CONTINUATION FROM VOL. 2,

OF THE

# TOPOGRAPHICAL GEOLOGICAL REPORT

OF THE PROGRESS OF THE

# SURVEY OF KENTUCKY,

IN THE COUNTIES OF

# GREENUP, CARTER, LAWRENCE AND HANCOCK,

FOR THE YEAR 1857,

BY

SIDNEY S. LYON,

TOPOGRAPHICAL ASSISTANT.

This page in the original text is blank.

# CHAPTER I.

## OBSERVATIONS ON THE GEOLOGY AND TOPOGRAPHY OF GREENUP COUNTY.

In my previous report on the progress of that part of the Geological Survey of Kentucky confided to my direction, the observations of Greenup county were set forth to the extent they had been made up to that time.

During the present season, corps No. 3, under the direction of Mr. Edward Mylotte, has extended the field work. The topography and geography of that county has been completed, except a narrow strip along the western margin of the county, including only the heads of some of the longer branches of Tygert's creek. The topographical work has been extended also across Carter county, east of Little Sandy river, as well as some distance into Lawrence county. For the extent and completeness of this work, I refer to the map of the survey accompanying this part of my report.

The observations on the eastern coal and iron region made last year were not sufficiently numerous, or in such close connection, as to warrant any safe general conclusions. The observations for the stratigraphical and geological features of this district have been very much extended during the present season, and a few deductions of a general character are here presented.

1. That the margin of the Eastern Coal-field of Kentucky, on the west, nearly coincided with the ridge of high land dividing the waters of Tygert's and Kinniconick creeks; and on the north the margin line nearly coincided with the present line of the Ohio river, from the mouth of the Scioto river to the mouth of Little Sandy river.

2. That the disturbing forces, operating during the deposition of the carboniferous formation of Greenup and Carter counties acted with very great energy along this margin, and that it was sustained nearly at the level of the water of the then existing sea, during the whole carboniferous period.

3. That the greatest subsidence occurred to the south-east and south-west, from the mouth of Little Sandy.

4. That the sea bottom, at the period immediately succeeding each subsidence, was very unequal, and waving, making long troughs and ridges alternately; and that, to a greater or less extent, this condition existed at every subsidence, with, however, this difference—the ridges of one period seldom agreeing with those of the period immediately preceding it, and not unfrequently the ridges of one period lie diagonally across the waves of the preceding one.

5. That as these periods of depression, and upheaval, succeeded each other, the rushing currents of water frequently wasted and carried away part of a bed and deposited the wasted materials in another place.

6. That the period of the formation of the several beds of iron stones, was one of general submergence, proved by the continuity of the beds over wide areas.

7. The character of the beds were much modified by the currents, sometimes transporting and mixing sand, and other transported materials, with the ferruginous deposits, and sometimes sweeping the beds previously formed, either entirely away, or leaving them merely in holes and pockets, formed by the inequalities of the original sea bottom.

8. That the final upheaving force, by which these measures were raised to the position they now occupy, many hundred feet above the level of the present seas, produced by lines of fracture, along which the course of the larger streams was determined, as well as a majority of the branches and drains, notwithstanding the immense denudation, there is no evidence that any branch, or stream, has been produced alone by the wasting force of running water.

9. That the forces producing the final elevation of the Coal Measures of Greenup and Carter counties, acting in lines of unequal force, has raised the high lands between the larger streams into ridges of curved and bent rocks, and associated materials—always making the dividing ridge between parallel streams higher from the bed of the stream to the top of the ridge, than the thickness of the rocks, &c., composing the ridge; the height of the hills always exceeding the thickness of the rocks, by the amount of the dip of the rocks from the center of the top of the hill to the bed of the stream. Furthermore, the waves producing the main and subordinate ridges, have been

crossed by a force which has thrown the great hills into waves of greater or less length. This last force appears generally to have crossed the lines of the first waves nearly at right angles. In a few instances, instead of waves and undulations, faults have been produced. It is to the effect of these two lines of undulatory motions, that are to be traced one of the most remarkable features of the country—the "low gaps;" at which places the main ridges are nearly severed, sometimes bent down, and sometimes broken by a fault; in which one side of the gap appears to hold the normal height of the ridge, while the other side has fallen towards the gap, from 75 to 300 feet. The faults are the exception, the waving and bent stratification is the rule.

From a careful consideration of the preceding propositions, it will be seen that each hill and valley of this country becomes in itself a special study. There are a few rules which have been found useful in the investigation of this country. If the measures are not exposed, there are in them several beds of alternately soft and hard materials, marking the hills with a succession of benches. The line of dip, with a few exceptions, is with the line of the creeks and valleys. The dip is also nearly always from the centre of the ridges towards the valleys. Pine trees universally mark the debris of coarse sandstones. Spruce and hemlock locally marks the millstone grit. Chestnut oak always marks heavy deposits of clay. These characteristics have a local application, and will hold good in the Coal Measures of Greenup and Carter counties.

The sandstones at the top of the Knobstone formation produces pine. The next sandstone in the ascending series, producing this tree, is the mass over the coal at Clinton Furnace, and upper bed at Ashland. The third sandstone, in ascending order, marked by pine, is the sandstone over the bed called the limestone ore of Laurel, Steam and Caroline Furnaces. There is still another sandstone marked by its belt of pine trees. This last lies high in the hills, and has been observed in but few places. A small point of a ridge at the head of Key's creek, on the rounded hill south of the Pike, near Mr. Scott's, on the highest points at the head of Stinson's creek, in the vicinity of Caroline Furnace, and at the head of Indian creek, are the only places where this member has been noticed.

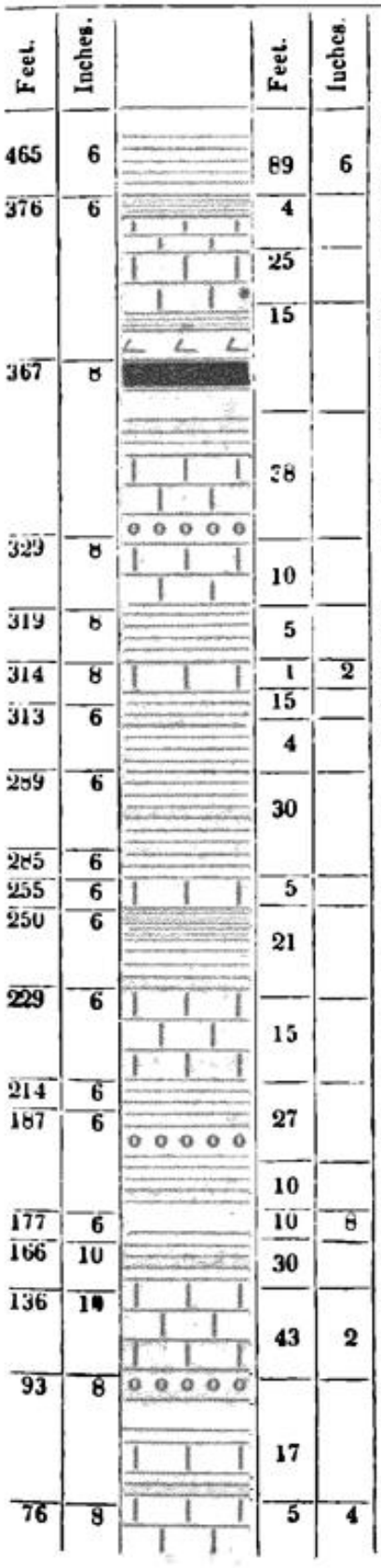
## STRATIGRAPHICAL ARRANGEMENT AND EQUIVALENT BEDS OF DIFFERENT LOCALITIES.

The following sections will partially exhibit the changes in equivalent members, and may serve as the key by which the beds of ore may be traced along the sides of the valleys, and sought for in their true geological horizon. It is to be observed, however, that the character of the ores and associated materials are much changed, even in inconsiderable distances. The horizontal place of a given bed is, also, much modified from a given locality. On descending a branch the bed is found to descend with the line of the valley. It may be expected that the bed will be found occupying a higher position on ascending the same valley. Further, as the line of stratification curves with the line of the sag of the ridges, so the ore beds are also depressed with the rocks between which they lie.

*No. 1. Section of the measures at Kenton Furnace.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 460 | | | 29 | | Covered space. |
| 417 | | | 87 | 6 | Scattered patches of kidney ore.<br>Micaceous sandstone and sandy shales. |
| 329 | 6 | | 12 | | Sandstone beds used in building furnace stack.<br>Bed of clay, probably the waste of clay slate. |
| 317 | 6 | | 23 | 6 | Top hill "Block ore." Soft, with light colored ochreous specks.<br>Covered space, probably, slate and shales. |
| 294 | | | 7 | | Top of seven feet, kidney ore beds. |
| 287 | | | 15 | | "Little Block" ore, 4 to 6 inches thick.<br>Space, with shale.<br>"Rough Block," 9 to 18 inches thick. |
| 272 | | | 5 | | Sandy shales. |
| 267 | 1 | | 8 | 1 | "Hearth Rock" beds. |
| 258 | 11 | | 16 | 11 | Rough, coarse sandstone. |
| 247 | | | 7 | 9 | Ore bed resting on the sub-carboniferous limestone at Boone and Kenton Furnaces. |
| 238 | | | | | Sub-carboniferous limestone. |
| 10 | | | 238 | | Knob freestone and shale, equivalent to the rocks of Triplett and Kinniconick creeks. |
| | | | 10 | | Base of furnace stack, resting on Knobstone beds. |
| | | | 0 | | Bed of White Oak creek. |

*No. 2. Section of the measures equivalent to those at Kenton Furnace as seen at Laurel Furnace. See map of Greenup county for relative position of places.*



