TOPOGRAPHICAL

AND

GEOLOGICAL REPORT

OF THE

COUNTRY ALONG THE OUTCROP BASE LINE, FOLLOWING THE WESTERN MARGIN OF THE

EASTERN COAL FIELD

OF

THE STATE OF KENTUCKY,

THROUGH THE COUNTIES OF

CARTER, ROWAN, MORGAN, BATH, MONTGOMERY, POWELL, ESTILL, OWSLEY, JACKSON, ROCKCASTLE, PULASKI, WAYNE, AND CLINTON, FROM A SURVEY MADE DURING THE YEARS 1858-9,

BY

JOSEPH LESLEY, JR., TOPOGRAPHICAL ASSISTANT.

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INTRODUCTORY LETTER.

PHILADELPHIA, November 1, 1859.

To David Dale Owen, State Geologist:

SIR: In compliance with your instructions, I herewith submit my Report of the Geological and Topographical Survey, for determining the western outcrop of the eastern coal field of Kentucky, made during portions of the years 1858 and 1859.

Very respectfully, yours,

JOSEPH LESLEY, JR.,

Assistant in Geological Survey of Kentucky.

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REPORT.

INTRODUCTORY REMARKS.

According to instructions received at the time of my appointment as Assistant of the Geological Survey of Kentucky, on the 5th of April, 1858, I made the necessary preparations to "prosecute and extend the Geologico-Topographical Survey along the margin of the eastern coal field;" and for that purpose started for headquarters, at Lexington, on the 25th of August following, where I was joined by my Assistant, Mr. William Whitehead, and his rodman, and thence proceeded to Irvine, in Estill county, that being selected as the most fitting point from which to commence the *outcrop base line* of the eastern coal field.

Work was commenced upon the 1st of September, and was actively prosecuted until the 13th of December, when the party returned to Lexington, and was disbanded. During the winter Mr. Whitehead was employed in working up the field notes in the office, and in obtaining data, such as copies of surveys made by the State and by the Lexington and Big Sandy railroad, the latter to be incorporated in our own work.

The corps again met at headquarters, in Lexington, on the 11th of April, 1859, and, proceeding to Irvine, as before, started from a point near that town, and pushed the line southwestwardly until it reached the southern border of the State, when the party returned to Lexington, and was disbanded on the 3d of September last, since which time the office work has been constantly in hand.

In running the outcrop base line, roads being selected, an odometer was used for the measurements, and a compass with side telescope and eccentric target for the courses. The compass was furnished with a clinometer for taking the angle of the slopes, enabling the compassman to check the barometric observations which were regularly taken at every station by the target-man; but as one of the objects of this survey was to "serve as the groundwork for the construction of a correct geographical map of the State," it was deemed necessary to follow with the spirit level, in order not only to fix positive starting points for the barometric

observations, but also to establish the exact height above tide of the principal stations along the line. These levels were of additional value for determining the dip of the rocks; while the bench marks, which may be found at nearly every fork of the road, will remain as sure starting points for future State or county surveys. As experience has shown that the original notes of surveyed lines, either for railways, turnpikes, canals, rivers, or common roads, are rarely to be found when wanted, I herewith add a table showing the number, description, and locality of each *bench mark*, with its elevation above low water of the Ohio river, at Catlettsburg, the datum level of the Lexington and Big Sandy railroad, and also above tide, as obtained from the published report of Mr. Ellet on the Mississippi and Ohio rivers:

DESCRIPTIVE TABLE OF BENCH MARKS.

No. of bench mark.	CARTER COUNTY.	LEVELS.	
		Above Catlettsburg.	Above tide.
1	On a sycamore, ¼ mile east from Grayson, and on the left bank of the Little Sandy river	101.079	597.079
2	On the S. E. corner-stone (below string-course) of the court-house in Grayson	200.830	696.830
3	On a beech, ¼ mile east from the Mt. Savage furnace, and 200 feet from the junction of Gum branch with Straight creek	127.054	623.054
	On a beech, 250 feet above R. McGuire's house, and on the north side of the Grayson and Mt. Savage furnace road	126.071	622.071
	On a white oak, in Wolf creek valley, near crossing of Grayson and W. Liberty road	177.080	673.080
4	On a white oak, on the Grayson and West Liberty road, near the mouth of a run above J Savage's house	170.955	666.955
5	On a beech, on the right bank of the Little Sandy, opposite the house of Greenup Clay, and near the Greenbriar creek road	136.275	632.275
6	On an ash, on the left bank of Bruin creek, and at forks of road to W. Liberty	137.382	633.382
7	On a cherry, below Abijah Whitt's house, and at a fork of the road leading to Tygert's creek	201.950	697.950
8	On a beech sapling, (against a poplar,) near H. M. Skegg's house, at a fork of the road leading westwardly to Olive Hill P. O.	336.516	832.516
9	On a beech, at a fork of the road leading to Tygert's creek bridge	345.180	841.180
10	On a white oak, on the dividing ridge between Little and Big Caney creeks, and at a fork of the road leading to Triplett's creek	448.603	944.603
	Bed of Little Sandy river, at the mouths of Laurel and Open forks	150.926	646.926
11	On a sugar tree, 1,380 feet above Cook's store, on the right bank of Open fork	220.617	716.617
12	On a sugar tree, at a fork of the road leading to West Liberty via Enoch's creek	243.199	739.199
13	On a mulberry, 630 feet above the last mentioned forks in road	256.017	752.017
	Water shed, between Open fork of Little Sandy and the North fork of Licking river	532.373	1028.373

DESCRIPTIVE TABLE—Continued.

No. of bench mark.	MORGAN COUNTY.	LEVELS. Above Cattlesburg.	LEVELS. Above tide.
14	On a black oak, near Cox's house and on road leading from Hampton's mill to West Liberty	300.394	796.394
15	On a large chestnut, on the west bank of the Licking river, and near Hampton's mill	266.800	762.800
	Foundation of Hampton's mill	237.453	733.453
16	On a chestnut oak, in the forks of the roads leading to Hampton's mill and to Hazlegreen	721.330	1217.330
17	On a white oak, in the valley of Brushy fork of Beaver creek, and in forks of road to Owingsville	630.639	1126.639
18	On a white oak, near where the Brushy fork road comes into the State road	771.478	1267.478
19	On a small white oak, on "Dry ridge," at the head of McCormick's branch of Beaver creek	789.032	1285.032
	BATH COUNTY.		
	Summit, on State road between Slate and Beaver creeks	765.200	1261.200
	MONTGOMERY COUNTY.		
20	On a large white oak in Slate creek valley, on the right of the State road, and 50 feet west of road leading to Red river	364.594	860.594
21	On a large double black oak, in a grove near the village of Jeffersonville	362.669	858.669
22	On a black oak, on one of the branches of Lulbegrud creek, and at fork of road to Stanton	350.964	846.964
	ESTILL COUNTY.		
	Low water of Red river, at mouth of Black creek, near the Powell county line crossing	123.300	619.300
	Top of the lowest course of stones at the N. E. corner of the Estill furnace stack	765.204	1261.204
	Top of the "State House" rock, near Estill furnace	968.250	1464.250
23	On a black oak, on a dividing ridge between Miller and Cow creeks, to the east of the Cow creek road, (the tree is marked, "221 miles + 2,004 feet")	892.369	1388.369
	Top of the S. W. foundation corner of cells in the new jail in Irvine	203.766	699.766
	'OWSLEY COUNTY.		
62	On a black oak, at a point where the road from Proctor intersects that from Estill furnace to Hazlegreen	763.324	1259.324
	Top of the "Standing Rock," at the corners of Powell, Estill, and Owsley counties	772.784	1268.784
60	On the S. W. corner of the foundation of the steam mill stack, in Proctor, at the mouth of the South fork of the Kentucky river	174.838	670.838
	Low water of Kentucky river, at the mouth of Sturgeon creek	130.359	626.359
59	On a white oak, to the right of road in Duck creek valley, 700 feet above Sturgeon creek road forks	162.253	658.253
58	On a chestnut oak, at a point where the path from Sturgeon creek comes into the Booneville and Irvine road, and on the dividing ridge separating Station Camp creek waters from those of Grassy and Granny-Dismal branches	794.192	1290.192
	JACKSON COUNTY.		
56	On a poplar, in the valley of Wild Dog creek, 50 feet north of the Manchester and McKee road	507.190	1003.190

DESCRIPTIVE TABLE—Continued.

No. of bench mark.	JACKSON COUNTY—Continued.	LEVELS.	
		Above Cattlesburg.	Above tide.
55	On a hickory, at the forks of the Big Hill and Manchester road, on dividing ridge between War fork and Laurel fork	867.103	1363.103
54	On a white oak, in Indian creek valley, 1,600 feet east of the jail in McKee	544.352	1040.352
	ROCKCASTLE COUNTY.		
51	On a large white oak, to the right of the county road, 50 feet from the Madison turnpike, and near Mr. Golding's, on the Big Hill	1058.590	1554.590
50	On a chestnut oak, on the left bank of Roundstone creek, near road crossing below house of Pleasant Fish	417.556	913.556
49	On the N. W. corner of the foundation wall of the Mount Vernon court-house	660.764	1156,764
48	On a black walnut, to the east of the Crab Orchard turnpike, and 125 feet east of Wm. Jones' house, and near forks of road to Skeggs' creek	880.640	1376.640
46	On a sugar tree, marked "6,871," standing on the north side of Skeggs' creek, 1,100 feet above Holbert McClure's house	366.587	862.587
	PULASKI COUNTY.		
45	On a sycamore, in the bed of Line creek, at the junction of the London, Crab Orchard, and Somerset roads	397.612	893.612
44	On a black walnut, in Dobbit's grave-yard, near Dallas P. O.	473.580	969.580
43	On a post oak, on ridge at forks of road to Buck creek, Crab Orchard, and the coal banks	718.159	1214.159
	Low water in Buck creek, at road crossing below W. R. Mize's house	258.900	754.900
42	On a white oak, to the west of Buck creek, southeast of the Bend meeting-house	554.417	1050.417
40	On a black walnut, near the house of John Bratcher Lee, on the Pittman's creek road, on right bank of the creek, and 300 feet from road crossing	340.631	836.631
39	On a black oak, near the mouth of Sinking creek, and near the house of Woods Leece	334.250	830.250
	Low water of the Cumberland river, at Waitsboro'	77.700	573.700
37	On a large elm, on the left bank of the Cumberland river, near the ford below Waitsboro'	107.199	603.199
36	On a black oak, near Long's mill, on the South fork, and at fork of road leading to the Jacksboro' road	396.777	892.777
	WAYNE COUNTY.		
35	On a sugar tree, at the cross-roads, at the Three forks of Big Sinking creek	364.179	860.179
	Summit, (at road crossing,) dividing Elk Spring from Big Sinking creek waters	802.500	1298.500
33	On a red oak, near the Widow Goddard's house, in the Elk Spring valley	477.059	973.059
	Top of the N. E. corner of the N. door sill of the Masonic hall, in the town of Monticello	439.019	935.019
30	On a white oak, ½ mile west of Newberry P. O., at the forks of the Livingston or old Alabama stock road	474.885	970.885
	CLINTON COUNTY.		
29	On a large black oak, near the Widow Owen's house, and at forks of road leading to Rowena	573.201	1069.201

DESCRIPTIVE TABLE—Continued.

No. of bench mark.	CLINTON COUNTY—Continued.	LEVELS.	
		Above Cattlettsburg.	Above tide.
	Summit at Wade's gap	813.800	1309.806
26	On a black oak, between Spring creek and I. Sloan's house, one mile north of Elliott's cross-roads	385.653	881.653
27	On a white oak, east of the Livingston or Alabama stock road, and 80 feet north of the Tennessee State line	523.184	1019.184

The smaller of the two maps accompanying this Report is intended to show at a glance the whole extent of the great eastern coal and iron field of Kentucky. It was compiled from the notes of the Survey, from old maps in the Internal Improvement office, and from railroad surveys, upon the basis of the large published map of the State, and correcting some of its numerous errors. New counties have been inserted, the boundaries of one proposed in the southern part of the State are indicated, and many of the present incorrectly marked lines have been placed in their proper positions.

The second, or large map, represents all the ground covered by the Survey, and is intended to show the positions of the coal openings, towns, county line crossings, and other points of interest; as well as a portion of the east and west parallel base line, the materials of which were kindly placed at my disposal by Mr. S. S. Lyon.

The elevations upon this map are shown by continuous horizontal contour lines, with intervals, representing 50 feet of vertical hight. The scale is three miles to the inch, being a reduction from the original plottings, upon a scale of 500 feet to the inch.

During the progress of the Survey specimens of coal, iron ore, and other minerals, were collected, as also full suites of characteristic soils from the different geological horizons traversed. Attention was paid to the milling power, culture of the soil, pasture lands, and timber, a description of which, in detail, will be found under the head of the different counties.

DESCRIPTION OF THE COURSE OF THE OUTCROP BASE LINE.

In order to render intelligible the numerous references which it will be necessary to make in the Report, I will here describe the route of the

Survey, from its northern terminus, at the town of Grayson, in Carter county, to its southern terminus at the Tennessee State line. Leaving Grayson court-house, the line follows the Louisa road up the left bank of the Little Sandy river to the house of John H. Vincent; thence across to the Little fork of the Little Sandy, at the mouth of Straight creek, up the latter, passing the Mount Savage furnace, to the mouth of Gum branch, where it joins the detailed surveys of Greenup and Carter counties, made in 1856 and 1857, under the superintendence of Sidney S. Lyon.

Returning to Mr. Vincent's, the line continues up the Little Sandy to the mouth of Wolf creek, which it follows to its head, striking the river again at a school-house, near the forks of the road to Elliot's, and thence keeping up to the east of the river to the Rock Spring meeting-house, where it crosses; thence southwestwardly across Gimlet creek and Little Caney creek, at a point near its mouth, to Elliot's mill, on Big Caney; thence south to mouths of Laurel and Open forks, and up the latter to its head, crossing the Carter county line on the summit; thence down the North fork of the Licking river to the mouth of Bear run.

