast the road crosses Tygert's creek, which here has its bed in a gorge cut into the sub-carboniferous limestone; and the rocks are dipping to the northeast.

One mile from the crossing of Tygert's creek the millstone grit is first seen. The belt of the sub-carboniferous limestone is about two and a half miles wide along the line of the road, and is probably three hundred to three hundred and seventy five feet thick, including the intercalated grey shale beds. For about one mile the road runs northeast and southwest, on the top of the masses of the millstone grit, which is here nearly horizontal; then the road takes a bend more to the east, and crosses the hills, which are capped with the shale beds at the base of the Coal Measures, consisting of soft shaly sandstones and grey shales, without any beds of hard sandstones. After passing this

hill, and descending on the opposite side, a limestone is cut by the road. The sandstone of the millstone grit thins out rapidly as we go northeastwardly.

From the top of the hill to the southwest of Grayson, to the Little Sandy river, the rocks dip toward the river rather more rapidly than the surface of the country, which carries down the rocks forming the hill tops before alluded to, and at the ford of the river forms the bed of the stream.

The following approximate section extends from the rocks at Little Sandy river, to the foot of the hill, southwest of Owingsville:

Total thickness. Feet.	Thickness of each member. Feet.	
2520	100	Soft beds at the base of the Coal Measures, in Carter county, with locally a bed of limestone, twenty inches thick, intercalated. This member varies in thickness in different localities.
2420	75	Seventy-five to one hundred feet millstone grit. This member, as well as the sub-carboniferous limestone, thins out toward the Ohio river near the mouth of Tigert's creek, where this member forms a mass fourteen feet thick, and the sub-carboniferous limestone is only twelve feet thick.
2345	100	Calcareous muddy shale, with a few thin beds of limestone.
2245	350	Sub-carboniferous limestone, thinning rapidly in the direction of the Ohio river.
1895	20	Twenty to seventy-five feet grindstone grit, (upper part of Knob formation?)
1875	725	Knobstone, Waverly sandstone of Ohio.
1150	120	Black (Devonian) slate, 100 to 150 feet thick.
1025	700	Buff porous limestone of Lewis, Fleming, and Bath counties.
325	75	Limestone producing red earth by disintegration.
250	100	Slaty mudstone, thin bedded.
150	150	Lower silurian or blue limestone, forming the base of the Owingsville hill.

In reporting upon the progress of the work in Greenup and Carter counties, it will be necessary to premise that the facts embodyed in the report have been mostly derived from a reconnoisance, in advance of the detailed work of the topographical party.

The eastern coal field was entered in a favorable direction for study-

ing its members from the base upwards, which I consider the best method, since the millstone grit is always a good base of departure.

At the crossing of the Little Sandy river this stream here flows in a bed worn into a mass of dark sandy micaceous shales, immediately above which rests the little, or eight inch, coal of Stinson's creek, which I consider the lowest coal in these measures. An opening has been made into this coal, about one hundred yards to the left of the road, at the foot of the first hill beyond Stinson's creek, but no satisfactory view of the coal and the associated measures could be obtained, as the drift had fallen in. The Stinson cannel coal shows itself in a number of places in the hills at the right of the road adjacent to Stinson's creek. This bed is worked here by Mr. James Clark; the bed at this place lies about forty feet below the top of the hill.

The following approximate section, here given, is the best I am at present able to furnish; most of the quantities are from actual measurement:

Section of the Stinson creek connel coal, and the associated beds, descending to the millstone grit.

Thickness. Ft.	In.	
18.	00	Covered space, consisting principally of sandy shales.
2.	0	Black bituminous shale, partly wasted.
	.8	Bituminous coal.
	.4	Clay streak
1.	9	Cannel coal.
1.	0	Under-clay.
40.	0	Sandy shales.
18.	0	Heavy sandstone.
32.	0	Shaly sandstone, soft and generally thin bedded.
	.8	Coal, (lowest coal here.)
1.	2	Under-clay.
50.	0	Sandy shales, equivalent of shales at cropping of Little Sandy.
1.	8	Limestone.
4.	4	Soft shales and shaly sandstone.
	.0	Upper part of millstone grit.*

All the workings I have seen of the cannel coal have been made by stripping the coal bed. The softness of the covering materials renders a perfect section, from natural outcrop, nearly impossible.

* This is a continuation of section heretofore given, pages 153, 54, and 55.

At three and a fourth miles from the crossing of Stinson's creek the heavy sandstone at Star Furnace caps the hill, dividing the waters of Stinson's and William's creek.

Under this heavy sandstone are two beds of argillaceous shales, separated by seventy feet of sandy shales; the upper bed is only a few inches thick, while the lower is several feet. The lower bed has been worked for iron ore, and furnished some good patches of ore, but no regular bed has been discovered in any of the shale beds at this locality.

Northeast of these ore diggings, and beyond the hill, is the Star Furnace Branch of Williams' creek. The Star Furnace is founded upon the rock which caps the hill to the southwest, and over which rests the Star Furnace Coal; this sandstone also underlies the Catlettsburgh, Reiley, Barrett, Cushing, and Williams' coal; also, the lower coal at the Williams' creek tunnel, and the twin coal near Ashland.

The following section applied above the Stinson creek cannel coal, will bring that section up to the Star Furnace coal:

Section at the Star Furnace, Carter county.

Thickness. Ft. In.	
25.0	Covered space.
4.0	Sandy shale.
2.0	Coal.
.4	Parting-clay.
2.6	Coal.
1.6	Under-clay.
20.0	Alternations of sandstone and shale.
	Ore bed, Kidney ores in shale.
35.0	Alternations of shales and sandstones.
.5	Black clay streak.
26.0	Star Furnace sandstone.
80.0	Dark-grey sandy shales,
	Sandy and argillaceous alternating.
	Place of Stinson creek cannel coal.

Thirty-seven feet below the twin coal of the foregoing section, is the position of the "Blue Ore" beds, which are estimated at the furnace at about three feet thick.