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 465 | 6 | 89 | 6 | Top of hills. The upper 89 feet local; capping only a few of the hills. |
| | | | | Covered space, probably clays. Timber, chestnut oak. |
| 376 | 6 | 4 | | Dark argillaceous shales, varying from 4 to 30 feet. |
| | | | | Sandstone, fine grained. This rock is local, and varies from a few inches in thickness, to 25 or 30 feet thick, frequently pebbly. |
| | | 25 | | |
| | | 15 | | Dark clay, from 1 to 30 feet. |
| | | | | Limestone ore. *Baker Bank.* |
| 367 | 8 | | | Coal 1 inch to 4 inches thick. |
| | | | | Under clay, from 1 to 4 feet thick. |
| | | | | Slope, with shale and sandstone at base, from 1 to 10 feet thick. |
| | | 38 | | *Place of Red and Buck Smith Banks.* |
| 329 | 8 | | | Top of bench, probably sandstone. |
| | | 10 | | |
| 319 | 8 | 5 | | Clay bed. |
| | | | | Sandy shales. |
| 314 | 8 | 1 | 2 | Hard sandstone. |
| 313 | 6 | 15 | | Sandy and clay shales. |
| | | 4 | | Clay bed. |
| 289 | 6 | 30 | | Sandy shales. |
| 285 | 6 | | | |
| 255 | 6 | 5 | | Bed of flag stone. |
| 250 | 6 | 21 | | Black clay shale 4 to 5 feet. |
| | | | | Shaley sandstones 16 feet. |
| 229 | 6 | 15 | | Soft coarse sandstone, equivalent to the bed used at Raccoon Furnace for bosh stone. |
| | | | | Lower part strongly marked by oblique lines of deposition. |
| 214 | 6 | 27 | | Drab micacious sandy shales. |
| 187 | 6 | | | Thin bed 3 to 5 inches--sandy, kidney and block ores. |
| | | 10 | | Drab, sandy, micacious and clay shales, alternating. |
| 177 | 6 | 10 | 8 | Covered space. |
| 166 | 10 | 30 | | Drab sandy shales. |
| 136 | 10 | 43 | 2 | Hearthstone bed of Laurel Furnace, equivalent bed used at Raccoon Furnace for hearth rock. |
| | | | | Lower part shaley sandstone. |
| 93 | 8 | 17 | | Lowest ore bed known at Laurel Furnace. |
| | | | | Rough blocks, and generally sandy. |
| | | | | Shaley sandstone and shales. |
| 76 | 8 | 5 | 4 | Sandstone. |

*This rock has been used for hearth.

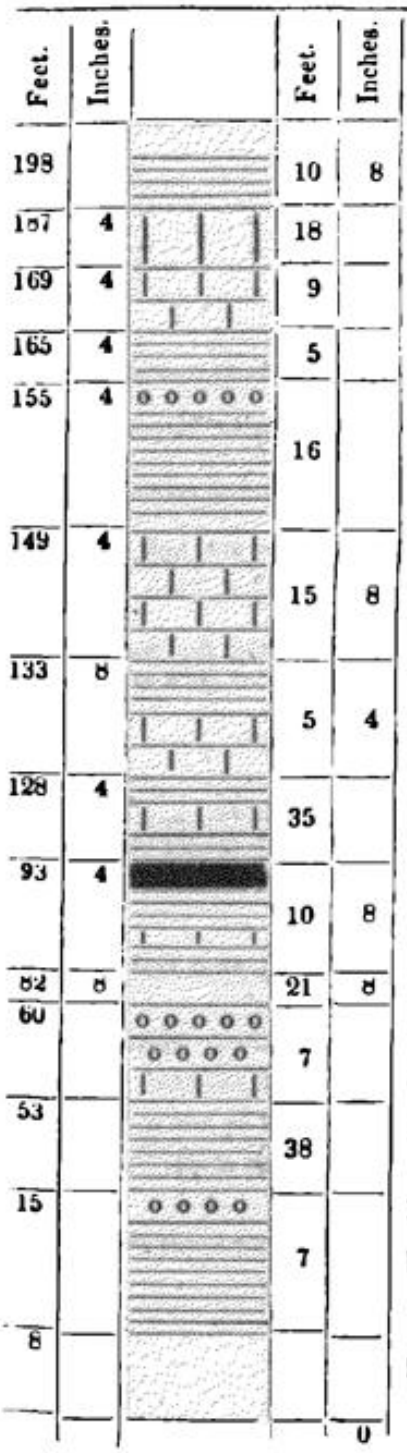
| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| | | | | 16 | Flagstones, thin beded, 2 to 6 inches thick. |
| 55 | 4 | | 5 | 4 | Sandstone. |
| 0 | | | | | Top of stack, Laurel Furnace. |
| 10 | | | 10 | | Thin beded hard sandstone. |
| 16 | | | 6 | | Six feet ledge. |
| 23 | | | 7 | | Seven feet ledge. |
| 31 | | | 8 | | Eight feet ledge. |
| 40 | | | 9 | | Nine feet ledge. |
| 50 | | | 10 | | Lowest rock seen at Laurel, 50 feet below the top of stack. |
| | | | ? | | Probable equivalent of the millstone grit. |
| | | | | | Locally a bed of shales and small coal. |
| | | | ? | | Fire clay. |
| | | | ? | | *Sub-carboniferous limestone. |
| | | | ? | | |

*See Sections Nos. 12, 1 and 16.

*No. 3. Section at Raccoon Furnace, from Raccoon creek towards the northwest.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 311 | | | 5 | | Ferruginous conglomerate, "poor ore," top of dividing ridge between Raccoon and Alcorn creeks. |
| 336 | | | 45 | | Place of *limestone ore beds* of Laurel, Steam, and Caroline Furnaces. |
| | | | | | Covered space, mostly argillaceous shales. |
| 291 | | | 20 | | Shale, sandstone and clay beds exposed at Triplett's bank. |
| 271 | | | 16 | | Company's ore bank, 10 inches to 2 feet. |
| | | | | | †Place of principal ore beds of Raccoon and Buffaloe Furnaces. |
| | | | | | Thin beded, soft micaceous sandstone. |
| 255 | | | 41 | | Bluff of heavy sandstone, top and bottom thin beded; middle of the mass very thick beded, composed of coarse angular sand and quartz pebbles, marked by ferreginous belts and patches. |
| 214 | | | | | Locally a thin coal. |
| | | | 16 | | Covered space; soft beds, mostly argillaceous shales. |

†The horizontal position occupied by equivalent ore beds, are severally thus: "Brown Bank," 295 feet, "Company Bank," 340 feet, "Tipton Bank," 350 feet. All these several openings are in one hill, and are highest to the west, or head of the creek.



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 198 | | 10 | 8 | Sandy shales, part of the bed micaceous. |
| 187 | 4 | 18 | | Thick, obscurely beded, very soft sandstone. |
| 169 | 4 | 9 | | Soft sandstone, bedding well marked. |
| 165 | 4 | 5 | | Sandy shales. |
| 155 | 4 | 16 | | Sandy, poor ore, 6 inches thick, (not worked )<br>Covered space, showing in several places, thin bedded, muddy sandstones and sandy shales. |
| 149 | 4 | 15 | 8 | Coarse sandstone, evenly beded.<br>Hearth rock of Raccoon Furnace, 18 inches thick. |
| 133 | 8 | 5 | 4 | Shale.<br>Rock used in construction of stack, 18 inches thick, rough and ferruginous when weathered. |
| 128 | 4 | 35 | | Sandy shales, with a few beds of sandstone intercalated. |
| 93 | 4 | 10 | 8 | Locally clay band, with thin coal.<br>Thin beded soft sandstone and shales. |
| 82 | 8 | 21 | 8 | Covered space, mostly sandy shales. |
| 60 | | 7 | | Sandy ore, here 4 inches, ¼ of a mile east, 18 inches thick.<br>Sandstone soft and imperfectly beded. |
| 53 | | 38 | | Ash colored and dark grey sandy shales with a few thin seams of argillaceous shale. |
| 15 | | 7 | | Bed of carbonate of iron.<br>Dark grey shales, bed of Raccoon creek. |
| 8 | | | | Bottom of pit 8 feet deep, bed of chert and silicious fire clay, resting on sub-carboniferous limestone ? |
| | | | 0 | |

*See sections Nos. 15 and 16.

*No. 4. Section at Steam Furnace, from stack to Carrington bank, southwestwardly.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 241 | 3 | | 16 | | Clay and clay shales. |
| 225 | 3 | | 5 | | Little block ore.<br>Clay bed, with kidney ore, ores not regularly bedded. |
| 220 | 3 | | 26 | | Coarse sandstone and conglomerate, over Carrington, or "Drift Bank." |
| 194 | 3 | | 3 | | Clay over limestone ore bed, from one inch to 30 feet thick. |
| 191 | 3 | | 1 | 3 | Limestone ore, Carrington Bank. The ore bed varies in thickness from ½ inch to 4 feet thick. |
| 190 | | | 5 | | Limestone used as a fluxing material. On the Steam Furnace lands it varies in thickness from one inch to 8 feet. |
| 185 | | | 10 | 8 | Clay beds over diggings west side of ridge. |
| 174 | 4 | | 16 | 2 | Covered space, probably clay shale. |
| 168 | 2 | | 16 | | Clay shales, probably duplicate of the above. |
| 152 | 2 | | | * | Ore beds, block and kidney, from 6 to 15 inches thick, resting on clay containing black carbonaceous bands. |
| 146 | 10 | | 5 | 4 | Sandstone. |
| 141 | 10 | | 5 | | Clay shale. |
| | | | 38 | 2 | Shales and shaley sandstones, alternating with beds of sandstone from 12 to 14 inches thick. |
| 103 | 8 | | 10 | 8 | Top of sandstone above ore diggings, called "Little Block" ore. |
| 93 | | | 32 | | Clay and micaceous sandy shale, exposed in ruts in the road. |
| 61 | | | 5 | † | Coal (?) dirt, covered by black bituminous shale.<br>Under clay. |
| 56 | | | 21 | | Clay shale, with intercalated beds of muddy sandy shales. |
| 35 | | | 25 | | Sandstone. |
| | | | 0 | | Quarry near Clerk's house.<br>Office door. |
| 6 | | | | | Bed of branch. |

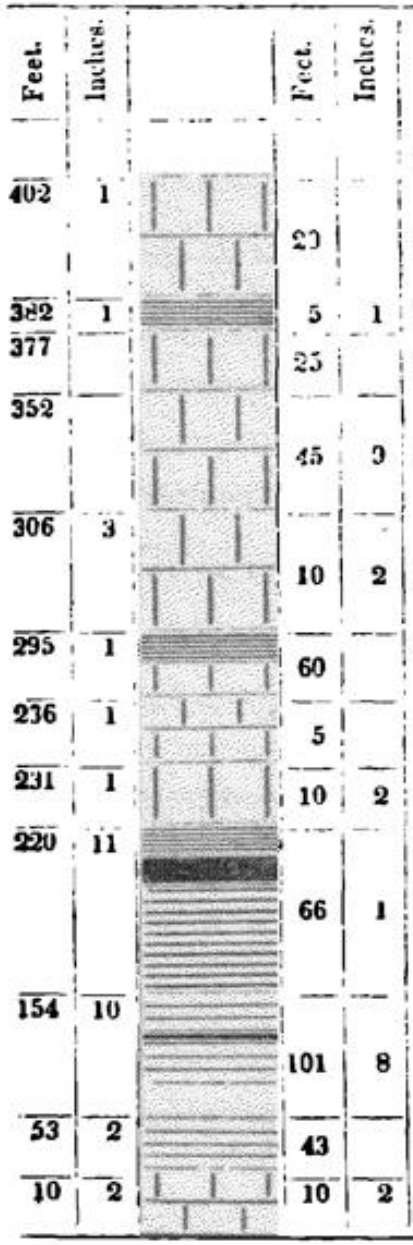
*Equivalent to the main ore beds of Raccoon and Buffaloe Furnaces; and the Buck Smith and Red Banks of Laurel Furnace.