Returning to Grayson, a line was run from the court-house westward along the old turnpike to Olive Hill P. O., on Tygert's creek; thence up Tygert to its head, on the ridge dividing Carter from Rowan county; thence to Kirk's horse mill, and so up Christie's branch of Triplett creek to the ridge dividing the waters of Licking river from those of the Little Sandy; thence along this ridge, crossing into Morgan county, at the head of Judd Day's branch of Mince's fork, to John Nichols' house; thence in a southeast direction, crossing the Devil fork, to the head of Bear run, and so down the latter to its mouth, to join the main line. From here the line follows the North fork for a few miles, and then taking up the town branch, and down the Lick fork of Elk creek, strikes the Gill's mill and West Liberty road, at Cox's; thence westward to Hampton's mill, on the Licking river; thence across, and up Tom's, and down Barney's branch to Blackwater creek; thence in a due west course to the head waters of Brushy creek, in Bath county, where it enters the State road leading from Hazlegreen to Mount Sterling, and follows the latter to Jeffersonville, in Montgomery county; thence south across the head waters of Slate creek to Black creek, following the latter to its mouth, and entering Estill county, at the Red River Iron Works, from

whence it follows Red river to near the mouth of Hardwick's creek, and up the latter to the Estill steam furnace; thence down the Cow creek road to Irvine court-house and Estill Springs. Returning to the Estill furnace, the line takes along the Hazelgreen road in a southeasterly direction to the "Standing Rock," at the corners of Powell, Estill, and Owsley counties; thence along a ridge southwardly to the town of Proctor, on the Kentucky river; thence down the left bank of the river to the mouth of Sturgeon creek; up the latter to Samuel Brandenburg's; and thence along Brushy mountain to the Station Camp road at Elijah Hurd's; thence along the Manchester road and county line to Wild Dog creek, where it crosses into the new county of Jackson, and keeps around the heads of the War fork of Station Camp creek to the house of Thomas Carson, on the "Big Hill road," and on McCammon's branch of Laurel fork of Rockcastle; thence down the waters of Indian creek to McKee court-house, and so in a northeast direction to the top of the "Big Hill;" thence due south along the Madison State road to Wm. Golding's, where the line enters Rockcastle county, and follows the county road along the ridge dividing Indian and Brush creeks to Pleasant Fish's, on Roundstone creek; thence across and up Renfro's creek and Langford's branch to Mount Vernon court-house.

From Mount Vernon a line follows the Crab Orchard turnpike to the point where it crosses the Rockcastle river. From this line the main line takes off at a point near L. Langford's, and runs down the East fork of Skeggs' creek to H. McClure's, near the mouth of the West fork, whence another branch line descends the creek southeastward to the Rockcastle river. From H. McClure's house the line follows a county road, crossing the West fork at Mink's, and thence around the heads of Eagle creek and down Mill creek to Line creek, at the forks of the Crab Orchard, Somerset, and London roads, in Pulaski county; thence down Line creek to its mouth. Returning to the forks of the roads, it crosses in an easterly course to Sinking Valley, and thence to the cross roads at Dallas P. O., from which point it runs southeastwardly to a deserted cabin, at the head of Whetstone creek; thence southwest to the Bend meeting-house, in the valley of Buck creek, and so across to the Long Hollow; up the latter and down the Blazed Hollow to Pitman's creek, crossing it at G. Meece's, and thence down it to John B. Lee's, at the crossing of the Somerset and Coal Banks road; thence

along this road for six miles to the former place. Returning to Lee's, the line follows the right bank of the creek to John Beatty's, when it strikes over to Waitsboro', on the Cumberland river. Crossing the river at the lower ford, it runs southeast to Long's mill, on the Big south fork; thence southwardly across Cedar and Middle Sinking creeks, to the Three Forks of Big Sinking creek, in Wayne county; thence up the Dry fork to its head, and down a branch of Elk Spring creek to the Monticello and Rock creek road; thence along said road, in a northwest direction, to Monticello court-house. From here the line follows the Monticello and Albany road, crossing Beaver creek at Ard's ford, and Otter creek at Phillips' Mill, to John Wade's on Indian creek, in Clinton county; thence south, by the way of Wade's gap, to 'Squire Guinn's house, on Smith's creek, (from here a line was run southwest to Albany court-house,) and so across to James Givens, on the Livingston or Alabama stock road, in Spring creek valley; thence up the creek to Long's gap. Returning to Givens, the line runs due south through Elliott's cross roads to the Tennessee State line, at a point to the south of John Crouche's house, on the waters of Wolf river.

GENERAL GEOLOGICAL DESCRIPTION.

The traveler from Frankfort, directing his steps towards Virginia or North Carolina, by any of the great routes, will, after passing over the so called "blue-grass country," encounter a belt of cone-shaped hills, extending from the Ohio river southwestwardly towards Tennessee. These hills are often found in groups, familiarly known as the "Green River Knobs," "Estill Knobs," "Red River Knobs," &c, and are composed of the olive-colored shales and overlying grit stones of the Devonian system, known in the reports of this survey as the Knobstone Formation. They have for their bases the Devonian black slates, and are frequently capped with limestone—a fine instance being that of the Sweet Lick Knob, near the Estill Springs, rising to a height of more than five hundred feet above the Kentucky river, the outline of which, with that of many other knobs in the vicinity, gives a peculiar charm to the scenery of this portion of the State.

Having passed this line of knobs, the traveler has fairly entered the great Appalachian coal field. He passes over in succession the black slates, olive-colored shales and sandstones just mentioned, the sub-car-

boniferous limestones, the sub-conglomerate coal and iron ore series, and capping all, the massive conglomerate or millstone grit, which, in its turn, forms the true base of the coal measures which stretch on to the confines of Virginia.

This series of formations sinks towards the southeast in a great wave, the crest of which being broken off towards the northwest, presents that line of bluffs and hill-slopes which forms the commencement of the "mountain district" of Eastern Kentucky. But the crest line of this great wave, running northeast and southwest, is, itself, undulating, rising and falling in a series, as it were, of cross-waves of no great length and depth, but quite sufficient to determine the principal lines of drainage out from the mountain country to the plain.

Along the eroded crest of this great wave, the outcrop base line was run, not only defining thus the irregularly shaped margin of the coal field, but also supplying material for the construction of the profile which accompanies map No. 2, and represents a nearly straight line, extending from Grayson, in Carter county, to a point on the Tennessee State line, one half mile south of Elliott's cross-roads, in Clinton county. The base of this profile is equivalent to a height of four hundred feet above tide in the Gulf of Mexico. The same base was used in the construction of all the profile sections which appear in the detailed reports upon the counties.

The lowest formation which appears upon the main profile is that of the knobstone. The thickness of this rock varies between three hundred and fifty and five hundred and fifty feet, the measurements being approximate, as but few opportunities occurred for obtaining whole sections of the formation. The lower and larger portion is composed of olive-colored mud rock, with pretty generally disseminated nodular masses of earthy iron ore. From this horizon flow the numerous chalybeate springs of eastern Kentucky. The upper portion is a thin-bedded and generally fine-grained sandstone, also olive-tinted, containing, as a characteristic fossil, a cock-tail fucoid, similar in appearance to that of the caudi-galli grit formation of northern New York. Portions of this rock are valuable for building purposes; and from certain strata, fine-grained grindstones are obtained.

The streams which cut through this formation, flow in broad, flat-bottomed valleys, with gently sloping sides, and produce, during the first

few years of cultivation, such as is here in vogue, from seven to thirteen barrels of corn to the acre. It must be borne in mind that these bottoms receive the washings from the overlying limestones, and, also, that the above average yield will not hold good for the longer settled districts, as the system of farming is very imperfect, and little or no attention is paid to manuring or draining. It is upon these bottoms that the greater number of experiments have been made in the culture of sorghum, or Chinese sugar cane. Here, also, grows, in its greatest perfection, the sugar tree, which, with the other maples, the white oak, and the beech, make up the principal timber. The beech is found near the top of the formation, and only there when the neighboring hills are capped with limestone.

Next in order, above the knobstone formation, comes that of the subcarboniferous or mountain limestone, extending along the whole line, but thickening southwestwardly from seventy feet, on Tygert's creek, to over four hundred feet at the Poplar Mountain, in Clinton county. It is composed of alternating white, grey, and buff-colored layers of rock, varying in quality from the most argillaceous claystone to the purest plaster limestone. Clear and copious springs constantly mark the junction of this limestone formation with the underlying knobstone; and its lowest strata contain, in many places, large, dark-green flint pebbles, which, judging from present appearances, must have been extensively quarried by the Indians. Traces of lead are found through the center of this formation, but not in sufficient quantities to be of value.

The drainage through this formation is peculiar, and deserves more than a passing notice. The valleys are dish shaped, broad and shallow, and rarely have streams running through them; for the water issuing from the very numerous springs is carried down through sink-holes and cracks in the cavernous strata below, and often re-appears at the surface only to take another plunge before it gushes out at last in some never-failing spring, near the mouth of the valley. We have thus valleys which are technically dry, the bottom being a mere series of dry, crater-shaped holes, which, with proper treatment, may be made to supply with necessary water the cattle of this really admirable grazing portion of the mountain district of the State. To the topographer, however, no country could be more difficult to work over; and not unfrequently a stranger would be entirely at a loss to guess the direction of up stream from down.

The soil of the valleys just described is generally a tough clay mixed with sand, where the overlying millstone grit series forms the escarpments on each side; but it is not unusual to see large portions of the side slopes bare. As near as I could ascertain it, seven barrels to the acre is the average crop of corn for this formation, although land freshly broken up and properly tended will yield from ten to twelve barrels to the acre. Clover and other grasses thrive well, and could be made profitable, if taken in connection with cattle raising, upon the top lands overlooking these limestone valleys.

The timber is principally white oak and beech; but black, red, and post oak, together with red cedar, white walnut, poplar, buckeye, and hickory, are common. Pawpaw throughout, and the muscadine grape in the southern portion of the district, mark this formation.

Overlying the sub-carboniferous limestone comes the millstone grit formation, which may be described in two divisions, the lower of which is made up of alternating sandstones and shales inclosing beds of coal and iron ore, and the upper a massive, coarse-grained, ferruginous sandrock, containing pebbles. This sand rock I shall hereafter, in this report, make mention of as *the conglomerate*, and the underlying strata as the *sub-conglomerate* coals, iron ores, &c. Though unexposed at the starting point of the section, I feel safe in saying that its entire thickness under the town of Grayson is not over ninety feet, a thickness which increases in the usual direction (S. W.) until it has become 305 feet in the Poplar mountain before mentioned. This, and the other formations with it, it must here be understood, not only *thicken* southwestwardly, but also *rise into the air* in that direction, as may be seen in the profile, where the top of the conglomerate, below Grayson, is five hundred feet above tide, whilst in the Poplar mountain it is seventeen hundred feet above tide.

The study of this millstone grit formation is of peculiar interest to the farmer, the geologist, and the civil engineer: to the farmer, because he may feed large flocks of sheep upon the table land above its cliffs and upon the rocky slopes below, which now lie waste, and thereby introduce a new and profitable culture requiring but little fencing or other labor; to the geologist, on account of its many changes in thickness and material; and to the engineer, because here he meets with his

greatest difficulty in the improvement of river navigation and in the construction of railways.

The two members of this formation thicken, as remarked above, in a southwest direction, but not proportionally, as I will now endeavor to show. At the northern end of the outcrop line, the conglomerate averages about 90 feet in thickness, and is underlaid by a few feet of somewhat ferruginous shales containing a thin coal; whilst upon the dividing ridge between Tygert and Triplett creeks, and the waters of the North Fork of Licking river, the former has attained a thickness of 150 feet, and is underlaid by eight feet of shale containing a well-defined bed of iron ore and a twelve inch vein of coal. To the east of this, on Devil Fork, the same vein of coal is five inches thick, whilst on one of the branches of Miner's Fork, the whole lower series is entirely gone; one hundred and forty-eight feet of the conglomerate resting immediately upon the sub-carboniferous limestone. Thin streaks of coal are jammed in between the layers of the base of the conglomerate, and even inlaid in the heart of the solid rock all along the line. In Estill county the sub-conglomerate series has attained a thickness of 50 feet, inclosing a workable bed of valuable iron ore and a vein of good coal twenty-seven inches in thickness. The conglomerate here measures 196 feet. To the east of this, at a point known as the Standing Rock, Mr. Lyon informs me that he found the upper member of this formation to be 210 feet thick, and the lower member 50 feet, consisting here of two feet of thin shaly sandstone, a one and a half inch vein of coal, and forty-eight feet of shales containing block and kidney ores.

Between this point, however, and the southern terminus of the line, a great change is seen to take place, the upper member nowhere now exceeding 80 feet in thickness, whilst the lower has increased to an average thickness of 225 feet, and contains two workable and three thin beds of coal, together with three distinct beds of shale containing iron ore. The point of change lies geographically between the top of the ridge dividing the Red river waters from those of the Kentucky river, and the valley of the Kentucky river itself. After a careful examination of this part of the line, especially of the ridge dividing Miller and Stufflebean from Hell creek, and also of the prongs of this ridge which lie between the waters of Sinking and Contrary creeks, I am not left in doubt that the lower portion of the upper or conglomeratic member

exchanges its character for that of an alternating mass of sandstone, shales, and shaly sandstones similar to, and therefore apparently increasing the thickness, of the lower member of the formation. The sub-conglomerate coal before mentioned holds its place at the base of the formation with the addition of later beds which came in above; and the whole is capped and protected by that unchanged upper part of the massive sand rock which appears upon the hill-tops and ridges of the Contrary creek waters in cliffs of 80 feet.

The upper or conglomerate member of the formation gives great character to the topography of the country, producing long, narrow, and steep-sided ridges, which give out at right angles similar narrow but shorter ridges, and these, in their turn, are fringed, as it were, with similarly formed still smaller fingers. Over this whole system of ridges along the eastern margin of the coal field lie, thinly spread, the lowest layers of the lower coal measures, in the midst of which the streams of the country take their rise. At first these waters flow along valleys smoothly cut in the coal rocks themselves, until the top of the conglomerate is reached, when suddenly, and usually with a single leap of from fifty to eighty feet, they plunge into gulfs worn out in the edges of this massive rock. Thenceforth they flow along between high natural walls until they reach the gently sloping terraces of the sub-conglomerate series, after which their way lies through the underlying limestones, knobstones, and black slates towards the comparatively level country beyond.

The soil of the millstone grit formation is poor, yielding, when first broken up, an average of only five barrels of corn to the acre, although this number has been increased to seven and eight in certain localities, and by careful cultivation can undoubtedly be made even more. Fruit grows admirably upon the slopes; and my attention was called to the fact, during the two seasons of our field work, that, unlike the fruit growing upon the lower limestone benches, it had here escaped the frosts.