Descending the branch from the furnace, toward Williams' creek, the rocks are found dipping, in an eastwardly direction, a little more rapidly than the slope of the country. A mile and a fourth from the furnace the road makes a sudden bend down Williams' creek, which

runs more to the north, (about N. 20° E.;) here the rocks are seen along the side of the road nearly on the strike line, and are generally found to conform, in a very considerable degree, to the contour of the spurs of the hills that come down to the rocks, rising the points, and descending to the valleys between them, so that every point is an anticlinal, and every ravine a synclinal axis—the rise being about equal to the fall. This state of case continues, with slight modifications, along the line of the road from the mouth of the Star Furnace Branch to the mouth of Catletts' creek; sometimes the rocks are found rising as high as three hundred and fifty feet.

From the mouth of the Star Furnace Branch, by the line of the road, to the Williams' creek tunnel, no new measures come in. The rocks rise and descend with the road line, or the measures rise and descend again in waves, the greatest elevation of which is probably fifty feet.

The materials, as well as the thickness of the individual members, are very much modified as they are traced from the Star Furnace Branch to the tunnel on Williams' creek; and were they not followed step by step, and never lost by the eye, they would hardly be recognized as the measures of the Star Furnace, yet they are their equivalent.

A starting point for the detailed surveys of Greenup and Carter counties was made at the south end of the Williams' creek tunnel, on the Lexington and Big Sandy railroad. The first line was carried from this point to Catlettsburgh, and from thence extended over the county. The lines of this work have been plotted, and reduced to the scale of $\frac{1}{50.000}$. There being large tracts of country not reached by these lines, the streams and roads only have been laid down; when the work has been sufficiently completed, and the lines brought sufficiently near each other, it is proposed to lay down the hills, and cross the map, in several directions, with geological sections, which will be done during the present season.

Passing over the hill at the tunnel, which is the dividing ridge between Williams' creek and the east fork of Little Sandy river, the waving arrangement of the rocks is such that the upper member of the coals at the tunnel rises nearly to the top of the highest ridge, and again fall toward the valley of the east fork of the Little Sandy, thus

bringing the lowest coal at the tunnel, i. e., the equivalent of the Star Furnace coal, down to the bed of the stream.

On the east side of the stream, near the water line of the creek, (now nearly dry,) is to be seen the equivalent of the lower coal at William's creek tunnel, which I shall hereafter distinguish as the Twin coal.

Section of Twin coal near bridge, east fork of Little Sandy.

Heighth. Ft. In.	*Thickness.* Ft. In.	
30.8	10.0	Grey shale, with Kidney ore and small bands of carbonate of iron ore.
20.8	2.4	Blue shale, (or grey metal.)
18.4	2.4	Coal.
16.0	6·0	Sandstone with oblique lines of deposition, equal to 45° from the horizon.
10.	1.	Coal.
9.	1.	Under-clay.
8.	2.	Fine grained sandstone.
6.	2.	Dark sandy shales.
4.	4.	Covered space probably shales.
	0.	Pool above bridge.

The reader may contrast this with that at the north end of the tunnel.

Section at north end of Williams' creek tunnel.

Heighth. Ft. In.	*Thickness.* Ft. In.		
95.11	35.	Covered space to top of hill, mostly shales.	
60.11	1.	Sandy shale.	
59.10	1.1	Argillaceous shale.	
58.9	1.2	Argillaceous shale, dark.	
57.7	1.6	Grey sandy shale.	
56.1	1.5	Black bituminous shale.	
54.8	1.0	Slaty coal.	
53.8	1.0	Yellowish-grey argillaceous shale.	
52.8	1.6	Bituminous coal in blocks.	
51.2	.7	Under-clay from five to eight inches.	
50.7	5.10	Indurated *fine clay*.	
44.9	.7	Coal.	
44.2	9.4	Yellow and bluish shale.	
34.10	31.0	Sandstone, heavy bedded.	
3.10	1.6	Fire clay.	
2.4	1.8	Coal, 1 foot to 2 feet.	Twin coal. One member lost.
.8	.8	Under clay.	
	.0	Bottom of tunnel.	

Section at south end of Tunnel, about 800 *feet distant from place of last section.*

Heighth. Ft. In.	*Thickness.* Ft. In.	
80.4	29.0	Sandstone.
51.4	1.	Coal.
50.4	2.	Under-clay.
48.4	6.0	Shaly sandstone and shales.
42.4	·6	Coal six inches to two feet.
41.10	.2	Carbonate of iron.
41.8	5.0	Argillaceous shale.
36.8	1.8	Pyritiferous ore?
35.0	35.0	Upper part of sandstone, equivalent of the Star Furnace sandstone.

With the exception of the six feet sandstone, in the last section, there is a great similarity between this coal and the lowest coal of the previous section; this sandstone also thins out and disappears in the short distance between the ends of the tunnel.

There is associated with the sandstone and shales below the Star Furnace coal a ledge of rock of a dark-grey color, about four feet thick, in many places exfoliating in thin scales of a ferruginous character, to which I would call your attention. (See specimen, No. 1001.)

The timber of the country in the northeast part of Carter county is generally white oak, beech, poplar, and some maple in the valleys. The soil is of a light yellow drab color, and thin.

Half a mile from the "east fork" is the village of Cannonsburgh; from this point the road, which runs up a tributary of the east fork, towards the mouth of Big Sandy, is nearly in the direction of the strike line; the conformity of the rocks to the shape of the hills is not so apparent immediately on the line of the road as it is on either side of it, at a short distance from it.

The sandstone above the upper coal at the tunnel generally rises to the tops of the hills—sometimes in an unbroken bluff on both sides of the road in the valleys, above which it rises sometimes about seventy five feet.

Descending the hill forming the western limit of the water shed of the Big Sandy this sandstone presents a remarkable appearance, which appears to have originated in a sliding motion of the beds from the S. W. toward the N. E. Here, also, certain bands of different colored

earths were first observed, which subsequently materially aided me in defining the Coal Measures elsewhere, both in Greenup and Carter counties, where horizons of sandstone and limestone were absent, as is the case in about two hundred feet of these measures lying above this sandstone, with a few exceptions, and these are quite local, or of very limited area; while these bands of colored earths are of great extent, and may be found in roadways and water-worn ravines, on almost every hill side composed of this geological equivalent. These bands will consequently be referred to frequently, as they form a distinguishing feature in many of the succeeding sections.