†Equivalent to the coal on Indian run—also, the coal at Caroline Furnace, and the upper coal of Clinton Furnace.

*No. 5. Section from the west side of Little Sandy river, starting at 174 feet of section No. 6, the bottom of this section being filled from section taken on the east side of the river, at Dr. Spalding's coal, in first hill south of Greenupsburg.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| | | | | | Top of hill. |
| 396 | 5 | | 25 | | Coarse sandstone, containing pebbles and ferruginous bands, "pot ore." |
| 371 | 5 | | 35 | | Sandy shales, and covered space. |
| 336 | 5 | | 30 | 6 | Hard, coarse sandstone, weathering into small holes, "honeycomb sandstone." |
| 305 | 11 | | 71 | 2 | Shaley sandstone and sandy shales, with interculated beds of "flagstones." |
| 234 | 9 | | 6 | | Coarse sandstone, weathering into circular cavities 8 to 10 feet deep. |
| 228 | 9 | | 12 | | Hard thick bedded sandstone. |
| 216 | 9 | | 3 | | Black bituminous shale, over 8 inch coal. |
| 213 | 9 | | 42 | 9 | Muddy sandy shales. |
| 171 | | | 6 | 5 | Sandstone, equivalent to that at 174 feet, in Sec. No. 6. |
| 114 | | | 57 | | Covered space, sandy and clay shales ? |
| 107 | 4 | | 6 | 8 | Dove colored sandy shales. |
| 105 | 4 | | 2 | | Bituminous shales. |
| 104 | 7 | | | 9 | Coal. |
| 103 | | | 1 | 7 | Silicious under clay. |
| 42 | | | 61 | | Sandy and clay shales. |
| 7 | | | 35 | | Sandy and clay shales, with thin flagstones intercalated, with a thin coal at its base, 1 to 3 inches thick. |
| | | | 7 | 0 | Fire clay, 7 to 10 feet thick, (road way.) |

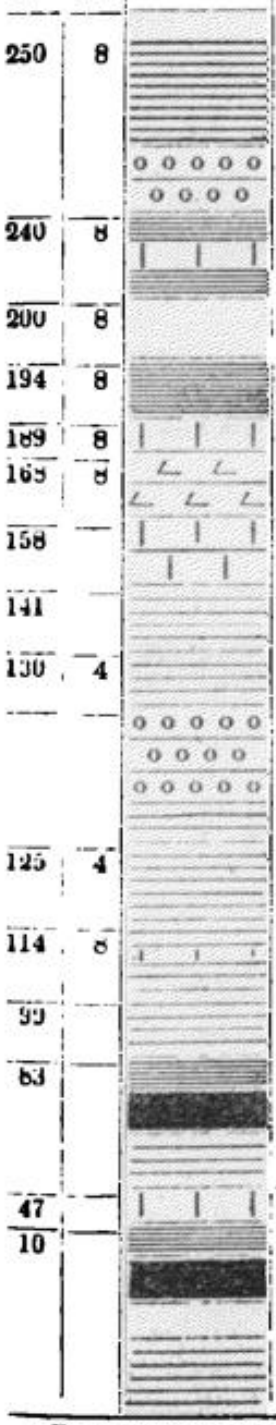
*No. 6. Section east side of Little Sandy river starting at surface of pool, 8 feet above low water of the Ohio river.*



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| | | | | Top of hills on the east side of Little Sandy river. |
| 402 | 1 | | | |
| | | 20 | | Sandstone. |
| 382 | 1 | 5 | 1 | Sandy shale, stained with ferruginous matter. |
| 377 | | 25 | | Heavy sandstone. |
| 352 | | 45 | 9 | Coarse sandstone, containing quartz pebbles, especially at the junction of the beds; containing also much "*pot ore.*" |
| 306 | 3 | 10 | 2 | Coarse grey sandstone. |
| 295 | 1 | 60 | | Covered space, composed of sandy and clay shales; 6 to 8 feet of sandstone exposed at the base of the mass. |
| 236 | 1 | 5 | | Soft sandstone, weathering into circular cavities. Equivalent of rock at 234 feet, section No. 5. |
| 231 | 1 | 10 | 2 | Heavy compact sandstone. |
| 220 | 11 | | | Black bituminous shale. |
| | | 66 | 1 | Thin coal, said to be 8 inches thick.<br>Thin sandy shales, space partially covered.<br>See section No. 5, for details of this space.<br>Place of 174 feet in section No. 5. |
| 154 | 10 | 101 | 8 | Covered space, principally shale and shaley sandstone, with a *little* coal in the upper 50 feet. See sec. No. 5. |
| | | | | Road from Greenupsburg to Raccoon Furnace. |
| 53 | 2 | 43 | | Covered space, shales and clay. |
| 10 | 2 | 10 | 2 | *Knobstone in place—wedge shaped ledges. |

*The millstone grit and sub-carboniferous limestone are both absent.

## *No. 7. Section at Caroline Furnace.*



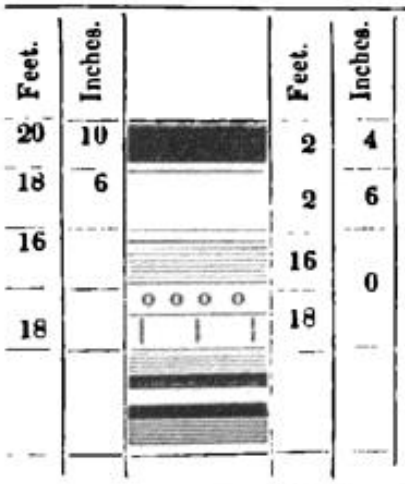
| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 250 | 8 | 10 | | Top of hills southwest of the furnace—the diving ridge between Indian creek, and the branches emptying into the Ohio. |
| | | | | Rough "*Top Hill Block*," 8 to 15 inches thick, under kidney ore. |
| 240 | 8 | 40 | | Shales and sandstone. |
| 200 | 8 | 10 | | Covered space. |
| 194 | 8 | 5 | | Argillaceous shale. |
| 189 | 8 | 21 | | Soft sandstone. |
| 165 | 8 | 10 | 8 | Covered space, place of limestone ore, and limestone. |
| 158 | | 10 | | Sandstone, probably slipped from above. |
| 141 | | 10 | 8 | Argillaceous shale. |
| 130 | 4 | 5 | | Bed of fire clay (?) |
| | | | | Place of ore bed at Steam Furnace, at 152 feet. See section No. 4. Equivalent to the main beds at Buffaloe and Raccoon Furnaces. |
| 125 | 4 | 10 | 8 | Ore diggings—no bed found, some loose ore from "*limestone ore*," at 168 feet 8 inches. |
| 114 | 8 | 15 | 8 | Soft sandy shales. |
| 99 | | 15 | | Clay bed at base of "bench." |
| 83 | | 36 | | Black clay bed, from 2 to 4 feet thick. *Place of Clinton Furnace coal* (?) |
| | | | | Shale beds, and covered space. |
| 47 | | 37 | | Sandstone. |
| 10 | | 10 | | Black shales<br>*Coal.<br>Under clay. |
| | | | | Sandy shales. Bed of branch at stack. |

*Equivalent to the Star, Steam, and Clinton Furnaces, and Indian creek coal beds.

## *No. 8. Section at Clinton Furnace.**

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| | | | | | Top of hill north of furnace. |
| 255 | 6 | | 5 | | Red clay. |
| 250 | 6 | | 8 | | "Top hill" sandstone, 8 to 10 feet thick, sometimes filled with pebbles. *Horizon of pine trees.* |
| 244 | 6 | | 1 | | "Top hill" ore, 8 to 15 inches thick. |
| 243 | 6 | | 2 | | Sandstone. |
| 241 | 6 | | 5 | | Yellow sandy shale. |
| 236 | 6 | | 5 | 4 | Sandstone. |
| 231 | 2 | | 4 | 8 | Sandy shales. |
| 190 | 6 | | | 8 | Fossiliferous sandstone, shells converted into lime. "*Bastard limestone.*" |
| 189 | 10 | | 22 | | Sandy shale. |
| 167 | 10 | | 2 | | Band of black argillaceous shale. |
| 165 | 10 | | 6 | | Brownish red fire clay. |
| 159 | 10 | | | 8 | "*Red block ore,*" equivalent to limestone ore of Steam, Caroline, Belle Fonte, and Laurel Furnaces, forming the so-called 15 feet red streak. |
| 159 | 2 | | 10 | | Sandy shale. |
| 149 | 2 | | 5 | | Band of red clay, probably slipped from above. |
| 144 | 2 | | 16 | | Whitish argillaceous shale.<br>Sandy shale. |
| 128 | 2 | | 10 | 8 | Sandy shale. |
| 117 | 6 | | 1 | 4 | Sandstone. |
| 116 | 2 | | 3 | | Shaley sandstone. |
| 113 | 2 | | | 8 | Kidney, and "*bastard limestone ore,*" 8 to 10 inches thick. |
| 102 | 6 | | 16 | | Sandy shale. |
| 86 | 6 | | 26 | | Sandstone, 18 inches thick.<br>Sandy shale. |
| 60 | 6 | | 17 | 4 | Sandstone, one foot thick.<br>Sandy shale. |
| 43 | 2 | | 10 | 4 | Sandstone. |
| 32 | 10 | | 12 | | Shales.<br>"*Little Blue Block.*"<br>Clay shale, roof of "*Clinton coal.*" |

*This section was given in the first part of my report. It is again introduced for the purpose of showing the change of equivalent measures, in short distances.