The timber is varied, the principal kinds being chestnut and oak, with yellow poplar, linden, buckeye, spruce pine or hemlock, and yellow pine, with heavy underbrush of the same; holly, ivy, and laurel, and occasionally pawpaw. The pine grows immediately upon the top, and sometimes at the base of the conglomerate member. Laurel always fringes

the top edge of the bluffs. Holly and hemlock are found in the immediate debris of the cliff. The ivy climbs the rugged faces of the rocks. This is the characteristic vegetation of the conglomerate member of this formation as we traced it along the whole line, and found it only in this geological connection.

The next formation in the upper order is that of the true coal measures; but as the line passed along the thinned out edges of its lower members, there is little at present to be described in this report on that formation. It presents to the eye a surface contour of gently sloping hills, composed for the most part of ferruginous variegated shales, containing the mere thinned out edges of those coal veins, which to the southeast and east, become of such importance.

The portion of this formation above described is rich in forest trees of large growth, principally white oak, chestnut oak, and chestnut; the bark of the chesnut oak being valuable for tanning purposes; there are also red oak, mountain maple, dogwood, and poplar, the last being the principal wood used in the country for building. Yellow pine is common. White pine is not met with upon this geological horizon.

This ridge soil is poor; but its forests afford a thick crop of tender underbrush and mast, upon which large numbers of cattle and hogs are annually fattened for home consumption or the market.

From observations made during the progress of this Survey, the following deductions present themselves:

1. That the margin of the coal field is everywhere marked by bluffs of the conglomerate member of the millstone grit formation.

2. That the carboniferous formations and those underlying them dip to the southeast in a great wave, which is not symmetrically formed, as may be seen by referring to the profile sections of the counties—particularly those of Morgan and Pulaski.

3. That this great wave is itself crossed by undulations, which rise and fall in a series, as it were, of cross waves, of no great height and depth, but which, running, as they do, in a northeast and southwest direction, are quite sufficient to determine the principal lines of drainage out from the mountain country into the plain.

4. That all the formations examined along the line, from the Devonian black slates upward to the true coal measures, thicken and rise into the air in a southwest direction.

5. That the lowest coal, and, consequently, the one which marks the margin of the field, is a sub-conglomerate coal, varying in its thickness, but persistent throughout the whole extent of the line.

6. That certain species of trees mark certain geological formations; the beech and red cedar, for instance, being characteristic of the limestone series, whilst the hemlock, holly, and laurel, mark the conglomerate.

7. That the soil of this portion of the mountain district is not so rich as that of central Kentucky, yet is susceptible of great improvement, and that, in all the counties traversed by the outcrop base line, the proportion of fair tillable land is sufficient to supply the wants of a much larger farming and mining population than that which now exists; also, that the poorer slopes or ridge lands are admirably adapted to the raising of cattle and sheep; and in the southernmost counties the grape could be grown with success, especially if planted upon the warm limestone benches of the east and west valleys.

8. That the amount of mineral lying idle for want of the means of exportation is enormous, and deserves the particular attention of the iron manufacturer; also, that when the still greater mineral wealth lying beyond, in the heart of the coal and iron field, shall have been explored, by a continuation of the present survey, additional inducements will be offered for the development of this wealth; and that the numerous main roads running in an east-southeast direction through this field, afford excellent opportunities for such a survey.

CARTER COUNTY.

The drainage of this county is effected through the valleys of the Little Sandy river and Tygert's creek and their tributaries, which divide the county, in a manner, into three sections. The first and smallest lies to the east of the county seat, and is composed of the true coal measures, a description of which was given in Sidney S. Lyon's detailed report of the Greenup county survey. The second, or middle section, comprises the high lands lying between the two streams mentioned above, and contains the sub-conglomerate coal and iron ore beds. The third section, west of Tygert's creek, owes its topographical features mainly to the conglomerate, which caps the ridge dividing Carter from Rowan, and thus protects certain outliers of the sub-conglomerate coal. The southern line of the county follows a high water shed, the top of

which averages 1,400 feet above tide, and is formed of coal measure shales. In this water shed, the two streams before mentioned take their rise; the Little Sandy flowing along the general line of strike in an east of north course, cutting its bed down through the conglomerate along its whole length to near the Greenup county line; Tygert's creek flowing in the same direction mostly through the millstone grit, limestone, and knob formations. By a reference to the coal field map, it will be seen that about two thirds of the area of this county contains the lower coal bed, which, as far as my observation went, never exceeds twenty-two inches in thickness, and is frequently lost altogether; at no point does it present inducements for mining beyond the demands of a strict home consumption. This coal, with its thinned and overlying conglomerate, sinks under water level to form a canoe-shaped basin along the line of the Little Sandy river, about the center of which the now abandoned salt wells have been sunk. Grayson court-house stands near the north end of this basin, on the slope of a hill formed of the lower coal measure shales. Three distinct coal beds show themselves in this immediate vicinity; the lowest, which is the first above the conglomerate, crops out in the bed of the river just above the mouth of Stinson's creek. It measures six inches in thickness, and has been mined for blacksmithing purposes. Thirty-five feet above it is another bed, from six to eight inches thick, which I believe to be the equivalent of that which shows itself along the bed of Town branch, and which has been struck in Mr. Carter's well, at a depth of thirty feet below the surface. One hundred and four feet above it is a third, which has been opened by Robert Carter, Esq., in the hill to the northwest of the court-house. It presents itself as a double bed; that is, two bands of fair bituminous coal, each 18 inches thick, are separated by 29½ inches of shale, and they are probably the equivalents of the two members of the Stinson's creek cannel coal, though of inferior quality. (Six openings have been made in this Stinson's creek coal vein, at the head of Tar Kiln branch of Stinson's creek, which, at the time of my visit in October, 1858, were being actively worked.) An average section, made up from each, gives

	Feet.	Inches.
Bituminous coal	1	
Slate		3
Inferior cannel coal		9
Cannel coal	1	3

Specimens of both the upper and lower portions were sent to Dr. R. Peter for analysis. The lower, or good band, is that used in the manufacture of oil at one of the establishments in Ashland.

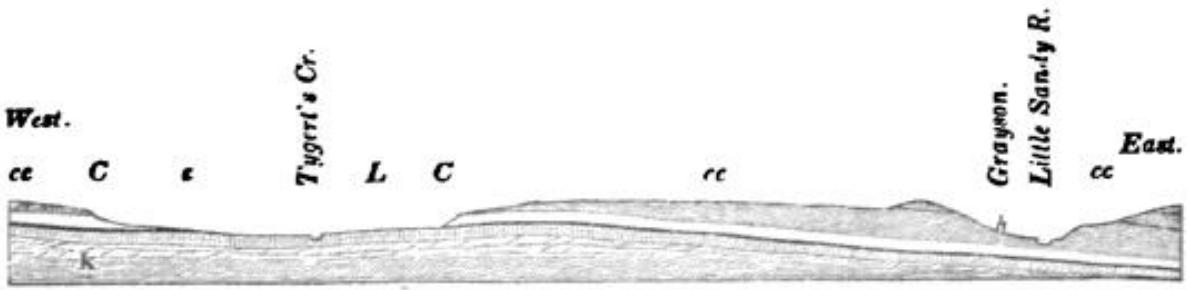
The following section will give a good idea of the stratification about Grayson:

		Feet.	Inches.
225	feet—Top of hills, the upper 76 feet being covered—probably shales	76	
	Thin bedded, yellow, micaceous mud rock	4	
145	feet—Bituminous coal	1	6
	Sandy micaceous shales, streaked with coal	1	5
	Yellow and ash colored mud rock	1	0½
	Bituminous coal, inclined to cannel at its top	1	6
	Covered space	59	
	Alternating shales and sandstones	20	
	Hard, dark-colored earthy limestone	1	
	Coarse yellow sandstone	4	
	Thin bedded micaceous sand rock	4	
	Compact, hard gray sandstone	5	
	Covered space—probably shales	7	
	Coarse, carbonaceous sandstone	4	
	Black slate, with stems		6
35½	feet—Coal worked in blacksmith shop		7½
	Ash-colored shales	35	
0	Coal in bed of Little Sandy river		6

The top of the conglomerate must be but a few feet below the river at Grayson; although at the first salt borings up the river it is 25 feet below the surface, and at the "Middle Lick," below the house of Doctor Lansdown, the probable center point of the canoe-shaped basin before mentioned, it is 50 feet below the surface.

The Carter coal vein shows itself near Ward's, to the west of the mouth of Straight creek; and the hills between the two, on the west side of the river, show terraces at the proper heights where it should come in; but none of the hills to the west of the river are high enough to take in the "Twin Coal" of Greenup county. The area of this bed west of the Little Sandy river must be necessarily small, inasmuch as the strata rise more rapidly than the streams, the evidence of which may be had along the route of our line towards Tygert's creek, where, upon the ridge

dividing that stream from Barrett's creek, the Poplar Plains road cuts into the sub-carboniferous limestone. The following section across the county will explain this more fully:



At the Tygerts' creek bridge the limestone just mentioned is seventy feet thick, and above, to the east, west, and southwest, are found constant indications of the sub-conglomerate iron ore dispersed through the shales which form the surface soil of this section of the country. Near J. James' house, on Barrett's creek, for instance, at a point where the limestone dips under the stream, a section is exposed, showing fifteen feet of calcareous shale, containing masses of earthy iron ore in seams. I was unable, however, to find any bed of it thick enough to work, though such may exist; in which case, should the Lexington and Big Sandy railway ever be completed, this will undoubtedly become an iron making region; and as a farming district it is unsurpassed by any in the county.

Above the bridge, and 1,800 feet below Rice's saw-mill, the bottom of the sub-carboniferous limestone, marked by flint pebbles, rises out of the creek, and the latter, from this point to the forks, a distance of over twelve miles, runs in the underlying knobstone.

In nearly every one of the valleys cutting into the western slope of the ridge which divides Little Sandy river from Tygert's creek, the sub-conglomerate coal has been seen, and in some few instances has been worked, always occurring immediately over the sub-carboniferous limestone, averaging not more than eight inches in thickness, and never exceeding twenty-two. This same vein has been worked by Mr. Pelfry, one mile below the head of Laurel Fork of Little Sandy river, where it is eight inches thick, and excellent for blacksmith's use. One half mile up Lick branch of Tygert, it is eighteen inches thick. It is in this

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cc. Coal Measures. *C.* Conglomerate. *c.* Sub conglomerate measures. *L.* Sub-carboniferous Limestone. *K.* Knob formation.

neighborhood, just above the house of Mr. Pelfry, that a fine spring issues from between the knobstone and limestone, the lower member of the latter being of a dead white color, and showing signs of lead ore. I was assured that at long intervals during the last forty years small quantities of that ore have been extracted. Although I heard of many such localities throughout the county, this was the only one I was able to find, as information respecting them is for the most part traditional, and jealously kept secret.

In connection with the vein of coal last mentioned the underlying iron ore is found, but not in any instance, when examined, was it present as a workable vein.

It will thus be seen that, although two thirds of the area of this county properly belongs to the coal field, yet the sub-conglomerate coal is only accessible upon the spurs that flank the valley of Tygert's creek, and upon the line of the Little Sandy river, between Laurel and Gimlet creeks; and also, that the true coal measures are confined entirely to that portion of the county lying east of the Little Sandy river, with the exception, as I mentioned before, of the lower workable bed, which does extend across that river, showing itself in the hills around and to the south of Grayson.

A large portion of Carter county is still in forest, particularly the two great water-shed ridges which run through it in a north and south direction, and are more or less inaccessible on account of the high bluffs of massive sandstone which underlie the coal measures. These hill-tops present few inducements to the farmer, who prefers the richer lands of the valley of Tygert's creek, where a broad bottom, cut out of the shales of the knobstone formation, yields ample crops of corn. The gently sloping sandstone and limestone terraces which flank this valley along nearly its whole length, afford also excellent grain and grass crops. The Little Sandy river, on the contrary, cuts its valley through the conglomerate, and winds between high cliffs from near its head to the region of the salt-works, where the valley widens and presents a warm, sandy, loamy, and pretty generally cultivated soil. I would here call attention to an indigenous growth of these bottoms. I refer to the cranberry, which, owing to the natural facilities of the country around Grayson, could be cultivated with success and profit, especially upon the lower of the two bottoms of the river, which could be flooded in the fall, after

sowing time, and thus remain until spring, when the water could be drawn off and the proper cultivation commence.

ROWAN COUNTY.

The outcrop of the coal field extends along the eastern edge and southern corner of this new county, covering a very small portion of its surface, in fact, embracing only the upper portion of the ridge dividing the waters of Tygert and Triplett creeks, and of the ridge between Christie's branch of Triplett and Miner's branch of the North Fork of Licking river. The drainage of the county is chiefly through the valleys of Triplett creek, and the eastern tributaries of Fox creek. These head up in the ridges before named, and flow into the Licking river through the sub-carboniferous limestone, knobstone, and black slates. The main body of the county may be said to be composed of the knob formation, the ridges being capped with limestone, and the main water courses exposing the underlying slates. The outcrop base line survey passes through the southeast corner of the county, mostly upon high ridge land, and presents the following traits: The top of the knobstone is first seen on the head waters of Triplett, near Kirk's horse mill, with 30 feet exposed of sub-carboniferous limestone over it, the lowest stratum of which is flinty. Above the limestone is a red clay, containing nodular iron ore. The coal bed coming next above, is wanting at this point, but further up the stream, near Sanford's store, a thin seam shows itself immediately under the yellow sand rock of the conglomerate member.

To the south of this, on Judd Day's branch of Miner's Fork, below the house of John C. Lykens, this sub-conglomerate coal is also wanting, one hundred and forty-eight feet of the massive sand rock, in a magnificent cliff, resting directly upon the limestone. But, at a point to the north of this, on Miner's Fork, the coal has been mined by Henry Upperhart 12 inches thick.