The sandstones of equivalent beds are more massive at the mouth of Catlett's creek than they are at the head of the creek, or on the head of Key's creek. Two of the distinguishing masses of sandstone, i. e., the mass over the Star Furnace coal, and the Star Furnace sandstone, which are separated by many feet of shales, coal, &c., come together and form one mass, on the farm of Mr. Gartrell, on the Ohio river; also, the bluff between Ashland and Hood's creek presents a similarly constituted mass; where these beds are thus brought together the coal equivalent to the Star Furnace, or twin coal, is absent.

From the mouth of Catlett's creek, (the line of which is a fault where it emerges from the hills,) the rocks rise as you go down the Ohio river; they also rise as you ascend the valley of the creek, equal to the ascent of the valley nearly to its head. The rocks also rise rapidly as you ascend the right hand branches of the creek, or to the northwest and south.

On the Horse branch, one mile below the mouth of Catlett's creek, the twin coal is worked by Dr. Cushing, on the east side of the branch —the coal having been again brought down to the level of high water of the Ohio river by a curving dip, conforming partially to the shape of the ridge dividing the Horse branch from Catlett's creek. A short distance from the mine of Dr. Cushing, Mr. Williams has opened the equivalent bed on the west side of the branch. The coal here gives the following section, varied at different openings:

Section Dr. Cushing's bank.

Heighth.	*Thickness.*	
3.7	2.0	Coal.
1.7	.7	Parting-clay.
1.0	1.0	Coal.
	.0	Top of under-clay.

The equivalent bed of coal near the mouth of Catlett's creek, is as follows:

Section of coal, mouth of Catlett's creek.

Heighth.	*Thickness.*	
3.2½	1.5	Coal.
1.9½	.9½	Parting-clay.
1.0	1.0	Coal.
0.0	.0	Top of under-clay.

This opening is estimated at sixty-five feet above low water of the Ohio river; it is covered at high water.

On Catlett's creek, half a mile above the place of section last given, the following section, with the associated materials, was obtained.

Section of (Twin coal) at Reiley's mill.

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
182.3	100.0	Covered space.
82.3	21.0	Heavy sandstone.
61.3	8.0	Place of coal?
53.3	18.0	Covered space.
35.3	12.0	Sandstone.
22.3	1.1	Coal.
21.2	.8	Parting-clay.
20.6	1.0	Coal.
19.6	3.0	Under-clay.
16.6	10.0	Drab argillaceous shale.
6.6	.6	Irregular belt of carb. of iron, varying from 8 to 3 inches.
6.0	6.0	Yellow-grey shales.
.0	.0	Sandstone bed of creek.

The bluff on the Gartrell farm, before alluded to, is one hundred and twenty-two feet eight inches in heighth, with a soft space near the center dividing it into two hard masses; the soft space is mostly soft sandstone, with a few hard thin bedded flagstones; it varies, where best seen, from two to eight feet. The rocks forming the lower end of this bluff dip to the southwest, at the head of a short ravine. At this point are seen a few thin and broken sheets of coal, wedged into and between the flagstones of the centre, or soft mass of the bluff; also, many impressions of fossil plants. The bluff is carried by the dip, about three-fourths of a mile from the Ohio river, to the rear of the city of Ashland; where it is composed of the mass forming the upper part of the bluff above the city and the mass, over the Clinton Furnace coal, which is worked in several places near the city. Below the

city the bluff, equivalent to the Gartrell bluff, again approaches the river, the two masses of sandstone still in close contact. This bluff continues unbroken to the bank of Hood's creek, where the great sandstones are again separated, and receive between them the equivalent of the *twin coal* and a small amount of shales. Here the coal is quite thin; near the centre of the bluff it is locally capped with limestone, which extends from the railroad, near Ashland, to Hood's creek, one and a half miles below. This is only about a mile from Bellefont Furnace. In this short space a most noticeable change has taken place, which is the introduction of a bed of argillaceous shales between the base of the limestones capping the bluff above Hood's creek and the sandstones on which they rest at that point.

The following sections of the equivalent measures at Hood's creek and Bellefont Furnace, will illustrate the character and extent of this change:

Section at Hood's creek.

Heighth. Ft. In.	*Thickness.* Ft. In.	
70.1	8.0	Earth stripping above limestone.
62.1	3.4	Shales, argillaceous.
58.9	.3	Limestone ore, three to ten inches.
58.6	4.0	Limestone, four and a half to five feet.
54.6	1.0	Shales.
53.6	21.0	Coarse sandstone, frequently full of waterworn pebbles.
32.6	2.6	Streaks of coal and shale.
31.0	31.0	Sandstone.

Under the sandstone at Hood's creek ford, twenty-eight feet below base of section, sandy shale.

Section at Bellefont Furnace.

Heighth. Ft. In.	*Thickness.* Ft. In.	
104.10	15.0	Clay stripped to raise ore and limestone.
89.10	.10	Limestone ore, eight to twelve inches.
89.0	3.00	Limestone, one to four feet.
86.0	2.00	Fire clay.
84.0	18.6	Bluish-grey shale.
65.6	15.0	Sandstone; no pebbles observed.
50.6	14.0	Black and blue-grey argillaceous shales.
36.6	3.6	Coal. Thin clay parting.
33.0	2.0	Under-clay.
31.0	31.0	Sandstone.