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 20 | 10 | 2 | 4 | Coal, equivalent to coal mined at furnace. |
| 18 | 6 | 2 | 6 | Under clay. |
| 16 | | 16 | 0 | Sandy shale.<br>Sandstone.<br>Locally a bed of ironstone. |
| 18 | | 18 | | Sandstone and sandy shale. |
| | | | | *Coal.<br>Clay parting.<br>Coal.<br>Under clay. |

*This coal, which is found in the cistern at Clinton Furnace, is undoubtedly the equivalent of the coal with the clay parting at Star Furnace, the lower coal at Catletsburg, the lower coal at the William's creek Tunnel, and the main Ashland coal.

## *No. 9. Section on Gum branch and Straight creek, Mount Savage Iron Works, Carter county.*

| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| | | | | Top of hill near iron road. |
| 366 | | 6 | | Clay on top of sandstone. |
| 360 | 8 | 21 | | Heavy sandstone, equivalent of the sandstone capping sec. No. 8. |
| 349 | 8 | 10 | 4 | Sandstone partially exposed. |
| 339 | 4 | 48 | | Covered space, shale and clay beds. |
| 291 | 4 | 16 | | Argillaceous shale, highest point in the road. |
| 275 | 4 | 8 | | Red band of clay, place of ore bed, on the north side of the hill. |
| | | 8 | | Wasted ore, yellow band of clay. |
| 259 | 4 | 10 | 8 | Clay.<br>Soft sandy shale. |
| 248 | 8 | 11 | 4 | Red band of clay. |
| 237 | 4 | 10 | | Yellow band of clay. |
| 227 | 4 | 3 | | Rough, or "*blue black ore.*" |
| 224 | 4 | 5 | 4 | Sandstone. |
| 219 | | 5 | 4 | Loose kidney ore diggings. |
| 213 | 8 | 21 | 4 | Covered space.<br>Place of limestone ore ? |

| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 192 | 4 | 11 | 6 | Sandy shales and soft sandstone. |
| 180 | 10 | 4 | 6 | Bituminous shale. |
| 176 | 4 | 5 | 4 | Black clay. |
| 171 | | 32 | | Whitish clay. |
| | | | | Covered space. |
| 129 | | 5 | | Red clay. |
| 124 | | 12 | | Whitish clay. |
| | | | | Ore diggings. |
| 112 | | 10 | 8 | Top of sandstone, 18 inches thick. |
| 111 | 4 | 11 | 8 | Top of a sandstone 20 inches thick. |
| 99 | 8 | 5 | 4 | Three beds of black and white clay, alternating. |
| 94 | 4 | | | Yellow sandy shale. |
| | | 10 | 8 | Bed of black clay. Coal? |
| | | | | White clay. |
| 83 | 8 | 21 | 4 | Sandy and clay shale. |
| 62 | 4 | 5 | 4 | Band of yellow clay. |
| | | | | Band of white clay. |
| 57 | | 4 | 8 | Two ledges of sandstone, 20 inches thick, over shale. |
| 52 | 4 | 10 | 8 | Two ledges of sandstone, 15 inches thick, over shale. |
| | | | | Sandy shale. |
| 41 | 8 | 26 | 8 | Sandy shale. |
| 15 | | 15 | | Covered space. |
| 0 | | | | Bed of branch. |
| 20 | | 20 | | Sandstone. |
| 23 | | 3 | | Grey shale. |
| 25 | | 2 | | Bituminous shale. |
| 27 | | 2 | | Coal. |
| 29 | 6 | 2 | 6 | Under clay. |
| | | 28 | | Sandstone. |
| 57 | 6 | | | |

*No.* 10. *Section on Whetstone creek, on lands belonging to the Raccoon Furnace Company.*

| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| | | | | Top of the hill. |
| 244 | 10 | 10 | | Rough coarse sandstone, containing quartz pebbles. |
| | | | | Place of limestone ore, equivalent of the *Baker bank*. |
| 234 | 10 | 27 | 8 | Covered space, waste of shale beds, loose ore scattered over the surface. |
| 207 | 2 | 21 | 6 | Covered space, sandstones partially exposed in the upper five feet. |
| 185 | 8 | 10 | 8 | Steep bank sandstone? |
| 175 | | 43 | 2 | Steep bank sandstones, partially exposed. |
| 131 | 10 | 21 | 8 | Covered space. |
| 110 | 2 | 21 | 8 | Covered space, occasionally exposing shaley sandstone and clay shale. |
| 88 | 6 | 21 | 6 | Loose kidney ore, 3 to 5 inches thick. |
| | | | | Clay shale. |
| | | | | *Bed of ore, composed of three members. |
| | | | | Sandstone and sandy shale. |
| 67 | | 54 | | Covered space, shale beds? |
| 13 | | 3 | | Coal 3 to 5 inches thick, imperfect. |
| | | | | Under clay. |
| 10 | | 10 | | Iron ore, resting on the sub carboniferous †limestone. |
| | | | | Rocks of the knobstone series. |

*This bed has a block from 6 to 14 inches thick lying above a flat kidney ore from 2 to 4 inches thick, covered by a layer of kidney ore from 3 to 6 inches thick. Where this bed had been opened the layers of ore were quite regular.

†The rocks of the millstone grit series are absent.

*No. 11. Section on the northwest side of Coal creek, on the lands of the Raccoon Furnace Company.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| | | | | | Top of hill. |
| 299 | 1 | | 59 | | Covered space, soft materials. |
| 249 | 1 | | 49 | 5 | Steep bench, probably sandstone. |
| 199 | 8 | | 38 | | Shale and clay slate. |
| 161 | 8 | | 3 | | Black bituminous shale with 2 to 3 inches of coal. |
| 158 | 8 | | 86 | 4 | Steep slope, showing sandstone ledges at several points. |
| 72 | 4 | | 10 | | Shale and rough thin bedded sandstone. |
| 62 | 4 | | | | Place of ore bed. |
| | | | 11 | | Cave sandstone of Coal creek. |
| 51 | 4 | | 13 | | Sandy shales, containing a few interrupted bands of coal. |
| 38 | 4 | | 32 | 4 | Thin sandy shale imperfectly seen. |
| 6 | | | 4 | | Bed of fire clay. |
| 2 | | | 2 | | *Knob sandstone. |
| | | | | 0 | Bed of Coal creek. |

*The beds of millstone grit and sub-carboniferous limestone are absent.

*No. 12. Sections exhibiting the changes in the character of the equivalent of the ore bed principally relied upon for ores at Raccoon and Buffalo Furnaces. "Island Bank," Buffalo Furnace.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 48 | 6 | | 2 | 7 | Top earth removed in mining. |
| 45 | 11 | | 1 | 2 | Thin flag sandstone. |
| 44 | 9 | | 4 | | Argillaceous ferruginous shale. |
| 40 | 9 | | 1 | | Muddy sandstone. |
| 39 | 9 | | | 2 | Thin bed of ore, quite calcareous, containing entrochites. |
| 39 | 7 | | | 3 | Sandy mudstone. |
| 39 | 4 | | | 4 | Ore bed in blocks. |
| 39 | | | | 3 | Sand bed from 2 to 4 inches thick. |
| 38 | 9 | | | 9 | *"Rough blue block ore."* |
| 38 | | | 38 | | Soft sandstone, thick bedded. |

*No. 12. (a) "Dennis Sheridan's Bank," formerly the Bailey Bank, Buffalo Furnace.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 47 | 8 | | 2 | 7 | Top earth. |
| 45 | 1 | | 3 | | From 3 to 6 feet of argillaceous shale. |
| 42 | 1 | | | 3 | Kidney ore bed 3 to 6 inches. |
| 41 | 10 | | 2 | 9 | Sandy shale. |
| 39 | 1 | | | 4 | Little block ore, from 3 to 5 inches thick. |
| 38 | 9 | | | 9 | "Blue block" apparently first quality ironstone, rejected because of its color. |
| 38 | | | 38 | | Sandstone, top ledges very soft. |

## *No. 12. (1a) Moran and Crump's Bank.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 49 | 6 | | 4 | | Top earth removed by stripping. |
| 45 | 6 | | | 6 | Bed of decomposed kidney ore. |
| 45 | | | 3 | | Fire clay of good quality. |
| 42 | | | 1 | | Reddish argillaceous shale. |
| 41 | 10 | | | 10 | Muddy sandstone. |
| 40 | 2 | | 2 | 2 | *Blocks of brown ore containing ochreous specks. |
| 38 | | | 38 | | Sandstone. |

*The 26 inch bed is solid, of uniform texture throughout, it separates into two unequal parts by a line parallel to neither face of the bed.