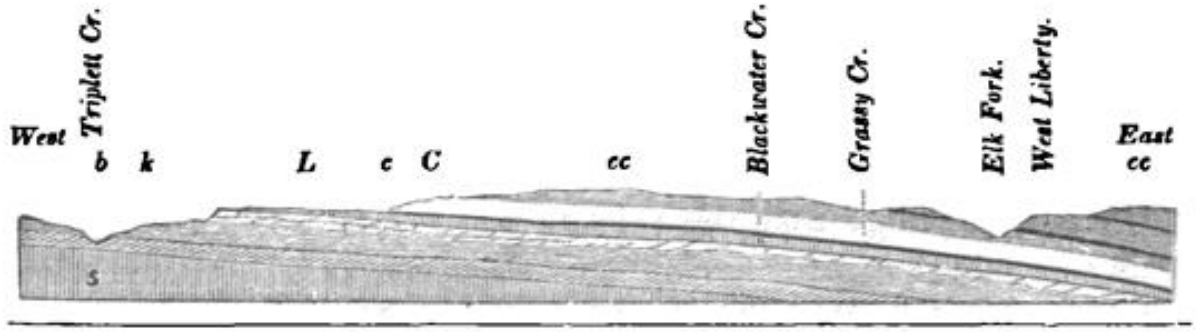
The ridges in this southeastern corner of the county are made by the conglomerate member of the millstone grit formation, covered with the lower ferruginous shales of the coal measures, which give to the tops of the ridges a peculiar potato-shaped form. In these shales I was able to trace, 70 feet above the conglomerate, a thin seam of coal, protected by a plate of sandstone, the undoubted equivalent of that coal bed which crops out in Town branch, near Grayson. None of these hills, however, are high enough to take in the low main bed of Grayson. The land in

this section of the county is poor, and gives the usual ridge timber of this formation—white oak, chestnut, and chestnut oak, with some few hemlocks, and a heavy undergrowth of the same, mingled with black jack. The following section shows the geology:

		Feet.
278 feet—	Shales, containing gravelly iron ore and a seam of coal 70 feet above the base	90
188 feet—	Conglomerate member of millstone grit	150
	Lower member, containing locally the sub-conglomerate coal and iron ore	8
	Sub-carboniferous limestone	30
0	Top of knobstone formation.	

MORGAN COUNTY.

The outcrop of the coal field is defined by an irregularly scolloped line, near the western boundaries of this county. It follows the contour lines of the ridge between Miner's and Devil forks, (crossing the latter at the intersection of the West Liberty and Morehead road,) and the dividing ridge between the North fork and the main Licking river; crosses the latter at a point half way between the mouths of Grassy and Blackwater creeks, and runs down the left bank of the river into Bath county, at the nose of the ridge between the river and Beaver creek. By reference to the map, it will be seen that nearly the whole area of the county is thus included in the coal field; although, perhaps, not more than one third of it may be said to contain the main coal beds above the conglomerate, which, as shown in the Report of 1857, (vol. 3, p. 158,) crop out in the vicinity of West Liberty. This is owing to the fact that that town lies in a basin very similar, no doubt, in shape, to that of the Little Sandy river; hence the coal beds which are found and mined upon Mordecai and Caney creeks, and upon the Elk fork of Licking, rise rapidly like the equivalent coal beds of Stinson's creek, in Carter county, towards the northwest, and are lost in the air, as is shown in the following section of the formation from West Liberty down the Licking river, across the western boundary of the county to Triplett creek, the mouth of which is in the Devonian black slates:



cc. Coal measures. *C.* Conglomerate. *c.* Sub-conglomerate measures. *L.* Sub-carboniferous Limestone. *k.* Knob formation. *b.* Devonian black slate. *s.* Upper Silurian rocks.

In order to define the outcrop of the sub-conglomerate coal, the base line was run too far to the westward to take in these cannel coals of West Liberty, which deserve a thorough examination in the future course of the survey. I would take occasion to say that the main road, which passes through this section of the State, is admirably adapted for getting a section of the rocks across the coal fields, its course being east southeast through Morgan and Floyd counties, and across Pike county, through Pikeville to the Virginia line—such a line would have the advantage of exposures along two rivers, the Licking and the West fork of the Big Sandy, and would cross and connect with the main east and west parallel base line just completed.

The sub-conglomerate coal, the outcrop of which has been now defined, is mined by stripping at many localities; measuring upon Miner's fork 12 inches, and at its crossing of Licking river one mile below Hampton's mill.

At a point on Devil fork I found it only 4½ inches thick, cropping out in the bed of the stream under the massive conglomerate, which here measures 140 feet in thickness. Wherever used, it has been found to be a good blacksmithing coal. In immediate connection with, and overlying it, such a streak of coal as has been before mentioned frequently shows itself, especially near the mouth of Perry's run, below Hampton's mill, where it averaged one half inch in thickness immediately underneath 50 feet cliffs of conglomerate. The same thing occurs at the road crossing Blackwater creek, where the coal measures 1¼ inches, and rests upon ash colored shales.

The second coal, above the conglomerate, shows itself upon our line near the house of William Kendall, in the bed of the North fork below the mouth of Bear run, where it measures twelve inches, and is protected by a capping of shales and shaly sandstones, containing impressions of Sigillaria and Calamites, and is based upon a hard sand rock. This coal can be traced all along the North fork from Bear run to the mouth of Town branch, and up the latter for a mile, where it measures 9 inches, having been opened by Mr. Kendall.

Crossing the ridge from this point to the Lick fork of Elk fork, it is again seen mined at several points near the house of Mr. Casby, where it has increased in thickness to 16 inches. This vein can be traced down the Lick fork to its junction, at Mr. Cox's, with the Big branch,

and also up the latter stream to near its head. The hills in this vicinity are, in some instances, high enough to take in the lower main cannel coal bed of West Liberty; but I could neither find nor hear of any outcrop. Judging from this circumstance, and from the visibly rapid dip of the strata southeastward, I am led to believe that no veins of workable coal will be found west of the ridge between Elk and Lick forks, and the ridge between Grassy and Caney creeks.

Below the house of Major Payton, and in the bed of Shoal branch, a 24 inch coal has once been worked, but is now abandoned. Farther down the stream, but still overlying the conglomerate, another opening, also abandoned and filled up, has been made; at both points the coal is overlaid with a mass of compact shaly sandstone, streaked with carbonaceous matter, and is probably the equivalent of the Casby vein.

On the south side of the Licking river there are indications of this same bed in Tom's branch of Grassy creek, near the school-house, and also in Barney's branch, above the house of Miles Kash, both resting upon ferruginous shales, and having for capping alternate layers of fossiliferous shaly sandstone and shales.

The sub-conglomerate iron ore is traceable along the outcrops of Morgan county, but nowhere showed itself on our line in workable quantities. Indications along Blackwater creek lead me to think that it may thicken in that direction, so as to become of value.

The western half of the county embodies the conglomerate member of the millstone grit formation, beneath rounded ridge cappings of soft ferruginous shales and shaly sandstones, over which are scattered farms, hemmed in by forests of white and chestnut oak, surrounded by precipices of conglomerate.

BATH COUNTY.

But a small portion of this county, viz: the southeast corner, is included in the coal area, and contains only the sub-conglomerate bed. Its outcrop may be defined as following the contour lines of the ridge which divides the head waters of Gilladie and Indian branches of Red river from the head waters of Beaver, Blackwater, Duck, and Salt Lick creeks, as far west as the head of Slate creek. In this county, for the first time, we met the sub-conglomerate coal as a double vein of workable thickness. Upon Clear creek there are "three feet of coal with a clay parting of one foot." It is principally mined near the head of Amet's

branch of Indian creek, where two openings, called the "Flower Hill Banks," have been made by Morris McCormick. When I visited this locality the lower opening showed a coal of fifteen inches in thickness. The same vein, with the same thickness, was opened further east, accompanied by a thin vein twelve feet above, and separated from it by shales. The old Flower Hill opening, 800 feet northwest of the first mentioned, and now filled with water, the dip being inward, is said to yield twenty-eight inches of solid coal. The "Tan-yard" and "Big" banks, owned by the same party, lie to the southeast, on another branch of Indian creek. The coal here I found to be two feet and nine inches in thickness, and about fifteen feet above the top of the sub-carboniferous limestone. The same bed has been lately opened still further east, and of about equal thickness, and perhaps better quality. The coal mined in this vicinity is used by the residents, who find it to be much cheaper than wood, though most of it is sent to Mount Sterling for blacksmithing purposes and the grate.

The sub-conglomerate ores of this county—the block and kidney ores underlying this coal bed—rest almost immediately upon the limestone, and are of sufficient thickness on Beaver creek to claim the attention of the iron-master; although at present the bad roads and the cliff-bound structure of the valleys, together with the total want of water navigation, are serious bars to success.

"The Dry Ridge," which forms the center of the mineral section of this county, attains, at the head of McCormick's branch, an elevation of 1300 feet above tide. I obtained here the following section:

	Feet.
325 feet—Top of Dry Ridge.	
Conglomerate member	100
225 feet—Sub-conglomerate member containing coal and iron veins	85
Sub-carboniferous limestone	140
0 feet—Top of knobstone formation, as seen just above McCormick's house	0

One well marked layer of the upper member of the millstone grit, a stratum of coarse, rose-colored sand rock easily disintegrated, may very well serve as a guide in searching for the sub-conglomerate coal, which lies about 60 to 70 feet below it.

The sharp summit of Dry Ridge carries the usual timber, although pine trees are more common here than along the northern end of the line. The old State road follows its crest, and the traveler has only to step to the right or left to find himself arrested at the edge of high precipitous cliffs, over which, at short intervals, plunge numberless waters,

wearing for themselves deep and narrow channels in the conglomerate. An interesting example of this is found at the Laurel Spring meeting-house, where the stream falls over a projecting ledge to a depth of 110 feet. Further east, Raccoon creek falls 41 feet down upon a shelving mass of the conglomerate, and then with another plunge of 44 feet reaches the bottom of the gulf. Instances of this kind are common, and though picturesque to the eye, present serious obstacles to the profitable working of the coal and iron beds which lie below these cliffs.

The valleys opening northward from this ridge deserve especial notice, as their streams, after quickly cutting through the conglomerate, flow along broad valleys in the limestone and olive shales of the knob formation, affording thus the only good farming land in this portion of the county. Particular attention was here paid to a collection of the soils; and careful analyses, made by Dr. Peter, show them to be of a better grade than those usually found in the same geological horizon. The side slopes of these valleys are beautifully terraced, and covered with a kind soil, which, with proper tillage, would yield 60 to 70 bushels of corn to the acre. Springs are abundant and of two kinds; one of cold hard water, issuing at the base of the limestone; the other a warm soft water, issuing higher up in the hills, and marking the place of the coal.

MONTGOMERY COUNTY.

The southern and western borders of this county lie along the crest of a ridge which encircles the head waters of Slate creek. The top of this ridge is formed of the conglomerate which protects the coal, the fringe-like outcrop of which overlooks the broad, knob-filled valley below. Its area is very small; but where opened up, it has proved to be of excellent quality; upon Petre-trace and Hawkins' branches, for example, where Mr. J. Wills has mined it for the Mount Sterling market. On the ridge between the two streams just named, I had a good opportunity of examining it; and from observations at other points I find it remaining in patches, protected by tower-like masses of the conglomerate, one of which, the "Pine Table," is conspicuous from a great distance. In Wills' "Hollow bank" the coal is double, the lower portion measuring eighteen inches, and the upper six, the two being separated by six feet of ash-colored shales. Across the ridge, to the southwest, is the "Cabin bank," now worked, where the coal appears in a single vein of twenty-four inches. One and a half miles to the north-

east is the "Pine Table bank," where the coal measures twenty inches, with a thin vein above. Between this and the Cabin bank is another opening, showing a thickness of coal from eighteen to twenty-two inches. One and a half miles to the southeast of Wills' banks, Mr. Jas. Ballard has opened coal twenty inches thick. The coal is thinner here than at McCormick's, further east, and lies but a few feet above the limestone, and thirty-six feet under the conglomerate, showing thus a thinning also of the accompanying measures. The sub-conglomerate iron ore does not make its appearance here in any force.

The top of this boundary ridge produces fine chestnut and white oak trees; whilst the lower benches of the limestone show a growth of sugar tree, locust, buckeye, linden, and poplar, and yield about ten barrels of corn to the acre.

Slate creek drains this part of Montgomery county, cutting through the limestones, which measure about the same as on Beaver creek, and through the knobstone, which is 330 feet in thickness, into the black slates; then winding about in the latter until it enters Bath county. In its bed, opposite Mr. Willis' house, are exposed in the olive shales three distinct, thin beds of nodular iron ore, traceable for a long distance up the valley. Further down, after having passed into the black slates, black sulphur springs become common. A fine one issues near the forks of the road to Flute's mill, and another on Sycamore creek to the southwest of Jeffersonville, near the house of 'Squire Halley. The valley is broad, and studded with conical hills formed of the knobstone. These knobs border the southern line of the county, and occasionally, when capped with the conglomerate, attain a considerable height, as is the case with the "Pilot Knob," between Black and Lulbegrud creeks, remarkable for its millstone quarries.

POWELL COUNTY.

The northern limits of this county follow a ridge which runs nearly east and west, whilst the southern line follows one running in a northwest and southeast course, the two nearly meeting at the western end, to allow just room enough for the passage of Red river, which flows in a due west course through the entire length of the county. One half of its area is covered with the sub-conglomerate coal bed, the outcrop of which may be defined as following around the ridges lying to the north and south of the river, as far up as the mouth of Gilladie fork, below

which it crosses; more than half of the area of this coal bed is therefore under water level.

Red river, which, with its tributaries, drains the entire county, enters from Morgan county through cliffs of the conglomerate; runs westward through the sub-carboniferous limestone and knobstone, and encounters the Devonian black slates first near the forks. Through these it winds until it abruptly turns and breaks out of the county near the Red River Iron Works.