At three-fourths of a mile from the Ohio river the road from Ashland to the Clinton Furnace intersects the line of bluffs, and ascends then by a gentle ascent. The coal mined near the road here is the equivalent of the coal mined near the Clinton Furnace. In the vicinity of these openings in the coal is to be seen a sandstone, remarkable for the coarseness of its texture, and for the softness and want of cohesion of the particles composing the upper part of the mass. This mass of sandstone overlies the coal, and in some districts serves as a a Geological horizon. The rocks dip towards the valleys, viz: On the east side of the road towards the valley of Key's creek, and on west and southwest towards the valley of Hood's creek. Half a mile from where the hills* commence the land is nearly level, or gently roling; further from the Ohio the measures dip to the southwest towards the small branches of Little Hood's creek, while to the left, or east side of the road, the dip is to the northeast, or toward the small branches of Key's creek. Two miles from the Ohio river a synclinal axis crosses the road at right angles with it; beyond this the rocks again dip to the northeast and north, towards this depression of the measures, after this on to the ridge dividing Key's and Little Hood's creeks.

The soft sandstone alluded to, as being above the coal on this road, may be traced, around the hills, either up Key's or Hood's creeks, to the neighbourhood of Clinton Furnace. The upper part of this sandstone is excessively soft in many localities. Above this soft sandstone the same variagated earths were observed, elsewhere alluded to. The indellible tints of these earths, derived from the weathering of the strata overlying this sandstone, afforded an excellent clue to the identification of the equivalent measures of Greenup and Carter counties, where the rocks themselves were not seen in place—since these colored earths may be seen in the cuts of the roads, the gullies, and slopes of the hill sides, when no rocks are in view.

The following section, taken in the cut of the Clinton Furnace road, is an illustration in point, as are several of the succeeding sections:

*Boulders and gravel of the drift period, have been deposited upon these hills, and on the flat country north of the main dividing ridges. These hills are from one hundred and fifty to one hundred and seventy-five feet high above the banks of the Ohio, at Ashland. No drift was observed at a greater elevation than these hills, nor in the valleys very slightly elevated above the banks of the river, nor on any of the streams behind the range of hills separating the Ohio river from the small streams running parallel to its course.

Section in road from Ashland to Clinton Furnace.

Heigth. Ft. In.	*Thickness.* Ft. In.	
186.0	8.0	Sandstone.
148.0	3.0	Yellow shale.
145.0	2.0	Black clay streak.
143.0	5.0	Yellow shales.
128.0	11.4	Top of red streak.
106.8	10.8	Top of sandstone, and foot of red streak.
96.0	11.0	Sandstone.
85.0	5.0	Top of red streak.
80.0	16.0	Bottom of red streak, above sandy shales.
64.0	5.0	Sandstone, fifteen inches thick.
59.0	32.4	Yellow-grey shales.
26.8	16.0	Foot of yellow streak.
10.8	10.8	Small gravel ore in road.
0.	.0	Top of soft sandstone above Ashland coal, equivalent of the Clinton Furnace coal.

The following section, taken near the Clinton Furnace, starts from the top of the sandstone under the Clinton Furnace coal, (it is also the equivalent of the sandstone over the Williams' creek tunnel coal, Star Furnace, Catlett's creek, and Horse Branch coal, and is distinguished here as the sandstone between the coal in the well and the Clinton Furnace coal,) will serve to show the relation of the ore beds here to the quantities between them:

Section at point of hill northeast of Clinton Furnace.

Heighth. Ft. In.	*Thickness.* Ft. In.	
117.8	38.0	Top of the bench, and bottom of a five-foot red streak.
79.8	42.4	Ore diggings, Kidney ore.
37.4	37.4	Ore diggings in sandy shale.
0.	0.	Top of sandstone over Well coal, and under Clinton Furnace coal.

The following section taken of the hill from Mr. Burwell's house, near the Clinton Furnace, will further connect the ore beds, and will also serve to show their relation to the bands of colored earths and associated materials:

Section at Mr. Burwell's house.

Heighth. Ft. In.	*Thickness.* Ft. In.	
216.4	8.00	Top of sandstone covered with red earth.
218.4	12.0	Sandstone in two beds, locally underlaid by fourteen inch bed of ore.
206.4	14.0	Yellow sandy shales, much disturbed by slipping.
191.4	5.4	Top of sandstone in solid ledges five feet.
186.0	5.4	Foot of sandstone.
180.8	10.0	Fossilliferous sandstone, fine grained, probably united by a calcareous cement; the fossils are calcareous; locally this is the place of the "top hill Bastard limestone ore." The fossiliferous bed is eight inches thick, and lies between thin beds of sandy shales.
178.8	24.0	Sandy shales fifteen feet thick.
154.8	1.0	Top of black streak 10 to 15 inches thick.
153.8	3.0	Brown-red fire clay.
150.8	3.0	Brown-red fire clay.
147.8	10.8	Block ore beds, (from 147.8 to 156. are the beds producing the fifteen feet red streak or band.) "Red block" of the furnace men, ten to twelve inches thick.
137.0	21.0	Sandy and clay shales alternating.
116.0	8.0	Top of five-foot red streak.
108.0	2.8	Whitish shales, argillaceous above and sandy below.
105.4	1.4	Top of sandstone, four ledges.
104.0	3.0	Sandstone.
101.0	16.0	Clay shales.
85.0	16.0	Sandstone in shale beds eighteen inches thick.
69.0	27.0	Sandstone one foot thick in sandy shales.
42.10	10.0	Sandstone eighteen inches thick in sandy shales.
32.0	11.8	Thin sheet carbonate of iron, two to three inches thick.
20.4	4.4	Top of Clinton Furnace coal.
16.0	16.0	Mouth of entry ditch, fire-clay bottom.
.0		Sandy shales and shaly sandstone.
5.		Hard sandstone over cistern or well coal.

The following section was taken from the equivalent measures of Carter county, about one and a half miles from Mount Savage Furnace. This section will illustrate the remarkable increase in thickness of the strata, as well as the great change in the materials composing them:

Section at Mount Savage, Carter county. This section starts at a point equivalent to thirty-two feet in the preceding section.