## *No. 12. (2a.) "Buck Smith Bank," Laurel Furnace, between the main forks of Oldtown creek.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 56 | 6 | | 5 | | Top earth removed by stripping. |
| 51 | 6 | | 1 | 8 | Bed of fine grained hard sandstone. |
| 49 | 10 | | 7 | | Fire clay with dark carbonaceous bands. |
| 42 | 10 | | | 10 | Kidney ore, 8 to 12 inches thick. |
| 42 | | | | 4 | Block, or square kidney ore. |
| 41 | 8 | | 1 | 8 | "Limestone" ore in two ledges containing entrochites. |
| 40 | | | 40 | 7 | Soft sandstone, top of mass in thick beds. |

## *No.* 12. (*b*) "*Tipton far Bank*," *Raccoon Furnace.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 66 | 4 | | 4 | | Top earth removed by stripping. |
| 62 | 4 | | 1 | | Lumpy sandstone. |
| 61 | 4 | | 4 | 3 | Fine grained saudy shale. |
| 57 | 1 | | | 1 | Band of black carbonaceous matter. |
| 57 | | | 2 | | Dark grey fire clay. |
| 55 | | | 2 | 6 | Black clay shale. |
| 52 | 6 | | 1 | 6 | Yellowish clay with bands of a lighter color. |
| 51 | 1 | | 1 | 1 | "*Red ore*," in two ledges. |
| 50 | | | 50 | | Soft thin bedded sandstone.<br>Heavy sandstone containing pebbles.<br>Thiner bedded sandstone, soft. |

## *No.* 12. (1*b*) "*Kidney or Blue Block Bank*," *Raccoon Furnace.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 64 | 11 | | 4 | | Top earth removed by stripping. |
| 60 | 11 | | 7 | | Clay shale with two bands of carbonaceous matter. |
| 53 | 11 | | | 5 | Bed of kidney ore. |
| 53 | 6 | | 2 | 9 | Clay shale with two black bands. |
| 50 | 9 | | | 3 | "Little block ore." |
| 50 | 6 | | | 6 | "*Red ore*," similar to the bed at Tipton bank. |
| 50 | | | 50 | | Sandstone. |

*No.* 12. (2*b*) "*Poynter Bank*," *Raccoon Furnace.*

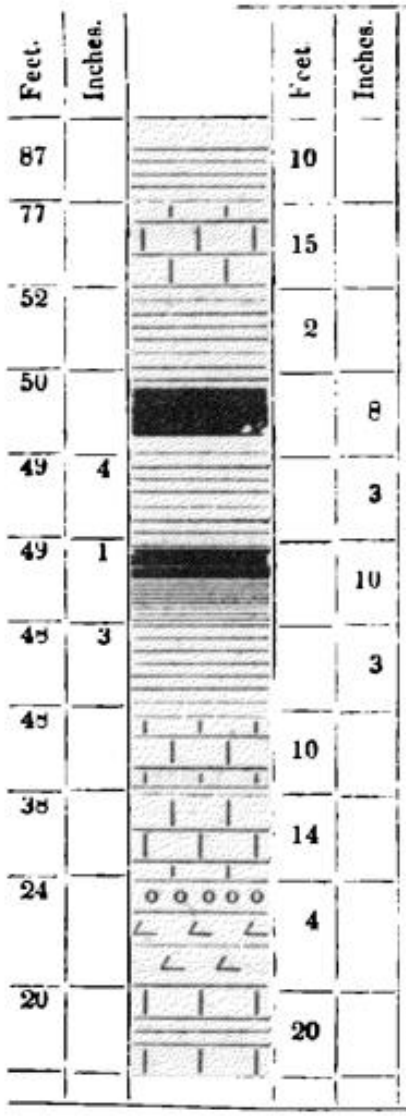
| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 61 | 2 | | 4 | | Top earth. |
| 57 | 2 | | 2 | | Clay shale. |
| 55 | 2 | | 3 | 9 | Scattered kidney ore.<br>Clay shale with one black band of carbonaceous matter. |
| 51 | 5 | | | 5 | Blocks of red ore, 3 to 8 inches thick. |
| 51 | | | 1 | | Blue fine grained ore, in regular bed. |
| 50 | | | 50 | ? | Soft sandstone.<br>Hard sandstone.<br>Thin bedded sandstone. |

*No.* 12. (3*b*) "*Company Bank, Raccoon Furnace.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 65 | 6 | | 5 | | Top earth. |
| 60 | 6 | | 2 | | Sandstone containing fossil plants |
| 58 | 6 | | 7 | | Clay shale. |
| 51 | 6 | | 1 | 6 | *Block ore, 18 inches to 2 feet thick. |
| 50 | | | 50 | | Sandstone. |

*Fifty yards southeastwardly of this bank, the same bed has been opened, where the ore is divided by a muddy sandstone, from 1 inch to 1 foot thick. The ores and sandstones are very unevenly bedded; the ore above and below the sandstone will average about 8 inches in thickness.

*No. 13. Section of Coal* and associate materials, on the lands of Caroline Furnace, equivalent to coal at 220 feet.* (*Page* 189, *report of principal Geologist for* 1856.)



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 87 | | 10 | | Top of the hill. Surface clay. |
| 77 | | 15 | | Sandstone, horizon of *pine trees*. |
| 52 | | 2 | | Black bituminous shale. |
| 50 | | | 8 | Coal. |
| 49 | 4 | | 3 | Clay and shale. |
| 49 | 1 | | 10 | Coal, the lower part quite slaty. |
| 48 | 3 | | 3 | Under clay. |
| 48 | | 10 | | Thin bedded sandstone. |
| 38 | | 14 | | Very coarse imperfectly bedded sandstone. |
| 24 | | 4 | | †"*Limestone ore*," the upper part of the bed consists of rolled pebbles of ore imbedded in ochreous clay, lower part imperfectly stratified. |
| 20 | | 20 | | Soft sandstone and sandy shale. |

*This coal is very local; it does not extend southward over one mile and a half, nor is it found extending eastwardly more than three miles; its place in the measures is indicated by dark clay deposits, frequently interrupted and often, repeated as often as 5 or 6 times in the same bed; in some localities a thin interrupted coal may be found.

†This ore is the undoubted equivalent of the Baker Bank, Laurel Furnace; Carrington Bank, Steam Furnace; "Limestone" ore of Pennsylvania Furnace; "Top hill ore" of Smith's creek; Limestone ore of Belle Fonte, &c.; further it is not the equivalent of the Limestone ores, so-called, of Kenton, Boone, and Buffalo Furnaces. The Limestone ore of Buffalo is quite local; the same geological horizon, on the lands of Buffalo Furnace, at a very short distance from the limestone ore, furnish ores without lime or containing an inconsiderable quantity of it. At no opening on the horizon of the Limestone ore of Buffalo Furnace, has ore been found (so far as I am advised) possessing the characters of the ores found at the Banks on the Buffalo Furnace lands.

*No. 14. Section of "Limestone Ore Bank," Lanheim hollow, on the lands of the Belle Fonte Furnace Company.*

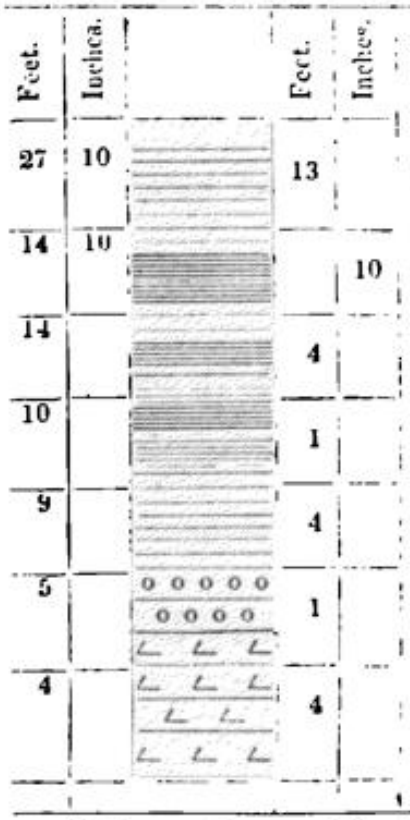
| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| | | | | Top of hill. |
| 138 | 10 | 60 | | Covered space. |
| 118 | 10 | 12 | | Clay shale. |
| 96 | 10 | 2 | 9 | Surface clay removed at the bank. |
| 94 | 1 | 4 | 4 | Hard fine fire clay, breaking with conchoidal fracture. |
| 89 | 9 | | 7 | Black clay. |
| 89 | 2 | 3 | 6 | Sandy argillaceous shale. |
| 85 | 8 | | 5 | Limestone ore of unequal thickness. |
| 85 | | 5 | 5 | Limestone, upper surface water worn and uneven; the beds lumpy; lower beds in ledges of even thickness. |
| 80 | | 5 | | Clay bed.<br>*Locally a thin coal. |
| 75 | | 31 | | Sandy shale with bands of black clay. |
| 44 | | 7 | | Locally a thin coal, from 3 to 7 inches thick. |
| | | | | Hearth rock beds of Belle Fonte and Clinton Furnaces. |
| 37 | | 22 | | Sandy shale. |
| 15 | | 15 | | Covered space. |

*The place of the ore bed equivalent of the main beds of Buffalo and Raccoon Furnaces—see sections 12 a, and 12 b.

*No. 14. (a) Section of "Limestone Ore Bed," Belle Fonte Furnace, Wolf hill, west side of Hood's creek.*

| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 35 | 10 | 10 | | Hard sandstone, 10 to 15 feet thick. |
| 25 | 10 | 7 | | Clay shale. |
| 18 | 10 | | 10 | Black clay. |
| 18 | | 7 | | Whitish clay. |
| 11 | | 1 | | Ore bed from 12 to 15 inches thick. |
| 10 | | 10 | | Soft sandstone, 8 to 10 feet thick. |
| 0 | | | | |

*No. 14. (a1) *Section of same bed, on the opposite side of the drain, southwardly, Belle Fonte Furnace.*



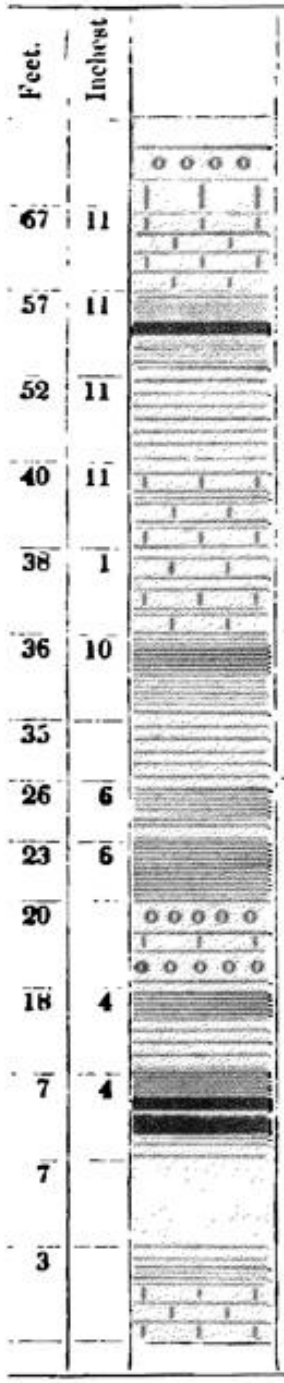
| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 27 | 10 | 13 | | Whitish clay shales. |
| 14 | 10 | | 10 | Black clay shales. |
| 14 | | 4 | | Ash colored clay shale. |
| 10 | | 1 | | Black clay shale. |
| 9 | | 4 | | Whitish clay shales. |
| 5 | | 1 | | Limestone ore. |
| 4 | | 4 | | Limestone, from 4 to 5 feet thick. |

*All the openings on this bed toward the south from the Lanheim hollow, except No. 14 *a* are covered by heavy beds of clay shale, with beds of black clay shale intercalated, varying in number from one to five.