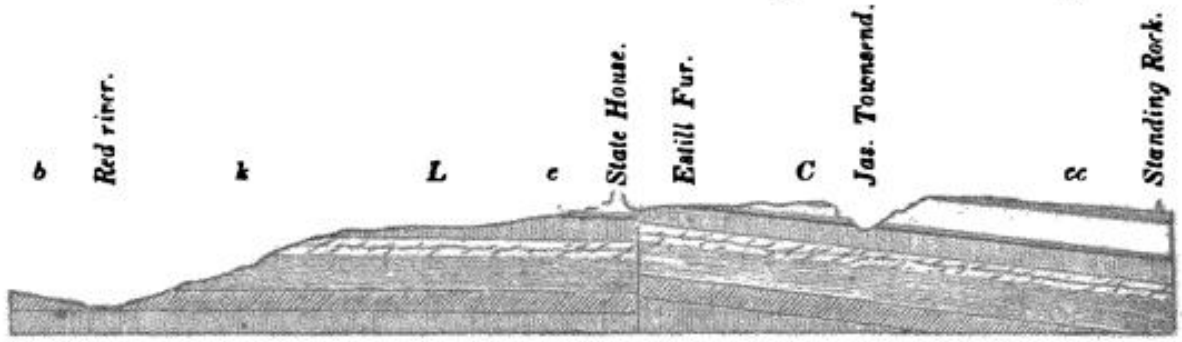
As the outcrop base line crosses merely the extreme western corner of the county, in the black slates, I had but little opportunity to examine the coal. Mr. Lyon, whose base line runs through the southern corner of the county, informs me that he found the coal near the head of Graining Block creek, and upon Little South fork, but only as a streak. Judging from its outcrops just over the line in Estill county, this thinning out is only local; for north of Red river the bed of the "Pine Table" and "Flower Hill" banks shows itself near the river, and is known to cross it at a point not far below the mouth of Gilladie creek. In the southwest corner, between the heads of Catamount and Hardwick's creeks, it has been opened and mined by J. W. Jones. It is here a double bed, as upon Indian creek. The following section shows its accompanying rocks:

		Feet.	Inches.
882 feet—	Top of "State House" rock.		
	Conglomerate member	196	
686 feet—	Shales and shaly sandstones	50	
	Hard black slate roofing	4	
	Coal	1	3
	Soft, dark grey shales	4	
	Coal	1	
	Shales, including block and kidney ore vein	15	
611 feet—	Sub-carboniferous limestone	161	
450 feet—	Knobstone formation	350	
100 feet—	Devonian black slate	100	
0	Bed of Red river.		

The rock known as the State House stands in the southwest corner of this county, one half mile northeast of the Estill steam furnace, and is a bold feature in the surrounding scenery, towering above all the hills in this region, and attaining an elevation of 1,464 feet above tide. A few hundred feet to the southeast of this rock occurs a down-throw, or fault, the general direction of which is with the strike of the great coal basin; that is, N. 30° E. As Mr. Lyon does not mention it as crossing the

east and west parallel base line, and as I could discover no signs of it north of Red river, I conclude that it extends but a few miles. The amount of down-throw may be measured along the iron road, leading out of Hardwick's creek to the furnace, where the top of the limestone formation is 1,216 feet above tide, whilst three eighths of a mile due south, near the furnace, it is 1,376 feet above tide, the difference being 160 feet.

The following section, carefully prepared from actual measurements and levels, will represent this local peculiarity; and, at the same time, the formations from the Standing Rock, at the east end of the county, to the State House Rock, and thence across the northern limb of Estill county to a point on Red river, near the mouth of Hardwick's creek. It will also answer for the extreme northern edge of Estill county:



The sub-conglomerate iron ore bed is well developed in the region just described, much of it having been used in the Estill steam furnace. It occurs in a compact layer, but sometimes also in kidneys, cemented with clay, and generally lies directly upon the sub-carboniferous limestone. It can be traced both to the north and south of Red river. To the eastward it seems to grow thin and uncertain. The nodular iron ore of the olive-colored shales is found also further up the river; but, owing to the dangers of navigation and the want of roads, neither the iron ore nor the coal can be profitably mined. These are serious drawbacks to the prosperity of this country. This county will not compare agriculturally with those bordering it on the southwest, west, and north; nor do its high cliff-bound table lands present so kind a soil; yet along a portion of its main water courses are to be found many broad bottoms, admirably adapted for the raising of sugar and Indian corn, whilst the limestone benches produce as well as in the other counties.

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b. Devonian black slates. *k*. Knob formation. *L*. Sub-carboniferous limestone. *c*. Sub-conglomerate measures. *C*. Conglomerate. *cc*. Coal measures.

ESTILL COUNTY.

By the recent setting off of Jackson county the coal area of Estill has been much reduced, being now confined chiefly to a narrow strip bordering on the south, west, and northeast. Its outcrop follows the contour lines of the ridge around the head waters of Miller's creek, on the north side of the Kentucky river, and the two short and narrow ridges between the Owsley line and Ross creek, and between the latter and Station Camp creek, on the south side of the river. Small detached areas occupy certain ridges around the heads of Red Lick, Middle, and Rock Lick forks. This coal bed has been opened at numerous points on the head waters of Miller's creek. At the Estill furnace it measures twenty-four inches, but thins away in an east direction. Its coal seems to be more highly esteemed by the blacksmiths where it is thinnest, for they are known to frequent openings at a great distance when a thicker and more conveniently worked bank is at their doors.

The iron ore underlying this coal seems to attain its maximum thickness in that portion of the county around the heads of Cow, Miller, White Oak, and Hardwick creeks, showing itself sometimes in the form of kidney ore, and sometimes in solid layers or blocks. The bed, varying from 7 to 24 inches, rests for the most part directly upon the sub-carboniferous limestone. Imbedded in the overlying shales is frequently found a twenty-four inch stratum of white quartzose sandstone, which may prove valuable for manufacturing glass.

To the presence of this ore, in connection with a partial river navigation and pretty fair roads, is due the erection of the furnaces which will be hereafter described, and which make the connecting link, as it were, between the great Hanging Rock iron region to the north, and the Tennessee iron making regions to the south and southwest. Lower in the series, especially along the valleys of White Oak and Cow creeks, large masses of nodular iron ore are disseminated through the lower portion of the olive shales of the knobstone formation; but in no instance yet known do these occur in sufficiently close contact to warrant the erection of iron works.

The limestone formation which caps the ridges in the vicinity just described, and which to the eastward is found under the conglomerate, becomes thicker and more cavernous than to the north. "Sinks" or pot-holes and caves are to be met with on every side. The first annoy the

farmer by carrying off the surface water under ground; and the miner by causing frequent ruptures in the ore beds, quite considerable areas of which disappear, being either lost or very difficult to reclaim. The caves are interesting as having, a half century ago, afforded shelter to the early settlers, who not unfrequently erected in them furnaces for the manufacture of saltpetre. The valleys in this formation are pretty generally settled and yield fair crops. The ridges flanking them are covered with chestnut, white oak, and pine, and afford good pasturage for cattle and for sheep.

Hardwick's creek flows for more than half its length through a broad valley cut out of the knob formation. Its sides are flanked with terraces of limestone, which give 8 to 10 barrels of corn and 10 to 12 bushels of wheat to the acre. For a mountain district, it is thickly settled, and much attention has been paid to the culture of the Chinese sugar cane, making a rich and cheap molasses, but with a greenish taste, because the cane is cut before it is fully ripe. It has been proved that if the stalks are allowed to become as yellow as those of the ordinary Indian corn, while the quantity of juice expressed may not be so great, a much superior article of commerce will be produced.*

In this valley coal has been bored for—the Devonian black slates having been mistaken for those belonging to the coal measures. In one of the borings the upper portion of the auger was blown out into the air by gas, and the lower so bent in the boring as to stop the work. At the head of the broad portion of the valley, Samuel T. Vaughn also sunk an auger to the depth of 405 feet, the result being a small but constant flow of petroleum. He reports having passed through, first 15 feet of surface soil, then 100 feet of black slate, then 100 feet of a light-colored earthy calcareous rock, followed by 190 feet of gray limestone, at the bottom of which the auger dropped into a cavity, and when withdrawn salt water was blown out for a short time, which soon gave place to the present flow of rock oil.

Above the mouth of this creek, in an abrupt bend of Red river, and in the extreme north end of the county, is the site of the first iron furnace built in this region. On account of its distance from the ore it was pulled down in 1831, and the present Estill steam furnace erected

* The lower portion of the valleys of Miller, Cow, and Station Camp creeks present the same advantages, and are also thickly settled.

in its stead. Here also a forge was built in the year 1810, and worked successively by T. Dye Owings, Mason & Gist, Jackson, Mason & Co., and Josiah A. Jackson. It is now owned and worked by the latter, and contains four fires and one hammer worked by water, and makes blooms from metal made at the Estill Furnace. The rolling mill attached to this forge, and owned by the same party, but now abandoned on account of the difficulty of obtaining stone coal, was erected in the year 1837 by Lawell, Jackson & Co., and contained 7 furnaces in all, 2 trains of rolls, and 5 nail machines, working up the blooms made in the forge into merchant bar iron and nails.

Estill Steam Furnace lies 10 miles S. S. E. from the forge, and was erected in 1830 by Mason, Wheeler & Co., rebuilt in 1849 by Lawell, Jackson & Co., and is now owned by Jackson & Jones—Mr. J. W. Jones being the resident manager. It is what is called a "quarter furnace;" has a capacity of 2,500 tons per annum; uses a cold blast, and makes pig metal from the ores found in the vicinity. The metal produced at this furnace chills to a depth of 1-16 inch in the pig, and is highly esteemed for the manufacture of railroad car wheels.

The Cottage Steam Furnace lies to the east of the last named, and was built in the year 1856 by Mason & Wheeler, and made in 1857 725 tons of metal from the sub-conglomerate gray carbonate ore of the region. It is a quarter furnace, and when in operation used a hot blast.

The Kentucky river flows in a west-northwest course through this county, dividing it into two nearly equal parts, and becomes, at certain seasons of the year, a highway along which the coals of Owsley county are transported to Lexington, Frankfort, and the ports along the Ohio. At the town of Irvine it fairly emerges from the mountain district, winding round the base of the Sweet Lick knob, and passing westward on through the comparatively level portions of the county, well described in Vol. III of the Reports.

In this county, as in others situated in the same geological position, occur numerous sulphur springs, the most noted of which are those near Irvine, issuing from the black slates at the base of the Sweet Lick knob, and described by Dr. Peter under the head of Nos. 601 and 602 of his report.

Besides these, there are three other distinct horizons: first, chalybeate springs issuing from the olive shales, and in immediate connection with

the deposits of nodular iron ore found everywhere in this formation; secondly, hard water springs gushing from caverns in and at the base of the sub-carboniferous limestone, and flowing over the grit stones of the knob formation; and thirdly, soft water springs in the shaly slopes under the conglomerate, good guides in tracing the sub-conglomerate coal bed. The so-called springs of the "sinking country" are merely the accumulated masses of these last, which, after flowing underground, re-issue from the caves of the underlying limestone, and frequently in sufficient force to be used as motive power for grinding grain.

OWSLEY COUNTY.

The whole of this county is included in the eastern coal field, with the exception of the lower portion of the valley of Sturgeon creek, and the valley of the Kentucky river, from the mouth of that stream to the Estill county line.

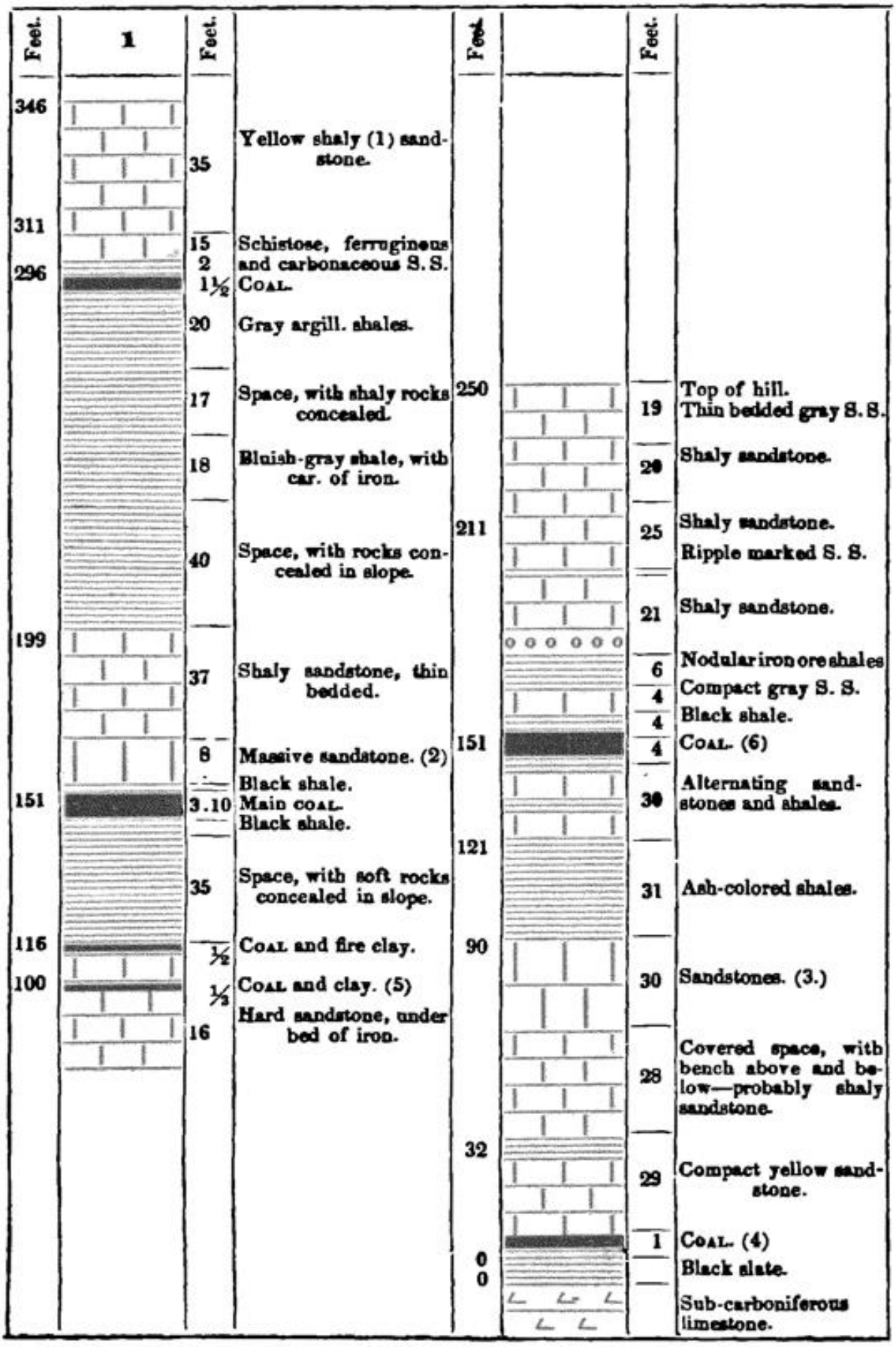
The lower member of the millstone grit formation is here increased in thickness, and goes under water level between the mouth of Contrary creek and a point three quarters of a mile above Proctor, thus leaving but a small area along the river from which to mine, though upon the streams to the west of Proctor, especially upon Sturgeon creek and its tributaries, the outcrop presents a wider field. These measures contain four, if not five, veins of coal, all of which have been found in the vicinity of Proctor, though but one has, as yet, received much attention from the miners. This one is known as the "main coal," and measures from 42 to 50 inches, and has been opened and mined as follows:

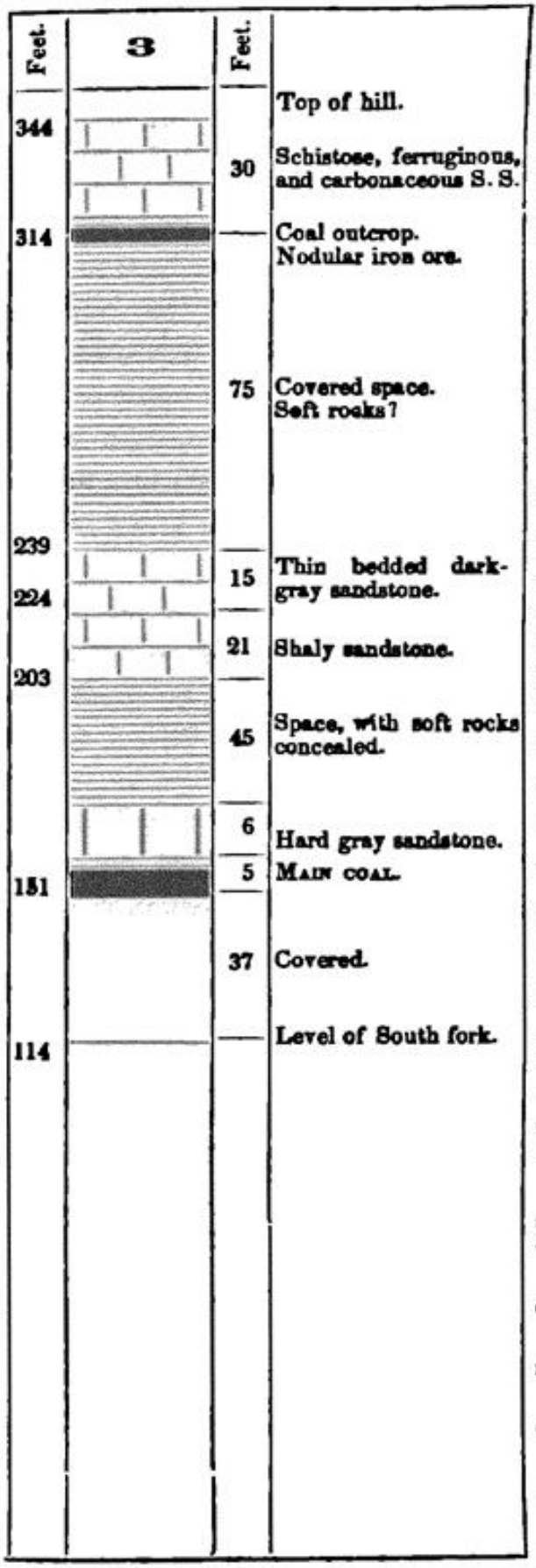
Dudley's lower river bank	817 feet above tide.
Philipp's bank, on Mike's branch	762 feet above tide.
Beatty's river banks	730 feet above tide.
Beatty & Blount's Lower Stufflebean banks, John G. McGuire's bank, on Upper Stufflebean creek	717 feet above tide.
Todd's bank, on Main river, above Proctor	680 feet above tide.
A. McGuire's bank, on the South fork	670 feet above tide.
Henry Smith's bank, on Duck fork.	
Dudley's old bank, on Sturgeon creek.	

More or less trouble is experienced in mining this "main coal," alternately thinning and thickening, as it does, so that water settles in the gangways in pools. A local peculiarity of this vein here seems to be, that, no matter where opened, it dips for a short distance sharply into the hill, and then obeys the general dip of the country, which, taken over a wide extent, I calculate at three fourths of a degree in a S. 52° E. direction. All gangways north of the Main river, near Proctor,

should be driven a little north of west, whilst upon the South fork they should be driven due west.

The coal is bright, and breaks with a square butt into fine large blocks, which bear transhipment. Specimens were collected for analysis. The vein is covered by a black shale bed, varying in thickness from one inch to four feet; but it has been really protected from erosion by a bed of massive gray sandstone, which, in every locality examined, was seen to overly it. In the shales, immediately above this last rock, is a stratum of iron nodules. Sixty feet below the "main coal" is a persistent mass of hard gray sandstone, with a bench, or terrace, both above and below it. These constitute good guides in searching for the main coal in this region, where no two sections can be obtained showing the same disposition of rocks, as may be seen by the following sections and their appended notes. No. 1 is reproduced from Vol. I, p. 216, of the Reports; No. 2 is a section of the rocks at Dudley's lower river banks, above the mouth of Contrary creek; and No. 3 is of the rocks at McGuire's bank, on the South fork:


Feet.
1
Feet.
346
35
Yellow shaly (1) sandstone.
311
15
Schistose, ferruginous and carbonaceous S. S.
296
2
1½
Coal.
20
Gray argill. shales.
17
Space, with shaly rocks concealed.
18
Bluish-gray shale, with car. of iron.
40
Space, with rocks concealed in slope.
199
37
Shaly sandstone, thin bedded.
8
Massive sandstone. (2)
Black shale.
151
3.10
Main coal.
Black shale.
35
Space, with soft rocks concealed in slope.
116
½
Coal and fire clay.
100
⅓
Coal and clay. (5)
16
Hard sandstone, under bed of iron.
Feet.
250
211
151
121
90
32
0
0
Feet.
Top of hill.
19
Thin bedded gray S. S.
20
Shaly sandstone.
25
Shaly sandstone.
Ripple marked S. S.
21
Shaly sandstone.
6
Nodular iron ore shales
4
Compact gray S. S.
4
Black shale.
4
Coal. (6)
30
Alternating sandstones and shales.
31
Ash-colored shales.
30
Sandstones. (3.)
28
Covered space, with bench above and below—probably shaly sandstone.
29
Compact yellow sandstone.
1
Coal. (4)
Black slate.
Sub-carboniferous limestone.



It will be seen by these that 150 feet above the main coal vein is another about 18 inches thick. It is found back from the river in those hills which are capped with the massive yellow sandstones of the conglomerate member. Below the main bed, and 35 to 40 feet over the hard gray sandstone above mentioned, occur locally two thin seams of coal close together; and still lower down in the series a third is to be found, 145 feet below the main bed, and just above the top of the sub-carboniferous limestone. This last mentioned does not exceed 12 inches in thickness in any of the numerous outcrops examined. On Sturgeon creek at its mouth, and also one mile above its mouth, this coal is underlaid with a two-inch vein of fire clay, the whole resting upon a fine grained black slate beautifully marked with Sigillaria. This slate has been mistaken and mined for cannel coal. Nodules of iron ore

(1) This rock attains a thickness of 80 feet, and forms the capping of the ridges back from the river.

(2) This rock is a single stratum of 12 feet, over Beatty & Blount's opening.

(3) At Beatty's river banks the top of this rock is 76 feet below the coal.

(4) This coal shows itself on Contrary creek, 15 feet above the L. S.

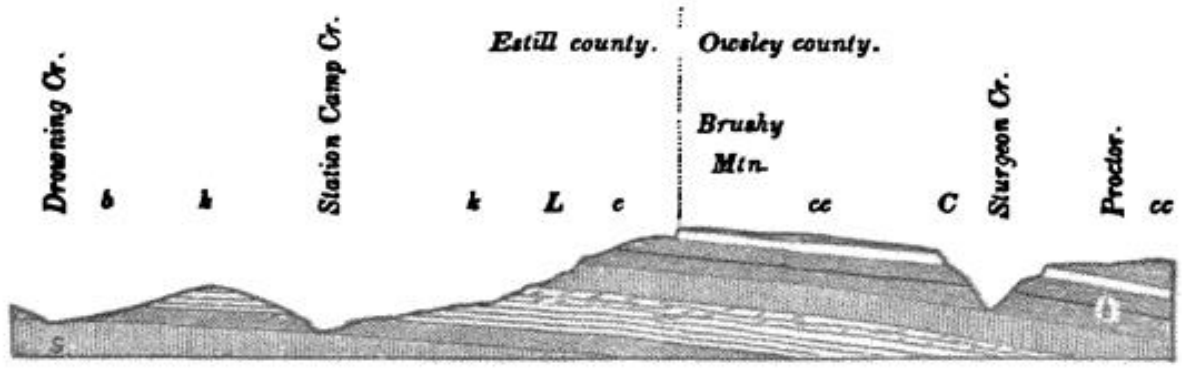
(5) A 2-inch vein of coal occurs on same level one mile up Contrary creek.

(5) This coal is 150 feet above the L. S. at a point one mile up Sturgeon.

are disseminated through the thin beds of shales which lie above and below this coal. Thin beds of carbonate of iron have been found in connection with the main coal bed, and nodules of the same occur under the upper coal; but at none of these three horizons could I find iron ore in workable masses.

Proctor lies in one of the cross waves of the coal field, and the sub-conglomerate member of the millstone grit formation seems here to have attained its greatest thickness, measuring 296 feet. To the N. E. in the ridge between the Stufflebeans and Miller's creek, it measures 195 feet, whilst in Powell county it is reduced to 85 feet. The upper or conglomerate member, however, increases in the same direction, from about 60 feet, near Proctor, to 90 feet on Miller's creek, and 196 feet at the State House Rock in Powell county, thus keeping the thickness of the whole the same throughout, in spite of the great changes in both its members. On the west crest of Brush mountain, in the southwest corner of the county, the covered slopes between the top of the limestone and the conglomerate measure 211 feet, and the conglomerate member itself is 82 feet thick, and forms the base of the surface soil of all that region.

The limestone on this part of our line has also increased to 191 feet in thickness. From these measurements, and others obtained down the Kentucky river, I am able to present the following profile section, extending from Proctor in a west course, across Sturgeon creek and Brushy mountain, to the county line, and thence into Estill county across Station Camp and Drowning creeks:



The drainage of the county is through the North, Middle, and South forks, which meet near Proctor and flow into Estill county through the

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b. Devonian black slates. *s.* Upper Silurian rocks. *k.* Knob formation. *L.* Sub-carboniferous limestone. *c.* Sub-conglomerate measures. *cc.* Coal measures. *C.* Conglomerate.

valley of the main Kentucky river. These streams cut deep, and the western portion of the county is mostly high ridge land, the Brushy mountain attaining an elevation of 1,300 feet above tide. North of the river the timber is large; oak, chestnut, mountain maple, with some pine and dogwood, being the principal growth.

JACKSON COUNTY.

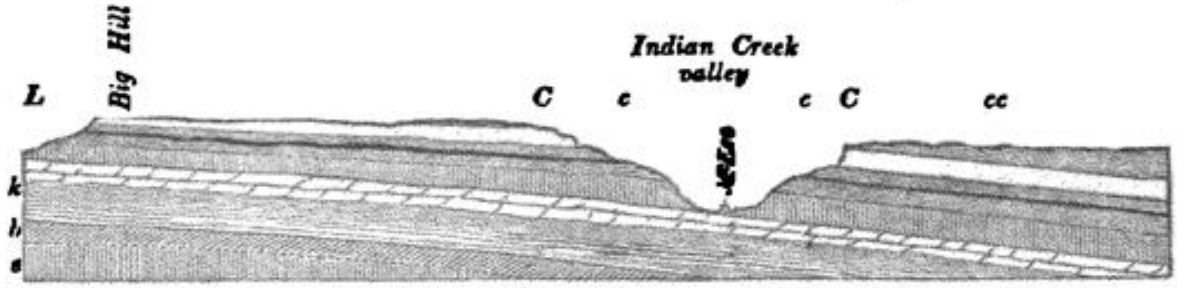
This county was erected in 1858 out of portions of Estill, Owsley, Laurel, Rockcastle, and Madison, and its general boundary may be described as follows: Commencing at the "Big Hill," it follows the Madison turnpike to the Rockcastle river; thence up the river to the mouth of Moore's creek and across to Terrel's creek, up the latter to the Gap between Sexton's Island and Sturgeon creeks; and thence along the road leading from Manchester to Irvine, to Station Camp creek; thence in a south of west course between Red and Rock Lick forks of Station Camp creek to the ridge dividing the former from the South fork; and thence along that ridge south-southwest to the point of starting, near Robert Cox's, on the Big Hill.

The whole county may be said to occupy that portion of the high land between the Kentucky and Cumberland rivers drained by the head waters of Station Camp and Sturgeon creeks northward, and by those of the Rockcastle river flowing southward.

Its county seat, McKee, is situated in Indian Creek valley, near the mouth of Birch Lick fork, and has an elevation of 1,040 feet above tide; whilst the "Big Hill," in the western corner, is, perhaps, the highest point, being 1554 feet above tide.

The surface soil is, for the most part, composed of the ferruginous shales immediately overlying the conglomerate, but in the southwestern part of the county the streams which are cut in the limestone open broad and productive valleys. In the extreme north of the county this latter formation is cut entirely through, presenting its stratum edges in bluffs, so that Rock Lick and a portion of War fork flow in the upper member of the knobstone along valleys as fertile as, or even more fertile, than those above.

The following presents a section profile of the county:



The sub-conglomerate coals extend over the whole county, except where cut out by the water courses just mentioned. Fully one third of its area, however, is, at present, practicable only by shafting, since the coals are under water level. The eastern portion has not been examined; but I am inclined to think that the upper, or Goose creek coals, may be found in the hills separating Sturgeon waters from those of the main South fork.

To the northeastward, on the heads of Granny Dismal, and Wild Dog, the lowest coal of the true coal measures is frequently met with, very thin throughout, averaging, where examined, about 4 inches, and lying in darkish fossiliferous, sandy shales, with a roofing of black ferruginous shales, measuring 12 inches in thickness.

The ridges in this vicinity are broad and flat, and grow the largest yellow pine yet seen along the line.