Heighth. Ft. In.	*Thickness.* Ft. In.	
378.0	6.0	Top of hill near "Iron road."
372.0	20.10	Top of heavy sandstone.
351.2	10.6	Foot of exposed part of heavy sandstone.
340.8	48.0	Heavy sandstone, top of steep slope.
292.8	16.0	Argillaceous shales, highest point in road.
276.8	1.0	Yellow streak.
275.8	15.0	Red streak, large amount of small surface ore.
260 8	10.8	Top of sandy shales.
250.0	5.4	Soft sandy shales.
244.8	16.0	Top of red streak, and foot of sandy shales.
228.8	4.4	Top of yellow streak, and bottom of red sandy shales.
223 4	5.4	Bottom of "Rough Block Ore;" three feet thick at this point.
218.0	5.5	Foot of sandstone.
212.8	16.0	Place of Kidney ore diggings in road.
196.8	5.4	Place of limestone ore, as seen on next hill to the eastward, where the bed is extensively worked, both by stripping and drifting.
191.4	16.0	Top of sandy shale.
176.4	5.4	Top of black clay streak, between shales four and a half feet thick. (Place of coal?)
170.0	32.0	Whitish clay.
138 0	3.0	Sandy shales.
135.0	14.0	Top of sandstone, twenty inches thick.
121.0	10.8	Ore diggings, "Grey Kidney Ore," in whitish argillaceous shale. Immediately above this ore bed is the five feet "*Red Streak.*"
110.4	10.8	Top of sandstone, twenty inches thick.
99.8	5.4	Three black streaks, whitish clay between.
94.4	10.8	Top of sandstone, fourteen inches thick.
83.8	21.4	Top of black streak, one foot thick, under yellow shales three to four feet thick, (sandy.)
62.4	5.4	Yellow streak, and top of whitish earth gravel ore.
57.0	4.8	Top of sandstone in two beds, twenty inches thick, sandy shale between the bed, four inches thick.
52.4	10.8	Top of sandstone, fifteen inches thick.
41.8	26.8	Top of slope.
15.0	15.0	"Iron road."
0.0		Bed of branch, sixteen feet above Gum branch coal, equivalent to Clinton Furnace coal.

Passing round the head of the Gum branch the different beds of ore, equivalent to the measures of the preceding section, have been

opened and extensively worked, on the slopes of the hills, at a greater or less elevation, depending on the displacement of the rocks. On the north side of the hill, from which the section was taken, a bed of block ore of excellent quality has been worked, about seventy-five feet below the base of heavy sandstone capping the hill. This bed was not seen on the south side of the hill.

Near Mount Savage Furnace two beds of coal are seen. The bed out-cropping near Straight creek, below the Furnace, is doubtless the equivalent of the Star Furnace (twin coal.) The bed opened above the furnace, and on the Gum branch, is the undoubted equivalent of the Clinton Furnace coal.*

The following section is from the equivalent of the Clinton Furnace coal, worked near the Furnace, Mount Savage Iron Works:

Heighth.	*Thickness.*	
Ft In.	Ft. In.	
27.6	20.0	Sandstone.
7.6	3.0	Grey shales.
4.6	2.0	Bituminous shale.
2.6	2.6	Coal.
.0	.0	Top of under-clay.

Section of same bed, three-fourths of a mile to northeast, on Gum branch.

Heighth.	*Thickness.*	
Ft. It.	Ft. In.	
22.0	15.0	Slope, partially exposing sandstone.
7.8	3.0	Three to ten feet grey argillaceous shale.
4.8	1.2	Black rash with clay streaks.
3.6	1.0	Bituminous shale.
2.6	2.6	Coal 1.6 to 2.6 inches.
.0	.0	Top of under-clay.

This out-crop faces the N. E., and the covering rock is much softer than at the first section near the Furnace, which faces the S. W. It is quite common to find the same bed of sandstone softer where the exposure faces the north than where it faces the south. These sandstones are much less affected, by the action of water and frost, on the southern than upon northern exposures.

The last section has a horizontal elevation of about seventy-five feet above the first. The rocks dip down the Gum branch toward Straight creek.

*See section at Reiley's Catlett's creek coal.

To the north, one-fourth of a mile, the same coal is seen near the road side, from one hundred and fifty to one hundred and sixty feet higher than the Gum branch section, no doubt by displacement occasioned by a fault, which has let down the Gum branch coal and its measures, or has lifted up the measures, on the north, or hill side. The line of this fault runs up the left hand branch of Gum branch by a course to the northwest. It is probable that it crosses the ridge at the head of the ravine. Its extent and character has not been particularly examined. Passing down Straight creek, a short distance below the Furnace, the equivalent of the twin coal of the Star Furnace, Catlett's creek, &c., is seen with the associated materials, on the north side of the creek. It is probable that a continuous section of all the beds may be obtained on this creek, from the Stinson creek cannel coal to the top of the section at Mt Savage. The materials under the twin coal, were seen in place here. A fine grained sandstone, lying in beds, from six to eighteen inches in thickness, forms the first member below the under clay of the coal, and is about twelve feet thick. The under clay here is from two and a half to three feet thick. Under the sandstone bed, above alluded to, lies a bed of ash colored shales, which is no doubt the equivalent of the shale beds seen at the foot of the ridge between Greenup and Buena Vista Furnaces. The same mass of shale is well presented in the coaling grounds of the Star Furnace on Cane creek, about two and a half miles south of Greenup Furnace, where a thin bed of coal may be seen in the shales twelve feet below the sandstone. This coal begins in a thread-like line on the north, and increases toward the south, in half a mile to fourteen inches thick. It has no under-clay. From the mouth of Straight creek, in the direction of the road to Grayson, the measures, rise but they have not yet been traced by the detailed survey. The sandstone above the lowest coal, in this part of the basin, is seen in the bed of the little fork of Little Sandy, at the first crossing below the mouth of Straight creek, also three fourths of a mile lower down the little fork, fifty feet above the level of the stream.

At the salt wells on Little Sandy, the brine is found in the upper part of the millstone grit. It may be possible that the bottom of the wells do not penetrate the millstone grit, but reach only the fractures through which the brine rises. The shale beds resting on the millstone grit here are of no great thickness. Passing down Little Sandy,

about a mile below Grayson, the millstone grit is seen on Barrett's creek, and the sub-carboniferous limestone, about one and a half miles above the intersection of the road with the creek, where the same order is observed as on the turnpike, which fully confirms the previous remarks made in reference to the sub-carboniferous limestone, on the N. E. side of the dividing ridge between Tygert's creek and Little Sandy. The measures are decidedly thinner on Barrett's creek, than where the turnpike crosses Tygert's creek, but no detailed measurements have been made here.