*No. 14. (a2) Section of same bed, (14 a) on the same hill, 300 yards distant south.*

| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 33 | 6 | 27 | | Alternate beds of white and black clay—there are 4 black beds each 1 foot thick. |
| 6 | 6 | 1 | 6 | Limestone ore. |
| 5 | | 5 | | Limestone, 4 to 5 feet thick. |

*No. 15. Section on Alcorn creek, near the house of Mrs. Greene.*



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| | | | | Place of ore bed at 60 feet in section No. 3. |
| 67 | 11 | 10 | | Sandstone, equivalent of the cave rock sandstone of Coal creek. |
| 57 | 11 | 5 | | Sandy shales containing coal and pyrites in interrupted beds. |
| 52 | 11 | 12 | | Sandy shale alternating with thin bands of argillaceous shale. |
| 40 | 11 | 2 | 10 | Shale alternating with thin beds of sandstone from 1 to 3 inches thick. |
| 38 | 1 | 1 | 3 | Argillaceous shale, with thin beds of sandstone intercalated from 1 to 2 inches thick. |
| 36 | 10 | 1 | 10 | Sandy shale containing segregated masses of sand. |
| 35 | | 8 | 6 | Sandy shale. |
| 26 | 6 | 3 | | Greyish yellow sandy shale. |
| 23 | 6 | 3 | 6 | Dark grey shale, sandy. |
| 20 | | 1 | 8 | Bed of argillaceous shale containing several thin beds of carbonate of iron, and small rounded masses interspersed. |
| 18 | 4 | 11 | | Thin beds of black shale, intercalated with beds of a lighter color. |
| 7 | 4 | | 4 | Coal and black bituminous shale. |
| 7 | | 4 | | Argillaceous fire clay, resisting the action of frost and weather. |
| 3 | | 3 | | *Silicious fire clay, weathering into angular fragments. Knobstone. |

*This bed of clay rests, non-conformably, on the knobstone; the millstone grit and sub carboniferous limestone are absent. One fourth of a mile down the creek a thin bed of millstone grit is seen, resting on the knobstone, wedged in between the clay and the knob sandstone. On the bed of millstone grit, the clay beds rest unconformably. The millstone grit evidently lies in a narrow trough in the knobstone, which crosses the creek from the southwest to the northeast. The surface of the disturbed beds of the millstone grit and knob sandstones having been levelled before the deposition of the clay beds, no trace of the sub-carboniferous limestone could be obtained, after the most careful and patient search.

*No. 16. Section near the limestone quarries, on the north branch of Oldtown creek.*

| Feet. | Inches | | Feet | Inches. | |
|---|---|---|---|---|---|
| 42 | 1 | | 19 | | Sandstone, probably the equivalent of the cave sandstone of Coal creek. |
| 32 | 1 | | 15 | | Shale, equivalent of the beds at 37 feet 5 inches, in section No. 15. |
| 17 | 1 | | 5 | | Fire clay, hard and compact breaking with conchoidal fracture. |
| 12 | 1 | | | 1 | *"Limestone ore,"* thin bed of carbonate of iron. |
| 12 | | | 6 | | Sub-carboniferous limestone, the surface water-worn before the deposition of the ore. |
| 4 | | | 4 | | Knobstone, 4 feet in sight. |

An examination of the accompanying map of Greenup and Carter counties, will enable you to locate these sections, and to trace the gradual changes in the measures. The base of a number of the sections rest on the sandstone called in this report "*knobstone,*" and the base of none of them is very far above this geological horizon, excepting section No. 9. The members of section No. 1 will be seen to contain three workable beds of ore, in the space of forty-five feet, with a space from which ore has been wrought, which, if continuous, would give four beds in 45 feet. The whole of the rocks properly included in the space from the top of the knobstone, is 213 feet, the upper hundred feet of which has not heretofore been found to contain any good beds of ore. It is composed chiefly of micacious sandstone and sandy shales. In an equivalent space in section No. 9, which is spread out and expanded to 431 feet 6 inches; and the coal measures would be still further increased at this locality if the shales and sandstones supposed to exist at the base of this section be added. The top of this section is barren of ores for 101 feet 4 inches, while the next

*This bed of sandstone is probably the equivalent of the sandstone at 60 feet in section No. 3.

space of 145 feet 8 inches affords four horizons, producing ores; in three of which the ores are worked from regular beds. The investigations at Mount Savage Furnace, did not increase the number of horizons in which regular beds of ore is found.

Section No. 3 contains 315 feet, and has six horizons in which beds of ore are found. The beds at 60 feet, 120 feet 8 inches, and at 15 feet of this section are not wrought. The bed at 120 feet 8 inches is not a workable bed at any point where it has been seen. The same remark is also true of the bed at 15 feet. The bed at 60 feet is locally a valuable ore, rising as high as 18 inches thick. The bed at the top of section, 311 feet, has not been wrought on any part of the lands of Raccoon Furnace, unless the bed about a mile from the furnace, under clay, be the equivalent of this bed. At eighty-seven feet from the base of the section at Raccoon Furnace, the rock used in the construction of the stack comes in; at 120 feet, a poor ore occurs, which has not, so far as I have been able to ascertain, been worked at any locality in Greenup county. Between the last bed, and the beds here known as the company's bank and its equivalent, occurs a small coal. It is of no value, being too small for profitable working. Between the coal and the horizon of the most important ores, a heavy mass of sandstone is interstratified, nearly sixty feet thick, on top of which rests the ore worked by this company, and from which the chief part of their ores are obtained. The horizon of this bed is a few feet below the tops of the hills, and most part of the bed can be reached by stripping. It is known by a great number of names, which are generally derived from the name of the parties who first made the working upon the particular part of the bed distinguished by these names.

The ores most relied upon at Buffalo Furnace, are obtained from the equivalent of the main bed at Raccoon Furnace. It lies near the top of the hills between Clay Lick and Oldtown creek. They are certainly in the same *geological horizon* as the ores at the Raccoon Furnace ore banks, notwithstanding they differ in a remarkable manner from the ores last attended to.

All the ore beds west of Little Sandy river, from Laurel Furnace to the Ohio river, except the "*Baker bank*," are found in section No. 3, notwithstanding the multitude of names by which they may be distinguished, and the infinite variety they present at the various points at which they have been opened in this large scope of country.

The main ridge dividing the waters of Little Sandy river and Tygert's creek, lies much nearer to the latter than the former stream. It is frequently partially interrupted by waves crossing the line of its length, thus producing several gaps.

South of the road from Greenupsburg to Liberty there is a small district capped by the limestone ore beds, equivalent to the Baker bank of Laurel Furnace; and the associated strata are found northeast of this road in all the dividing ridges, with this same limestone ore, which has been exposed by openings made in several places.

The interval of several miles southwest of the head of Alcorn creek has suffered the loss of this member, so that the tops of all the hills are capped by rocks which lie under the limestone ore bed.

It would appear that there has been a greater elevation between the heads of Coal, Whetstone, Alcorn, Clay-lick, Raccoon and Oldtown creeks than along the line of these creeks, or of those which empty into the Ohio river; swelling up the hills at the head of the branches and running in an elevated ridge, from the great dividing ridge southeastwardly toward Little Sandy. Either in consequence of denudation of the summits of the hills around Raccoon and Buffalo Furnaces, or because the elevation has taken place prior to the deposition of this bed, the limestone ore bed is here wanting. It is very probable that the strong currents of this period may have swept out this bed after it was deposited. Evidences of the devastating force of the currents of this period are manifest on the hills at the head of Alcorn creek, at the Carrington and Heighton banks at Steam Furnace, and near the office at Caroline Furnace, where the ores have been swept out and the limestone upon which it was bedded wasted and water-worn. In some places the ore is reduced to a coarse water-worn conglomerate, mixed with quartz pebbles and small rolled pieces of sandstone, giving evidence of a long continued action over a large district; where these coarse sandstones are frequently a true conglomerate, fifteen to thirty feet in thickness. This wasting did not reach the *Baker bank* at Laurel Furnace, but it extends from a point two miles east of it in a broad belt to the Ohio river opposite Ironton. If the bed was wasted after it was deposited, as I am inclined to think, some good pockets or patches of this ore bed may perhaps be found to the northwest of Little Sandy river.

Near the line of the Ohio river, where the intervals of the iron ore and coal bed spaces are contracted between sandstone ledges, no good beds of either coal or iron have been found; in fact, from the examination of the spaces which should exhibit the ore and coal beds, it is highly probable they do not exist near the Ohio below Greenupsburg. About two miles from the Ohio river, the limestone ore caps the hills on Smith's and Coal creeks, in good workable thickness, of good quality. The lowest ore bed examined at Raccoon Furnace is also a good bed of ore on both of these streams.

The horizon of the ore beds worked at Buffalo and Raccoon Furnaces, the "*Company*" and "*Island banks*," has not yet been sufficiently examined; no openings have been made; the materials above and below this horizon are quite soft, near the place of the ore, and no section could be made of it without an opening should be made, it is therefore only known as a covered space in sections made between Raccoon creek and the Ohio.

The ore beds of Steam, Caroline and Belle Fonte Furnaces have a common character. The limestone ore bed horizon is mostly relied upon for ore stocks, but considerable quantities of ore have been obtained at Steam Furnace from the first bed lying below the limestone ore, known as the Carrington and Heighton Banks—see section No. 4. These banks affording sufficient stock of easily reducable ore, other beds have not been sought for, although they exist upon the property. The bed at 60 feet in the Raccoon section No. 3, is quite thick, on the streams emptying into Little Sandy river, west of Steam Furnace. Where this bed was opened it produced blocks about 15 inches thick, but at the locality where it was seen, it appears to contain a notable quantity of sulphur, and had been rejected at the furnace, but it does not follow that it should be elsewhere pyritiferous, especially since the same ore horizon affords ores of excellent quality at some localities.