From the dividing ridge between War fork and Laurel fork, the line pitches down into Indian creek, where it first strikes the main coal vein of the county. This coal has in no instance been fairly opened, and is very imperfectly stripped, so that its real thickness and quality is hardly known.

On the Bee branch of Indian creek its outcrop measures 18 inches. In Bill's branch of Indian, one and a half miles north of McKee, it has been scraped out from under its sandstone capping to a depth of 14 inches, and proves to be an excellent coal. Appearances in the vicinity induced me to believe that this coal would increase very much in thickness under the neighboring hills. It lies about 150 feet under the sandstone bluffs capping the ridge, and about 60 feet above the limestone. To the northwest of McKee, on Birch Lick creek, near the house of James Isaacs, it lies 60 feet above the limestone, and measures 2½ feet in thick-

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cc. Coal measures. *C.* Conglomerate. *c.* Sub-conglomerate measures. *L.* Sub-carboniferous limestone. *k* Knob formation. *b.* Devonian black slates. *s.* Upper Silurian rocks

ness—the upper 2 inches being impure—and is imbedded in bluish ferruginous shale, 6 feet of which underlies a 16 inch band of hard sand rock. It has again been opened by Mr. H. Sloan, on the same stream, further up, where it measures 2 feet in thickness, and presents the same peculiarities as at the Isaac's bank. Through this whole region a well pronounced terrace marks the place of this coal. Its outcrop has a rather sulphurous appearance, which the bed will probably lose when worked. This same bed has been found cropping out in the valleys on the other side of the long ridge, which lies to the north of this county. The rocks in this region all dip to the southeast.

Up the Clover Bottom waters, in the ridge, the bed measures 30 inches thick, with the same characteristics: an impure upper portion, and an overlying hard band of sandstone; but the accompanying shales contain more iron ore.

At the Big Hill there appears to be a thinning out of the coal measures, the main bed also coming to a knife edge; but the iron ore at this point shows itself in greater force. Below William Golding's house, for instance, along the slopes overlooking Horse Lick waters, a distinctly marked horizon is easily traced by large and numerous masses of carbonate ore lying in a band on the surface.

Beech timber attains a large size in all the valleys cut in the limestone, and the laurel thickets mark, as usual, the face of massive sandstone which bluffs out near the tops of all the ridges.

ROCKCASTLE COUNTY.

This county may be divided into two equal portions; the western half being formed of long rolling ridges of the sub-carboniferous limestone, and the conical hills of the knob formation; whilst the eastern half, as can be seen in map No. 1, is composed of islands (so to speak) of the coal measures, which lie out from the shore of the great coal field. These outliers are protected by patches of conglomerate, forming the tops of ridges which lie between the western tributaries of the Rockcastle river, all of them cutting down into the sub-carboniferous limestone. The general dip of the rocks is to the southeast; so that the streams, which flow *westwardly* into the river, cut very little into the limestone. The line of the Rockcastle river is, therefore, the true edge of the solid coal field.

The millstone grit and sub-carboniferous formations of this county

obey the general law of thickening along the southeast line of strike; and thin away northwestwardly from the Rockcastle river towards the outer limits of the coal field, as will be clearly shown.

The conglomerate member, which, in the southeast, is 80 feet thick, thins out towards the head of Roundstone creek. Along the ridge dividing it from the Kentucky river waters, nothing remains of it but detached masses or thin plates, which lie immediately upon, or but a few feet above, the limestone. A remarkable number of holes here occur in this rock, to be accounted for only by reference to the cavernous character of the underlying limestones. On Roundstone creek, six miles above its mouth, a quarry has been opened into this rock, which was formerly extensively worked for millstones.

The sub-conglomerate member, with its coal beds, seems to obey the same law; for on Skeggs' and Eagle creeks, and on the Rockcastle river, near the mouth of Roundstone, it measures 240 feet; whilst on the ridge, at the head of Brush fork of Roundstone, it has decreased to 102 feet; and still further to the northwest, on the ridge near the Mullin place, on the Scaffold Cane road, it measures but 40 feet in thickness.

At the point last mentioned, I found the sub-carboniferous limestone 115 feet thick; in the ridge to the south of Reed's tannery, on Clear creek, 145 feet; whilst on Roundstone creek it is 152 feet, and at Mt. Vernon 182 feet thick. From measurements made in the adjoining county, I have reason to believe it attains a thickness of from 220 to 240 feet in the southeast corner of this county.

The cavernous member of this limestone occurs about 100 feet below the top of the formation, and, where exposed by the erosion of the valleys, it swallows up the waters which come in from the neighboring hillsides only to yield them up again at the mouths of lower caves, or in powerful springs at the very base of the formation, at its junction with the knobstone; a fine instance of which is seen in Langford's branch below Mount Vernon. There is a higher level, 50 or 60 feet above this, where springs are common, issuing from a fine grained, white lime rock, much esteemed in this and the adjoining counties for burning. The Main street of Mount Vernon, (1,156 feet above tide, opposite the courthouse,) is upon this stratum, locally known as the Marble limestone. At this level spread out wide terraces, over which are scattered the farms

of this portion of the county. Below this level the limestone shows at times a semi-oolitic structure; and where I examined it on Renfro's creek, it was accompanied by a red streak. In the valley of this stream, and in Roundstone creek, are to be found great numbers of geodes, containing quartz. Their place in the rocks I could not satisfactorily determine, although it is probably no great distance above the Marble limestone.

The next lower formation occurs at many points upon our line; but being mostly beneath the drainage level of the country, it was impossible to get its thickness.

The upper portion of the knobstone in this county is in thin olive-colored layers, of a fine compact grain, well suited for building stone. Grindstones are often made of them.

The coal bed of this county that has been most worked covers but a portion of the area described as belonging to the coal measures, and it is only in the eastern parts, bordering on the Rockcastle river, that it may be looked for as sufficiently thick to be worked with profit. Even there the want of good roads will be a serious drawback, as the river affords no facilities for transportation. In fact, navigation is impossible at such points as at the Narrows, so long as vast blocks of the conglomerate are permitted to keep undisputed possession of its bed.

This coal, as in Jackson county, has not been mined, but only stripped. Upon the nose of the ridge, between Clear and Brush creeks, it was found, by Mr. Langford, to measure 33 inches, with a sulphurous bench, four inches thick, running through the middle; it has a six feet capping of shale, upon which rests a ten-inch band of extremely hard rock. One mile south from Mt. Vernon it has also been opened upon the farm of Charles A. Ledd, who reports it to be a good coal, of 29 inches in thickness. In Graves' Hollow, branch of Skeggs' creek, it has been mined by C. Jones; but, owing to the bank having fallen in, I was unable to obtain its thickness. It lies here 80 feet above the limestone, and has been also opened in many places on the West fork of Skeggs' creek; but all the banks examined were found caved in; and, in fact, in no instance could I form a correct judgment of either the real thickness of the bed or of its quality, for it was never mined far enough in to get past the impure "tailings."

Above Henry Mullins', on Taylor's Spring branch, and near the top

of the ridge, a bed of coal, measuring 39 inches, has been struck, with a black slate floor and roofing. This is unlike the others, and higher up above the limestone, and may be the equivalent of the main coal of Proctor; but there are not sufficient proofs to establish the fact.

The lower small vein, just above the limestone, can be traced along nearly the whole extent of the line. In the hill east of Mount Vernon it appears in connection with a chalybeate spring.

Agriculturally speaking, this county is more favored than its north-eastern neighbors, inasmuch as the fertile limestone terraces spread over a greater portion of it; and the valleys, being often cut in the shales of the underlying olive shales, are, consequently, broad, and present facilities for lowland culture impossible in the higher formations.

I noticed one fact in regard to the high ridge land, which I think worthy of remark, viz: that the fruit trees in the numerous small orchards had not been injured like those in the lowlands by the unusally late frost of the present year.

Sugar trees and hickory abound all along the limestone valleys, as well as some beech. The heavier growth of the ridge land would be very valuable were the river cleared of obstructions for its transit to a market.

PULASKI COUNTY.

This is the largest of the counties traversed by the outcrop base line; and one half of it is coal measures — divisible into three districts. The first lies between the Cumberland river and the Big South fork, locally known as the "Texas District." The second, and, at present, most important of the three, is circumscribed by the contour lines of a system of ridges filling up the space between Rockcastle river, Cumberland river, Buck creek, and Sinking Valley. The last mentioned valley, strangely enough, does not appear at all on the map of Kentucky, although it is near twenty miles in length. Its course is nearly due south, to the east of, and parallel with, Brush fork of Buck creek, into the latter of which it empties, a few miles above the crossing of the Somerset and salt works road. The third district occupies a small, irregularly shaped area between Pitman and Buck creeks, and between the Cumberland river and the road leading from Somerset to London.

The average thickness of the sub-conglomerate member of the millstone grit formation, in the second of these districts, is about 200 feet.

At McKee's mines it reaches 233 feet. Further west it is 191 feet thick. It contains five beds of coal, two of which are workable, the lower being known as the "McKee vein," and the upper as the "Main vein."

The dip of the rocks continues to be, as in Rockcastle county, to the southeast. This is shown best by the fact that the top of the limestone is 102 feet above the river, at the mouth of Roundstone creek, in Rockcastle county; but by the time it goes down to the mouth of the river it is but just above the water level. This portion of the county is, therefore, fortunate in having its coal beds near the river for transportation, and so situated that they can be entered by the miner on all three sides of the area—upon the waters of both rivers, and upon those of Buck creek. This is particularly noticeable in the comparatively small space between the mouths of Buck creek and Rockcastle river, where no less than fourteen streams cut through both beds and afford ample facilities for the construction of cheap tramways down to the landings.

The lowest of these five beds, lying about 27 feet above the top of the limestone, is thin.

The second, in ascending order, varies in height above the limestone from 80 to 93 feet, and is irregular in thickness. An opening has been made in it by Alexander McKee, at the point of a nose between two branches of main Big Lick creek, one and a half miles back from the river, down to which latter runs an iron railway. It is a double bed, and has a clay parting, which thins as it enters the body of the hill. The bed shows an outcrop of from one and a half to three feet; but at the McKee mines I measured, in the left hand gangway, four feet six inches of coal, with a clay parting of thirty inches. In the right hand gangway a mere streak of clay separates one foot of an upper bench from three feet nine inches of a lower bench, permitting the miner to take out four feet nine inches of coal. As to the continuance of this thickness of the bed throughout the entire area, I was unable to form an opinion, as it has been thoroughly opened with a view to transportation only at the Nashville company's mines, above mentioned.

It is to be remarked that this double bed on the Cumberland corresponds, in its height above the limestone, with the two thin beds, one of six and the other of four inches, which occur on the Kentucky river above Proctor, and which are noted in Vol. I, p. 216, of this Survey;

and, also, that the "Main coal" of the Cumberland is at the same height above the limestone as the main vein of Proctor.

The third coal bed, which varies in thickness from six to twelve inches, comes in 40 feet above the double bed last described, or 125 feet above the limestone.

The main bed of this region, 25 feet above the last, or 150 feet above the limestone, has been opened in many places, and varies in thickness from 39 to 54 inches. About 50 inches seems to be the usual thickness in the mines examined.

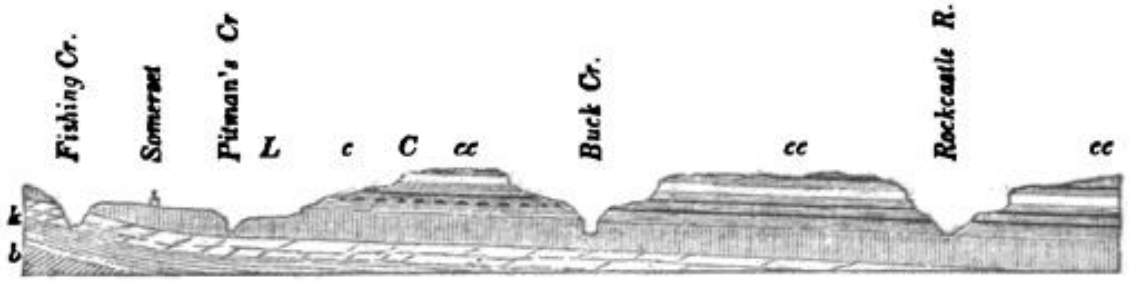
The fifth bed occurs about 15 to 20 feet above the last named, and is found in connection with the iron ore described on p. 235 of Vol. I of the Survey.

The base of the conglomerate lies 25 feet above this. It measures about 80 feet in thickness, and, for the most part, forms, in this portion of the country, the capping of the ridges; but immediately overlooking the Rockcastle river, it is covered with a sufficient quantity of the shales of the true coal measures to take in a 3½ to 4 feet vein of coal.

There are three distinct beds of shale containing iron ore traceable in the hills on the Cumberland river and upon the route of the outcrop base line, which, in this county, skirts the western margin of the coal. The first of these, a gravelly ore, shows itself under the lowest coal, and from 15 to 20 feet above the limestone. The second lies about 10 feet above the McKee vein, or 90 feet above the limestone; on main Big Lick creek, just above Mr. McKee's house, it shows itself in kidney-shaped masses, weighing from 1 to 35 pounds, and embedded in a gray shale stratum 5 feet thick. Two analyses show this to be a thirty per centum ore, containing sufficient calcareous matter to flux itself. The third ore bed lies near the base of the conglomerate, and will probably prove to be the most productive. There are also indications of an earthy iron ore just above the main coal bed; such, for instance, as that over the Sear's bank in the Pitman Hills, and the 9 inches band showing itself just above the Widow Pointer's house, at the head of No Name branch of Line creek. Below the house a 12 inches coal vein has been opened by J. Burdine, which, from its accompanying kidney ore, and from its height above the limestone, I judge to be the equivalent of the third coal bed. The same coal bed has been opened in the ridge dividing the Clifty's from Whetstone creek, where it measured 9 to 10 inches.

Indications of the McKee coal bed are found in the northern end of the Pitman Hills, in the heads of Blazed and Long Hollows, and the streams running into Buck creek.