The Kenton salt well is situated in the bed of Tygert's creek, which is here worn down into the knob-sandstone. The well is on the farm of Mr. Jacobs, about six miles northwest of Grayson.

On the west side of the creek the following section was obtained:

Section near Mr. Jacobs' house.

Heighth. Ft. In.	*Thickness.* Ft. In.	
164.	32 4	Elevation of hill at Mr. Jacobs' house.
131.8	31.4	Top of millstone grit.
100.4	13 4	Sub-carboniferous limestone in place.
90.	57.0	Drab shales in place.
42.	42.0	Ledge of Knob sandstone in place.
0.	0.	Bed of Tygert's creek on Knob sandstone.

In the bed of the creek, at the base of the above section, are seen numerous lines of fracture, crossing the creek by a course N. 30° E. From one of these fractures rises the brine, which was manufactured into salt on the first settlement of the country by Simon Kenton.

On the east side of the creek one-fourth of a mile from the Kenton well are several caves which are formed in a local bed of coarse grindstone grit lying immediately under the sub-carboniferous limestone. The grains of sand forming the grindstone grit are probably cemented by a calcareous cement and the rock is the cavernous member of Carter county. In some localities the bedding faces of this rock is thickly studded with angular fragments of Hornstone or flint. Extensive diggings may be observed in many places in this neighborhood, at the outcrop of the sub-carboniferous limestone, often covering half an acre or more of ground. The excavations are shallow, only about six or seven feet deep. The people of the country have various opinions as to the origin and object of these works. Some of the old workings having been recently opened, a good opportunity was thus afforded to make

an examination. The materials thrown from the recent opening were a reddish friable earth, fragments of limestone, fragments of flint, and kidney shaped seggregations of flint, weathered out of the adjacent limestone. These are quite symmetrical, about five inches long, three inches wide, and from one and a half to two and a half inches thick. They split at right angles with the long diameter, and perpendicular to the thickness, thus producing long oval pieces with parallel faces. The largest produced are four inches long, from one and a half to two and a half inches wide, and from a quarter to three eighths of an inch thick. Bushels of the ends of these nodules were discovered near some of the workings, with some fragments of the oval pieces, few or none in an entire state, hence I infer that these diggings were made by the aborigines of the country for the purpose of procuring the material from which they made their arrow-heads.

Where the grindstone grit was observed, on the first branch above Mr Jacobs' farm, it separates into slabs from three to six inches thick, in the line of the deposition of the sand, which forms an angle of 30° with the superior and inferior faces of the regularly stratified layers. These rocks will afford good grindstones, both for neighborhood use and shipment. The bed is, as we have said, local, and does not cover a very great extent of country. For the present I refer them to the upper members or last beds of the knob-stone division of the sub-carboniferous rocks. Its thickness varies from a few inches to twenty-five feet. My examinations were next directed across the drainage of the country, nearly north from the small creek entering Tygert's creek at the narrows, to Grassy creek, and thence over the hills to the North fork; thence to a large creek called Three Prong; (not laid down on Millne & Bruder's map;) thence down Three Prong, three-fourths of a mile; thence across the hills to Leatherwood creek; thence down that creek two miles; thence across the hills to the head branches of the south fork of White Oak creek, and Kenton Furnace; thence down White Oak by the road to Greenupsburg; then with the line of the Ohio river to Springville.

All the creeks crossed by this route to Greenupsburg have thin beds of this grit on the knob-stone, which sometimes rises sufficiently high to compose the entire dividing ridge; at other localities a thin capping of sub-carboniferous limestone and millstone grit; at others, in addition, a few feet of the lower member of the Coal Measures, are to be found on the

top of the highest ridges. Along the entire line from Tygert's creek there is manifestly a thinning of the sub-carboniferous limestone, millstone grit, and the Coal Measures, evidently marking the margin of the coal basin towards the northwest. It is highly probable that many of the beds found in considerable force east of Little Sandy river will be found, on examination, to have entirely thinned out, even before they reach that river; other beds lying three or four hundred feet higher in the series east of Little Sandy, may, on White Oak creek, be found resting on the millstone grit, which has thinned out to twelve feet, and here rests on the knobstone—the sub-carboniferous limestone having entirely disappeared. It is highly probable that the line of the margin of the basin was frequently changed, from the time of the deposition of the knob-stone to the end of the coal period.

The coal basin being shallower near the margin, the measures between the ore beds are much thinner here, and the ore beds much closer together here than east of the Little Sandy. There is reason to believe, from the evidence seen on my route from Tygert's creek to the mouth of White Oak creek, that the line of least disturbance during the coal period, was not far from this line; where the route crossed Grassy creek the line of least disturbance was three or four miles to the northwest. It is worthy of particular note that the ferruginous depositions have here extended to the edge of the basin, and ferruginous materials have been infiltered, or have even run over the denuded sub-carboniferous limestone, as may be well observed at the limestone quarry of the Kenton Furnace.

Beds of reddish marly clay are frequently seen resting on the millstone grit, from five to ten feet in thickness. At every step, from Tygert to White Oak creek, are convincing proofs of the thinning out of the sub-carboniferous limestone and millstone grit; at some points the sub-carboniferous limestone either was never deposited, or has been swept away by denudation before the deposition of the millstone grit, which in some localities is seen resting on the knob-stone series: at other localities constituting a mass from twelve to twenty-five feet thick. The underlying member—the knob-stone—has, on the other hand, experienced an enormous expansion. At one locality it was found six hundred and thirty feet thick, without including a portion of the base of the formation under the drainage.

The lowest ore bed observed locally rests on a bed of chert; the same bed, when the chert is absent, rests on the sub-carboniferous limestone and frequently fills fisures in that rock, extending down to the top of the knob-stone. The ores found in this geological horizon belong to the Hematitic class.