Southwest of the strip of country before alluded to, near Laurel Furnace, the limestone ore is covered by heavy beds of clay, marking the margin of the currents from the southwest, that have wasted this ore bed. The clays of this bed, when opened, are distinguished by one or more lines of carbonaceous matter deposited in them; these black streaks are sometimes repeated four times in one section of twen-

ty-five feet in depth. The greatest depth seen, of the clay covering the limestone ore, is 27 feet, and it appears to be of still greater thickness on the lands of the Belle Fonte Furnace Company, on main Hood's creek; all the ores dug have a heavy clay covering. One mile northeast of the furnace, the same bed lies under a heavy sandstone, and the ores are mixed with sand and quartz pebbles. It is worthy of note, that as the clay covering comes in over the ore bed, the limestone beneath it disappears. I have not been able to find it outcropping south of Steam Furnace, nearer to that furnace than the Pennsylvania Furnace ore banks, where it differs materially in appearance from the same bed at Steam Furnace. In chapter 1, of my report for 1856, is a section of the limestone ore and clay, on the lands of Pennsylvania Furnace. The contrast between that section, the Baker bank, (section No. 2,) and the Carrington and Heighton bank, will illustrate the difference in physical structure of this bed. Associated with this ore bed at the Baker bank, is a thin coal, from 1 to 6 inches thick, lying below the ore bed, the ore resting upon it, with an interval of an inch of clay between them. A bed of coal is found associated with the limestone ore between Steam and Caroline Furnaces. This bed has been worked for the coal; the ore associated is in thin and in irregular patches; at present it is not worked. At the ore bank opposite Ironton is a thin coal, separated by a clay parting. This bed of coal is quite local, extending southwardly only about two miles, when the coal entirely gives out, and its horizon is represented by dark bands in the clay over the limestone ore. Eastwardly beyond Amanda Furnace, the hills are not sufficiently high (geologically,) to receive it; the high lands south of Ashland are sufficiently high, but it has not been found; its place is there filled by sandy shale and clay beds, marked by a single band of carbonaceous earth, exhibiting no coal or fossils.

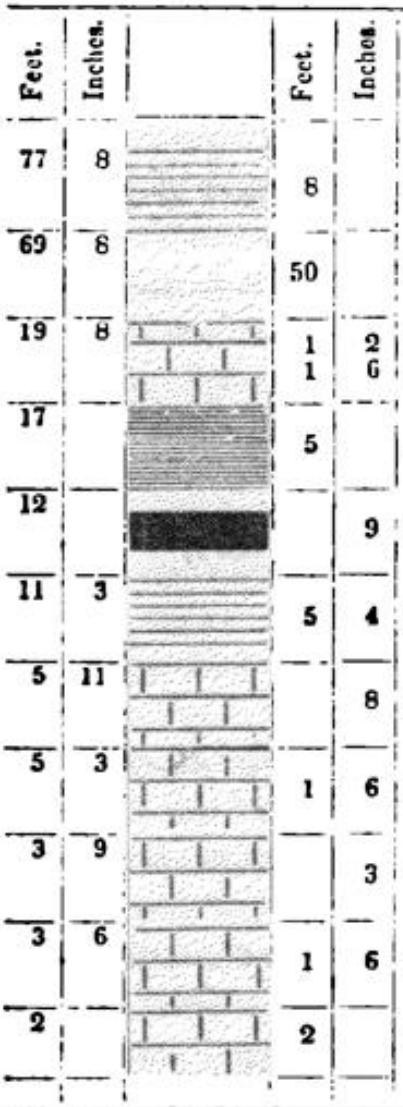
An island must undoubtedly have existed during the deposition of this bed, while on the southeast the surrounding bottom subsided periodically at the rate of from one to six feet. This accumulation of carbonaceous matter was deposited during the periods of quiet, which was not of sufficient duration to produce coal on the margins around, which gradually thinned out toward water too deep for the growth of the coal producing plants. The parting of earthy matter between the coal was brought in during one of the downward movements, which has so fre-

quently marked the clay deposits south of Amanda and Belle Fonte Furnaces. Evidence of local elevations and depressions, during the deposition of all the measures above the knobstone, are to be met with at every step.

In the vicinity of Clinton Furnace, the limestone ore bed is much changed in character, and the limestone which underlies it west of Hood's creek, is entirely absent. It has not been seen at any locality east of the line of the road from Ashland to Williams' creek. The arrangement of this bed with reference to the associated materials, where it has been observed over a large district, is subject to an infinite variety of modifications. One of the most remarkable is to be seen at the Lanheim hollow, on the Belle Fonte Furnace lands, on Hood's creek. The bed of fire clay laying above the ore in that section, (sec. 14,) appears to be of most excellent quality. The clays over this ore bed, half a mile distant, do not appear to possess the qualities found in this bank.

The horizon of the hearth rocks used at Belle Fonte and Clinton Furnaces, lies about 69 or 70 feet below the ore beds at the Lanheim hollow. The section at the quarries of this rock exhibits one of the many thin non-continuous coal beds found in this part of Kentucky. The following section is made for the purpose of showing this peculiarity, as this bed extends for about two miles to the northeast, with various interruptions. It is probably the equivalent of the Belle Fonte and Clinton Furnace coals, although the connection with either of these beds has not been traced from any other locality :

*Section of Hearth Rock Beds of Clinton and Belle Fonte Furnaces.*



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 77 | 8 | 8 | | Clay and shales. |
| 69 | 8 | 50 | | Covered space. |
| 19 | 8 | 1 | 2 | Loose fine grained sandstone. |
| | | 1 | 6 | Coarse sandstone in place. |
| 17 | | 5 | | Argillaceous shale. |
| 12 | | | 9 | *Coal. |
| 11 | 3 | 5 | 4 | Drab colored shale. |
| 5 | 11 | | 8 | Fine grained sandstone. |
| 5 | 3 | 1 | 6 | Fine grained sandstone. |
| 3 | 9 | | 3 | Thin sandstone. |
| 3 | 6 | 1 | 6 | †Hearth rock bed. |
| 2 | | 2 | | Coarse sandstone. |

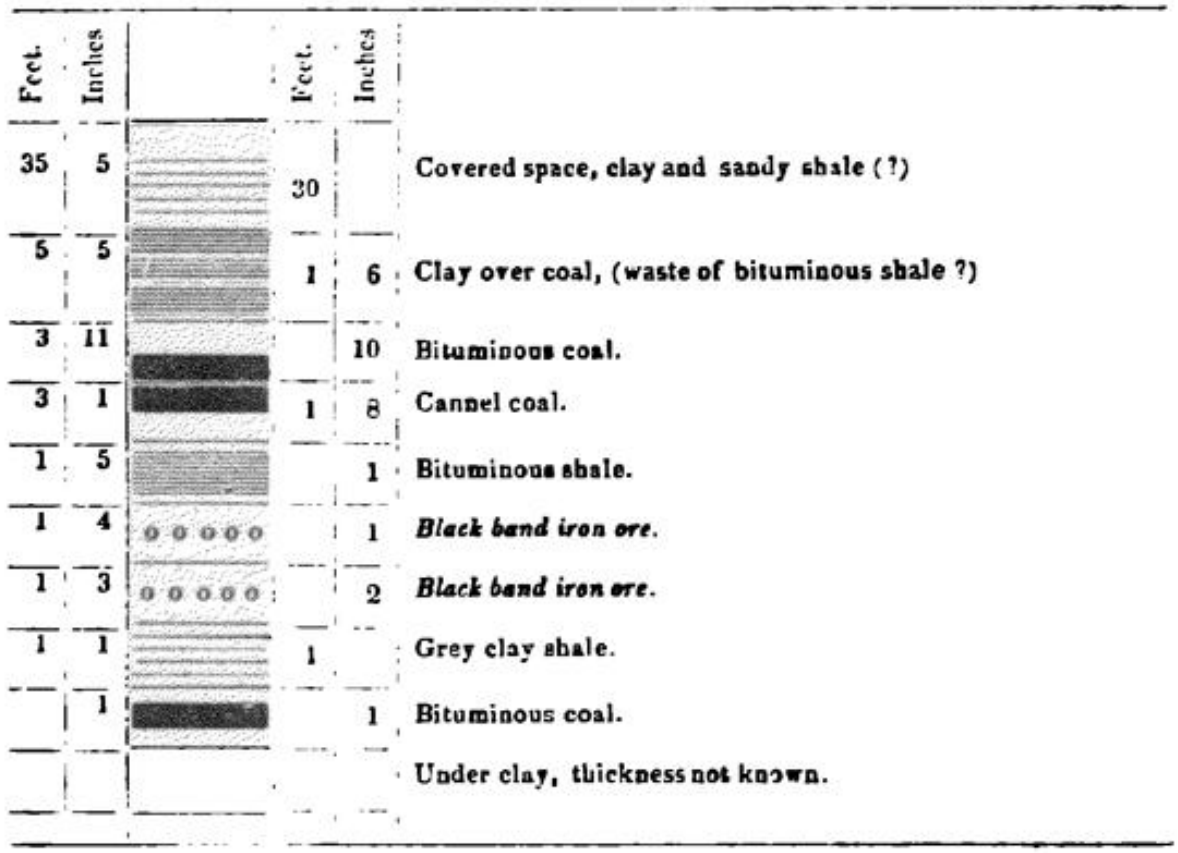
The limestone ore bed, in its greatest elevation on the upper branches of Hood's creek, lies from thirty to fifty feet below the highest part of the ridges, and frequently two hundred and fifty feet below the hilltops, as at Key's creek, when it is evidently in a fault or slide. At the narrows of Key's and Catlett's creek a bed of ore of recent origin has been discovered; its extent is not known. It has been opened to a thickness of four feet. The remains of the leaves of the beech (?) and a great variety of roots of recent plants and trees are found in it, generally in a state of decay. This deposit will probably be found quite local.

*The bed in the face of the quarry 75 feet long, is lost at either end of it, in a dark carbonaceous matter, between beds of drab shale.

†The hearth rock bed is of fine grained sandstone, with lines of mica about one sixteenth of an inch apart, deposited between the grains of sand composing the bed.

The coal worked at Steam Furnace has been traced by outcrop from the Furnace to Indian creek, and identified with the bed of Cannel coal on that creek.