The probable equivalent of the main bed has been opened in the hills 1⅞ miles S of E. from Collier's Mill, on Pitman's creek. It lies 152 feet above the limestone, and near the crest of the ridge overlooking Buck creek. When worked, it measured 39 inches, with a clay parting. The bed will be found to exist and yield well on both sides of the Pitman Hills, furnishing a bountiful supply of fuel to the thickly populated districts to the west and northwest, which, in fact, must draw their contingent from this region, as no coal of any account can be found west of Pitman's creek, owing to the rapid rise of all the strata northwestward, as seen in the following section, made from the junction of the Cumberland and Laurel rivers to Fishing creek, through the village of Somerset:



The sudden increase of dip can be plainly seen on the river, to the south of the county seat; for the whole 150 feet of knobstone, exposed at Waitsboro', goes under water, at the mouth of Pitman's creek, in a distance of only two miles. In like manner, the lower portion of the overlying limestone, at Pitman's creek, forms the tops of the high hills between Somerset and Fishing creek.

Pulaski county, considering the great extent of its good farming land, based upon the limestone and knobstone formations, and the breadth of its mineral area, and its valuable forest timber—stands among the very first of the counties of the mountain district. At present, this whole region is nearly inaccessible: as the rivers, which would otherwise be highways for the exportation of its productions, are not, and can not be put, in navigable order, until the huge masses of conglomerate, which lock up the Big South fork and Rockcastle river, are blown away, and

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ee. Coal measures. *C*. Conglomerate. *c*. Sub-conglomerate measures. *L*. Sub-carboniferous Limestone. *k*. Knob formation. *b*. Devonian black slates.

something is done to circumvent the dangerous shoals which obstruct the main Cumberland river and retard the development of its coal banks.

The proposed railroad, to connect Lexington, Frankfort, and Cincinnati with the rich valleys of Eastern Tennessee, if carried through the rolling limestone portion of Pulaski county, could cross with comparatively little difficulty the Cumberland river just below the coal, and there, gaining the ridge which runs through the Texas District, could be carried over a nearly level country to the eastern slopes of the Cumberland mountains overlooking Knoxville. This would, at once, bring the coal into market, and open up the valuable white pine lands which border on Tennessee, and also the red cedar lands to the north of them.

The limestone formation continues to thicken through this county southwestwardly, measuring 250 feet at two points on Buck creek, and 242 feet in the Long Hollow. Through it is cut the long, dish-shaped Sinking Valley, with side slopes yielding fine crops of blue grass and grain. The upper portion of Buck creek, also, runs in this formation, but passes into the underlying knobstones just above the crossing of the salt works road. Pitman's creek runs in it to its mouth. These last two streams furnish admirable milling power; and the introduction upon them, within the last few years, of the finer kinds of millstones, has given a wonderful impetus to the farming interests of the neighborhood. Now that wheat can be properly ground, and so made profitable at a distance, the old system of an endless succession of crops has given way to the more healthful alternation of deep-rooted grasses and grains, improving the worn out lands, and increasing their money value; while another and remoter consequence is seen in a more attentive and successful sheep raising.

WAYNE COUNTY.

One half of the area of this county is embraced within the coal field, which contains not only the five sub-conglomerate coals, but in the extreme southeast corner the large beds of the upper coal measures are said to show themselves. Like that of Pulaski, its coal area may be divided into three districts; one, embracing all that high ridge land lying between the Big and Little South forks and the Tennessee State line; a second, the ridges lying between the waters of the Sinking creeks, on the east, and the Elk Spring and Kennedy's creeks, on the

west; and a third, the high lands between Elk Spring creek and the Little South fork, and between Otter and Beaver creeks.

As yet, the main coal bed of the Cumberland river district is the only one which has received attention, openings in it having been made along the Big South fork, and in the ridge at the head of Fall and Big Sinking creeks; but at only two of these points are the mines now worked.

Ascending the Big South fork, the Dodson mines come first, high above the river, near the summit of the nose projecting between the South fork and Big Sinking creek, lying 160 feet above the limestone, and said to average 46 inches in thickness. It is a sulphurous coal, embedded between three feet of shale below it, containing an earthy iron ore, and three feet of shale above it, capped with a three feet band of hard gray fossiliferous sand rock, very similar in appearance to that found overlying the main Proctor bed. Over this is 20 to 30 feet of shale, forming the top of the ridge, which is strewn with iron ore. At the same geological level across the river, the ferruginous shales are *reported* to contain an amount of ore equal to a thirty-six inch vein.

One hundred feet below this coal bed, and seventy-one above the limestone, is the outcrop of another, which is probably the equivalent of the McKee bed, and which is said to be three feet thick.

Thirty-three feet below this last, and twenty-eight feet above the limestone, is the small coal bed found elsewhere in this position.

The main bed can be traced from Dodson's all along the ridges dividing Big Sinking, Turkey creek, and Long branch; and in the ridge dividing the latter from Little South fork, are to be found the long since abandoned Esslemen's mines. The coal is reported by the old settlers to have been impure, and for that reason abandoned. None of these ridges, near the river, are high enough to take in the solid capping of conglomerate, which begins, however, from this point to show itself towards the south and west. Passing the Little South fork, the next opening is called Dick's Bank. It lies in the nose between the Big South fork and Wild Dog creek, facing the former at an elevation of about 350 feet above low water. It is now abandoned; but, when worked, it is said to have produced a good coal, averaging forty-six inches. The floor for three feet is composed of a compact bluish shale, and the roof of a sandy shale, filled with carbonaceous matter, in the form of stems and leaves,

capped in its turn by the universally found stratum of hard gray sandstone. Above are about 100 feet of ferruginous shales, containing a thin vein of coal, the whole protected by massive cliffs of the conglomerate, which here form the ridge top. The McKee and lowest beds are reported to be here; but I could see no outcrop, though their terraces are strongly marked. This Dick's vein, as well as the Dodson vein, is described as pitching into the hill and then becoming level, a peculiarity strongly marked in the main coal bed of the Kentucky river.

The ridge containing the main vein which has been opened at Dick's bank claims particular attention, as it probably affords the best coal of any yet mined up the South fork, which is no doubt partly due to its excellent capping, and also because it is at the present head of navigation—the celebrated Dick's Jumps, just above the mouth of Wild Dog creek. These Jumps are formed of immense masses of the conglomerate which have fallen from the neighboring hills, and now lie in the river, blocking it up, and rendering navigation from above impossible. This is a serious obstacle to the prosperity of the neighborhood, as the coals could be worked much more cheaply further up, where the southeast dip has brought them down nearer to water level. A careful examination of the river, leads me to believe that a small expense would get rid of these masses of rock, lying, as they do, in very deep water, where a single heavy blast would cause many of them entirely to disappear beneath the surface.

Just above the mouth of Wild Dog creek, and, indeed, at many points on the river, excellent sand beaches occur, where boats could be built and turned, without much danger; and the limestone benches, which here line the river and its branches, could be cultivated and made to supply, not only the builders, but the miners, with all the necessary cattle and grain, the fine water power of the creeks being used to grind the latter, and the ridge land above affording excellent summer pasturage for cows and sheep.

West of the Jumps, and in the ridge dividing Turkey creek from Denney fork of Sinking, the main bed has been opened by Jackson Denney, 160 feet above the limestone, and forty-five inches thick, marked with seams of sulphuret of iron at the outcrop, but said to lose this blemish when pursued beneath the hill. Eighty feet above it runs the base line of the conglomerate cliffs, which are here 90 feet high.

Within 30 feet of the base of the cliffs lies a heavy band of shale, containing iron ore. At the usual distance below the main coal are the well defined terraces, which mark the lower coal veins. Here it is that the ripple-marked, fine-grained sandstone, overlying the lowest coal, shows itself in force, in successive layers of about eight inches thick, and quarrying in ten foot slabs, admirably adapted for building purposes.

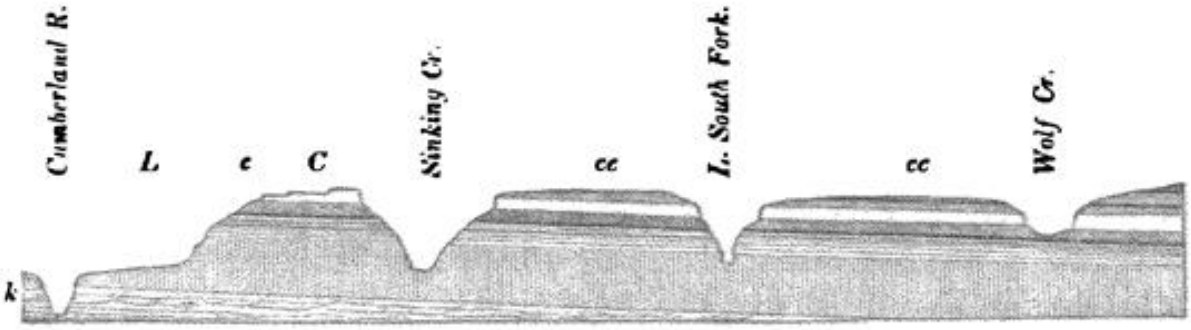
To the northwest of this, two coal banks occur in the long ridge lying between Middle and Big Sinking creeks, and the waters running north into the main river. The first of these is Sloan's, described in Vol. 1, p. 244, of the Reports; whilst the second has been recently opened by a Mr. Alexander, on that part of the ridge between the Dry fork and Elk Spring creek. The outcrop measures forty-two inches —the lower three inches slaty; its capping is a gray, shaly sand rock; and its elevation above tide 1,370 feet.

The hills around Monticello are not high enough to take in the main coal bed; but the lower one has been opened at various places in the vicinity, and is praised by the blacksmiths.

The main bed will, no doubt, be found extending over the whole of this county south of the Little South fork, and can be mined along nearly its whole length, as well as on the Big South fork as high up as Wolf creek, where it is said to cross the river and go under water level.

The iron ore belt lying above the McKee bed is strongly marked on the river in the vicinity of the three Sinking creeks; but, unfortunately, I was not able to remain a sufficient length of time in the neighborhood to get its thickness, though I believe it to be well worthy the attention of iron masters.

The conglomerate in this county, where measured, attained a thickness of 90 feet, and the lower member of the formation measured 240 feet. Wayne may be said to be based upon the sub-carboniferous limestone, in which nearly all the streams have cut their beds, the Cumberland river being the only one which runs in the underlying knobstone, whilst Rock creek is the only important one which cuts its whole length in the overlying millstone grit formation. The following section, from the S. E. corner of the county to Mill Springs, on the river, will explain this, and also show the general disposition of the rocks and their dip:



No county on our line is so favored by an equal distribution of farming and mineral land as this. Rich, broad, and gently sloping limestone vales run up between the narrow ridges containing the precious minerals; while to the northwest extends throughout the county, in a broad band, that fertile limestone table-land, paradoxically called "The Barrens;" and below this elevated terrace are the equally rich bottoms of the Cumberland river. "The Barrens" have a gently undulating surface, of the red calcareous soils of the *Lithostrotion* division of the sub-carboniferous limestone, and, at the period of the early settlement of this country, were nearly destitute of trees, being represented in the records of that day as having the appearance of open prairies covered with long, rank grass. But at present, where not under cultivation, they luxuriate beneath a heavy growth of timber, principally of black oak and black walnut, through which hickory, dogwood, and black gum are common. The surface, in many parts, is strewn with the yellow, cherty masses, so commonly met with in Kentucky at this geological horizon, embedded in a red clay soil, which, at some points, is, at least, twenty feet deep. A different kind, called "nigger heads," is found with them, and produces, when ground up, a manure, said to be particularly adapted to the soil upon which it is strewn. Between the wide rolling noses of the Barrens, are frequently to be met estuary-like bottoms, called "flat lands," "crawfish lands," &c. These extend over wide surfaces between Otter and Beaver creeks, and grow timothy and herd grass well, but trouble the farmer to get from them good crops of corn or grain. The timber is mostly white oak and pin oak, hickory, and sugar tree. Specimens of the soils of this county have been carefully collected for analysis.

The Barrens of this county are full of sink holes, caused by the

k. Knob formation. *L*. Sub-carboniferous limestone *c*. Sub-conglomerate measures. *C*. Conglomerate. *cc*. Coal measures.

cavernous character of the underlying strata, spoiling the surface drainage of the country, and compelling the farmer to sink deep wells for his supply of water, unless he lives near the edges of the great plateau, in which case he will be abundantly supplied from the large springs which issue from the face of the cliffs, and which, if utilized, could perform much of the lighter labor of the farm. The streams which cut through the limestone in a northwest direction fall rapidly, and would furnish an abundance of power.

CLINTON COUNTY.

The coal area of this county is very small, and includes only the western half of the Poplar mountain, along with two outliers: the first on Short mountain, between Otter and Indian creeks; and the other, occupying the top of the ridge between Wade's and Caney gaps. The main coal bed of the Cumberland river seems to be the only one which has been worked in this county. At Dr. Long's bank, in the north point of Poplar mountain, it is 165 feet above the limestone, and 35 feet below the conglomerate, which latter caps the ridge at this point, and is 70 feet thick—the top being 445 feet above Wade's gap, or 1,678 feet above tide. There are terraces below this main bed which correspond to those of the lower coals on the South fork; but no outcrop signs were discovered in the Poplar mountain. Dr. Long's coal shows a thickness of four feet, and has a solid roofing of fossiliferous sandstone, which undulates along some of the drifts, at the expense of the thickness of the bed. These are called "horse-backs" by the miners, but bear only a distant resemblance to those properly so called, whether in metallic veins, or in more disturbed coal regions.

South from these banks, in a spur of the Poplar mountain, known as the Copperas knob, this same bed has been opened in several places by Lewis Huff. It lies 160 feet above the limestone, and presents the same peculiarities as at Long's, being 4 feet thick and containing sulphuret of iron nodules. It has been traced in the other spurs of the mountain, and is known to exist in the spur extending westward from Long's bank to the Caney gap, north of Albany.

I was prevented by sickness from examining the iron ores of this section as fully as I could have wished, though there seems to be but little hope of finding them sufficiently developed to warrant the erection of blast furnaces. In the Sinking country, to the south of Albany, my

attention was called to large areas covered with an apparently rich iron ore, some specimens upon the farm of George M. Denton having the usual brown hematite character, whilst others were honey-combed and very fossiliferous. No diggings having been made, it was impossible to arrive at the quantity of this ore, specimens of which have been submitted to the State Chemist for analysis.

The outcrop base line terminates in the southeastern corner of this county, at a point on the Alabama stock road, 1,996 feet south of John Crouch's house. A white oak, standing to the east of the roadway, and marked, "St. 9272 B. Line," shows its terminal station.