On Grassy creek a new furnace is in process of erection. The stack is built upon and into the masses of the knob-stone, the lower part being excavated into the solid mass of this member in place, the material for the walls and inner lining are obtained from the same formation. I think it extremely doubtful whether this stone will be found to stand fire well.

The ores on which the main dependence is placed to supply the furnace lie on the top of the hills, associated with the chert bed of the sub-carboniferous limestone. I visited some of the localities where the ores are now being tested, at one, lying one and a quarter miles from the furnace, the ores are found between chert beds, and are of variable thickness; from one inch to ten or fifteen. The bed on which the ores rest slopes toward the valley at an angle of about fifteen degrees, and is of a very uneven surface, full of irregular shaped cavities, of unequal size and depth, the margin of these cavities touching the margin of all surrounding ores. It is into these holes that the ore has infiltrated, filling some and partially filling others, leaving a surface of ore and a few points of the bottom to form a surface somewhat less rough than the bed on which the ore rests. Upon this last surface rests a bed of chert and the debris of the millstone grit above it. The opinion expressed at the furnace is that the best ores lie at the head of Grassy, or to the west. In my opinion the best and most abundant ores are to be sought down Grassy or to the east.

The following section was taken at one of the ore beds of Grassy Furnace:

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
48.	23.0	Top of hill; masses of millstone grit.
25.	25.0	Foot of millstone grit; covered space.
0.		Ore bed from one inch to fifteen inches thick, resting on a bed of chert.

Some few of the highest ridges north of Grassy, and south of Three Prong, are capped by a few feet of the materials forming the base of the Coal Measures; and the ore beds, equivalent to those

worked at Kenton Furnace, may be found in some of them. The valleys are from one hundred and fifty to three hundred feet deep, and as before stated, are in part or entirely sunk into the masses of the knob-stone. The sides of the valleys are in many places perpendicular walls.

In traveling through the country, from one valley to another, the small branches are usually followed to the top of the dividing ridge; the ridge is then followed until another suitable branch offers for the descent into the next valley. Good roads, except by the lines of the valleys and branches, are an impossibility. Practicable roads may be had along the valleys.

The remarks, in reference to the dip of the rocks, and their conformability to the contour of the hills made of the measures upon Triplet's creek, are equally applicable here, and of the whole line traveled from the narrows of Tygert's creek to Greenupsburgh.

Section on White Oak, near Kenton Furnace.

Heighth. Ft. In.	*Thickness.* Ft. In.	
272.10	36.2	Top of hill.
236.8	20.8	Red streak, shown by road wash.
216.0	15.6	Loose chert in road.
200.6	185.0	Top of second bench of knob-stone.
15.6	15.6	Foot of abrupt part of hill.
.0	0.0	Bed of white oak creek.

On the north side of this hill ores are now being dug. A section was carried from these openings, and the place of the ores located in the foregoing section.

Section on north side of hill.

Heighth. Ft. In.	*Thickness.* Ft. In.	
272.	15.6	Top of hill, and top of the foregoing section.
256.6	15.6	Top of thin masses millstone grit? and locally, place of clay ironstone.
241.	10.4	Base of sandstone; millstone grit?
228.	0.	Top of block ore, six to eighteen inches thick, under ten feet four inch clay shales.

There is a thin bed of shales under the ore bed, which rest on the knob-stone. It may be possible that the sandstone quarried as millstone grit in the above section, may be one of the sandstones of the Coal Measures. If this be the case the sub-carboniferous limestone and millstone grit are both absent at the place of the section.

The bed of ore heretofore worked at the Kenton Furnace, lying under and in the fissures of the sub-carboniferous limestone, is probably of the same geological period as the ore beds under the chert at some, and upon the beds of limestone in other, localities. The ores in the fissures of the limestone at Kenton Furnace are peculiar to this locality, so far as I am at present advised.

From the mouth of Little Sandy, river and for some distance up that stream, the knob-stone forms the mass of the hills, which have a capping of the superior measures of from fifty to seventy-five feet. The remark is equally applicable to the river hills of the Ohio. From the mouth of Sandy to Springville along the line of the Ohio river hills, in a few places, are found beds of limestone, probably belonging to the sub-carboniferous period.

The following section, taken near Springville, does not include the entire thickness of the knob-stone division—part of the mass lies below the bed of the Ohio river:

Heighth.	*Thickness.*	
Ft. In.	Ft. In.	
677.6	69.6	Top of hill.
608.	22.0	Top of grindstone grit. Member of knob-stone?
586.	218.0	Covered space, principally shales.
3 8.	19.4	Top of ledges of rock, and foot of shales.
348.8	17.6	Thick masses of drab-grey rocks.
331.2	5.2	Thick masses of iron stained rocks.
326.	5.2	Thick masses of blue-drab rocks.
320.10	32.0	Ledge flesh-grey rocks.
298.10	21.0	Ash-grey shales.
277.10	28.	Ash-grey shales with flagstones intercalated.
149.	16.	Slope covered by land slide.
133.	91.	River road.
42.	42.	Sawmill.
0.		Low water Ohio, October 1856.

At a short distance from Greenup Furnace is a thin coal, lying under the bed of Cane creek. The openings into this coal, which is mined for blacksmith's use, were fallen in, and no measurements could be made of the coal.

The following section was taken of the hill immediately above the coal:

Heighth. Ft. In.	*Thickness.* Ft. In.	
154.10	21.8	Top of hill at point.
133.2	47.6	Second bluff.
86.6	40.0	Top of first bluff, upper part of shales.
26.6	16.6	Foot of sandstone bluff.
10.0	10.0	Blue shales.
0.		Top of coal.

This coal is slaty, and said to be eighteen inches thick.

The following section is from the equivalent beds of the section last given, immediately opposite Greenup Furnace, where the materials composing the hill are better exposed:

Section at Greenup Furnace.

Heighth. Ft. In.	*Thickness.* Ft. In.	
144·8	32.0	Top of hill, sandy shales.
112.8	32.0	Foot of red streak. Some ore has been taken out here.
80.8	24.8	Top of black bituminous shale, eighteen inches thick.
56.	6.0	Top of thick sandstone, and foot of thin sandy shales.
50.8	13.0	Foot of thick bedded sandstone.
39.0	17.8	Thick bedded sandstone, thin bedded ledges 7 feet thick.
21.4	21.4	Foot of thick masses sandstone, containing many casts of fossil shells, mostly spirifer.
.0	.0	Top of shales above coal 16.6 inches thick.
16.6	16.6	Top of coal, under bed of branch.

The following section is from the point of the ridge between Greenup and Pennsylvania Furnaces, ascending, from the valley of Cane creek, by the line of the road from Pennsylvania Furnace to the quarry of limestone. The section begins at the top of the sandstone, at thirty-nine feet in last section:

Heighth. Ft. In.	*Thickness.* Ft. In.	
244.8	16.0	Top of hill, loose rough sandstone.
228.8	11.8	Rough block ore bed.
217.0	44.4	Top of covered slope.
162.8	92.8	Soft sandstones on top of sloping covered space, mostly beds of sandy shale.
70.	11.0	Foot of steep sloping covered space.
69.	32.4	Small ore in road.
37.8	10.8	Bottom of bed of argillaceous shale.
27.	7.	Sandy shales in place.
20.	20.	Top of steep rounded slope.
0.		Top of sandstone.

About a mile to the northeast of the terminating point of the foregoing section, and on the same ridge, is the quarry from which the limestones used at Greenup Furnace are procured.

The following section taken at this quarry will exhibit the arrangement here:

Heighth. Ft. In.	*Thickness.* Ft. In.	
42.10	26.6	Top of hill, covered space, loose sandstone on top.
16.4	5.0	Surface exposed by cut at quarry.
11.4	3.0	White argillaceous shale.
8.4	1.0	Black clay streak.
7.4	3.3	Silicious argillaceous clay.
4.1	.6	Limestone ore bed.
3.7	1.4	Blue-grey sandy shales containing numerous silicious segregations, hard and compact.
2.3	.6	Ledge of limestone.
1.9	1.0	Ledge of limestone.
.9	.9	Ledge of limestone.
0.0	.0	Blackish sandy shales, with carbonaceous partings.

It was very desirable, that this limestone should be traced to other localities. Its geological place could be traced, but owing to the softness of the covering masses no outcrop could be found. The thirty feet of materials immediately above are very soft, and the chances of the limestone being found in outcrop, unless exposed by a land slide, are rare indeed.

About one hundred and fifty yards from the quarry, and on the east side of the same ridge, and nearly on the same horizontal level, is an ore bank which has recently been opened in argillaceous and fine sandy shale, producing beautiful, fine-textured, clear-bright red ore, in part, and part grey—"*see specimen* 91, *Greenup county.*" This ore, in its external character, resembles the *eisenkalkstein* of Fallenburgh, which you kindly furnished me for comparison with the Greenup county ores. The German ore possesses more evenness of fracture.

About one fourth of a mile to the southeast of the ore bank last mentioned the hill is a few feet higher. An ore bed was formerly worked on the top of the sandstone, supposed to be the equivalent of the sandstone at the top of the section at the quarry.

The following section, taken from a sag in the top of the ridge, will give a few feet of these measures:

Heighth.	*Thickness.*	
41.	4.0	Top of hill capped by four feet clay shales.
37.	21.0	Sandy shale.
16.	8.6	Ledge of sandstone, one foot thick, in sandy shales.
7.6	7.6	Bottom of red streak.
.0	.0	Sag above limestone bed.

In the vicinity of Greenup Furnace a thin bed of cannel coal is seen, lying high in the hills; it is eleven inches thick at the place of exposure. The coal lies ninety-eight feet below the top of the hill, and about one hundred and forty-six feet above the level of Cane run, at the furnace. It is probably the equivalent of the *black* streak, 18 inches thick at 80 feet 8 inches, in the section opposite the Furnace.

CHAPTER III.

Report of the progress of the work on the base line.

Uniontown, Union county, having been fixed as the initial point of the base line, Mr. Joseph S. Harris, with his corps, No. 2, were detailed from the survey of Hopkins, Christian, and Muhlenburg counties, where that corps had been operating during the summer, to conduct this important work.

An approximate determination of the latitude of the initial point was first obtained, at Uniontown, which gave the latitude of this place 37° 46′ 4″.

A monument of stone, three feet long, was placed in the inclosure of Dr. John T. Berry, (marked, on the top, as "initial point of Base line, Kentucky Geological Survey.") The theodolite used for this work was six inches, No. 48, of Windeman make, Washington City, D. C. Reading to 02′. The chain was of steel, thirty-three feet, and adjusted by Christuman's patent two pole steel tape.

Two sets of observations were made to determine the magnetic declination. It had been contemplated to make observations for declination at distances not greater than six miles apart, along the entire line, but it was found to consume too much time, and the weather being frequently unfavorable for such observations, those at No. 1,192 and at No. 3,326 were the only ones found to be practicable. The first gave 5° 58′ 4″ east; the last 6° 22′ 3″ east.* The direction of the line was checked, from time to time, by observations for azimuth, and such corrections made as were necessary.

The distances made by the line are kept in feet. The base line was carried from Uniontown, Union county, to Wm. Smith's farm, near the Hawesville and Hartford road, Hancock county, 322,975 feet, or sixty-one miles eight hundred and eighty-five feet. The line was intended to run due east from the initial point to the Virginia state line, near the corner of Pike county, Kentucky.

*This should be repeated; it is undoubtedly too great, unless part of the effect be attributed to local attraction.

At 187,369 feet, crossing of Green river.
At 233 300 feet, Center of third street, Owensboro'.
At 269,280 feet, Panther creek.
At 296,318 feet, Knottsville.

The plan of the base line will be plotted and ready for the report of the operatives of this summer, 1857.

The map of Hopkins, part of Christian, and part of Muhlenburg, and the map of Greenup, part of Carter counties, &c., are also in a state of forwardness, and will also be ready for the engraver in July or August.

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