*Section of Indian creek "Cannel Coal Bank, on the lands of the Steam Furnace Company.*



| Feet. | Inches | Feet. | Inches | |
|---|---|---|---|---|
| 35 | 5 | 30 | | Covered space, clay and sandy shale (?) |
| 5 | 5 | 1 | 6 | Clay over coal, (waste of bituminous shale ?) |
| 3 | 11 | | 10 | Bituminous coal. |
| 3 | 1 | 1 | 8 | Cannel coal. |
| 1 | 5 | | 1 | Bituminous shale. |
| 1 | 4 | | 1 | *Black band iron ore.* |
| 1 | 3 | | 2 | *Black band iron ore.* |
| 1 | 1 | 1 | | Grey clay shale. |
| | 1 | | 1 | Bituminous coal. |
| | | | | Under clay, thickness not known. |

At Steam Furnace the coal has no clay parting in the opening where it was examined; in the above section which was taken two miles distant to the southeast of section (No. 15,) the whole arrangement of the bed is totally different, as well as the character of the materials. Near the place of the above section the horizon of the limestone ore bed is occupied by a thin bed of coal heretofore alluded to.

Irregularities like the above are constant throughout Greenup and Carter counties. The same beds, variously modified, are to be found on the lands of all the furnaces now in operation in Greenup, except the higher beds before alluded to in the vicinity of Caroline and Amanda Furnaces, which are not found west of Little Sandy in Greenup county. The highest measures seen in the county, are best developed, and

best seen at the old banks of Amanda Furnace, near the heads of Indian creek and Pond run.

During the present season many parts of the country that were examined last year, have been re-examined, and the opinions expressed in the report, of the progress of the work last season, have been fully confirmed. It is to be expected, from indications to the south of Greenup county, that the coal beds are increased to good workable thickness on the Big Sandy river. The uncertainty in the thickness, and irregularity of the coal beds found in Greenup county, forbids the hope of any large and profitable coal mining being carried on in the county. Coal will probably be found in sufficient abundance for the consumption of the neighborhood. The true mineral wealth of the county is its numerous and excellent beds of iron stones.

In conclusion, it is deemed proper to state, that every facility was afforded the Geological corps operating in Greenup and Carter counties, by the iron masters, and the people generally, in the prosecution of their labors, the importance of which they fully appreciated.

I would also take this occasion to bear testimony of the worth, capacity, and energy of Mr. Edward Mylotte, who conducted the field work of the eastern division. He was unfortunately drowned while the field work was being reduced. That part of the work will be somewhat delayed, but it is expected that the map will be finished by the time the Legislature meets, and in time to be engraved and distributed with the printed reports.

### HANCOCK COUNTY.

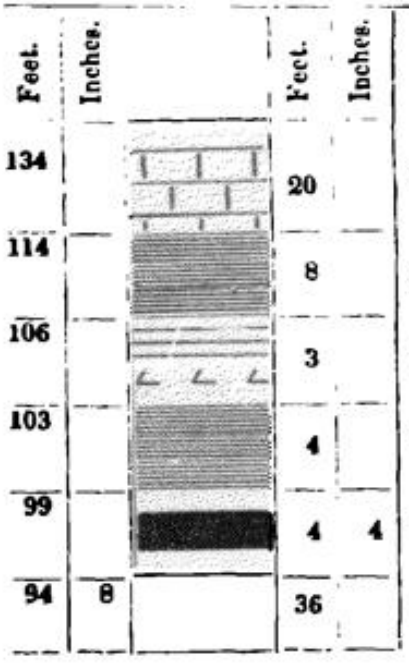
During the past summer a field party has been operating in Hancock county, and the detail surveys have been carried over all that part of the county lying between the Daviess county line, and a line due south from Hawesville, to the line of Ohio county. The lines have been run with sufficient accuracy and proximity to each other to lay down the topography of all the roads, streams, principal ranges of hills, the houses of the inhabitants, out-cropping coal beds, &c., within the territory alluded to. For want of sufficient time, this field work has not been reduced and reported. All the force at my disposal has been, and is now employed on the office work of the *Eastern District*. The work in Hancock county was entrusted to Mr. Aaron Baker, and so far

as it has been carried this season, it has been under his direction. The accuracy and completeness of this work cannot be known until it shall have been reduced.

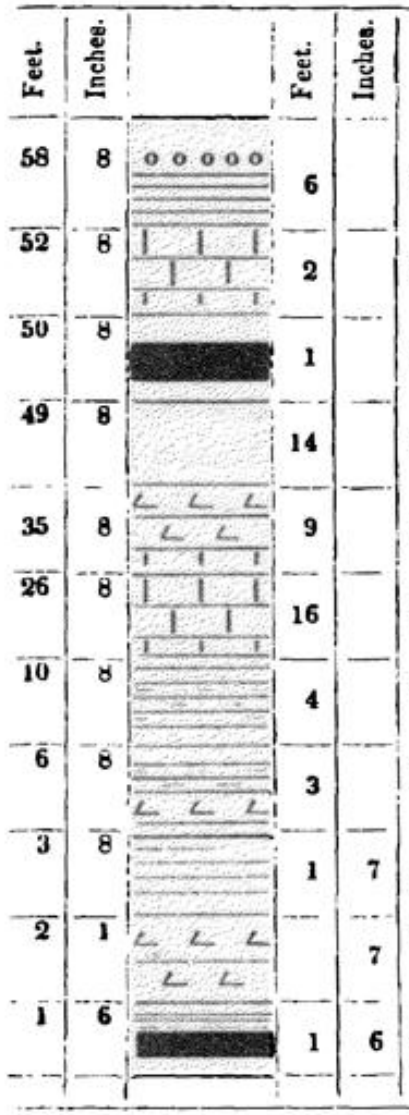
The base line from the mouth of Highland creek, which was brought during the last seasen, by Mr. Joseph R. Harris, to Hancock county, was taken up at the termination of the work of Mr. Harris, by a party under the direction of Mr. Joseph Blackwood. By an accident the instrument used by this party was so injured that it had to be sent to the maker for repairs, and the party was discharged until the repairs were made. Another party, for the work of the base line, is now organized, and the work will make such progress as the means at my disposal shall warrant. As the report to the Legislature will have gone to press before the return of this party, it cannot be reported upon in time to be embodied in the operations of the last two years.

A commencement has also been made towards the detailed examination of the geology of Hancock county, during the present summer, which, with that previously made, gives the key to all the river border of the county, from Hawesville to Lewisport.

The following addition to the published section of the coal at Hawesville, exhibits measures in the vicinity of Lewisport, in ascending order, as follows—the base of the section resting on the top coal of section No. 4, published in the report for 1854–5:



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 134 | | 20 | | Soft yellow sandstone, and surface earth. |
| 114 | | 8 | | Sandy shale. |
| 106 | | 3 | | Marly shale, and seggregations of limestone 3 to 5 feet thick. |
| 103 | | 4 | | Black bituminous shale. |
| 99 | | 4 | 4 | Lewisport coal, (Estes' coal, &c.) |
| 94 | 8 | 36 | | Covered space—soft measures. |



| Feet. | Inches. | Feet. | Inches. | |
|---|---|---|---|---|
| 58 | 8 | 6 | | Sandy shale, under place of iron ore. |
| 52 | 8 | 2 | | Sandstone. |
| 50 | 8 | 1 | | Coal. |
| 49 | 8 | 14 | | Covered space, probably under clay and shale. |
| 35 | 8 | 9 | | Limestone, 6 to 8 feet thick. |
| 26 | 8 | 16 | | Thin sandstone and sandy shale. |
| 10 | 8 | 4 | | Sandy calcareous chert beds, containing productus chœnetes, entrochites, &c. |
| 6 | 8 | 3 | | Cherty calcareous beds, in two well defined ledges, fossils; as above. |
| 3 | 8 | 1 | 7 | Marly, sandy, indurated mud. |
| 2 | 1 | | 7 | Very black, hard, pyritiferous limestone, with vermicular markings, containing a few productus terebratulæ, &c.—turns yellow by exposure to the atmosphere. |
| 1 | 6 | 1 | 6 | Argillaceous shale.<br>Coal, top of the section of 1855–6. (See report.) |

The line of outcrop on the Ohio river having been carefully traced, from the Reverday mine to Lewisport, the measures are found to dip away from the Ohio, and by faults and flexures, to sink from the hill tops at the Reverday mine to the level of the Ohio at Lead creek, where that creek emerges from the hills on the land of Mr. Adams; so that the 85 feet freestone in section No. 4, before alluded to, is found in the bed of the creek from 25 to 30 feet below high water of the Ohio. There is a reversal of dip at this point, and for a short distance the rocks dip up the Ohio river. Below Lead creek for 4 or 5 miles the country is quite level, and the river bottoms are spread out about 2 miles wide, abutting against a line of low hills, part of the dividing ridge between Lead and Yellow creeks. The hills in the rear of the river bottom are rounded, and covered by the waste of the soft materials in the upper part of section before alluded to. The dividing ridge

between the creeks is thrust forward into the bottoms of the Ohio, and terminates near the river in the bend opposite Troy. Lead creek, which held a course behind the hills parallel to the Ohio, and with the course of that stream, as soon as it passes the barrier of the hills, runs parallel to its first course, and enters the Ohio a short distance below Hawesville. On the other side of the dividing ridge Yellow creek, which had run north, as soon as it reaches the vicinity of the "bow of Lead creek," makes a right angle to its first course, and enters the Ohio above Lewisport. The dividing ridge between these creeks terminating in a bold rocky bluff, near the house of Mr. Mason, is principally composed of the heavy sandstone immediately over the Hawes' main coal, and the coal itself is brought within thirty feet of the surface at the end of the bluff. From this point the rocks dip up and down the river, and the anticlinal axis of the fold runs nearly south toward Yellow creek, for about two miles, when it curves toward the east. Between Mr. Mason's and Hawesville there are one or more minor folds, nevertheless the Hawes' *main* coal may be reached at any point along the line of the bluff and hills between Mr. Mason's and Hawesville, at distances varying from 30 to 120 feet. It is to be observed, however, that the rate of dip observed in the vicinity of Mr. Mason's, and in the Hawes' mine, that the coal would be brought up so rapidly that it is highly probable that it does not reach the river line. Between Mason's and Lewisport the same coal may be reached at proper distances from the Ohio river at various depths: as above the fold toward Hawesville, gradually sinking deeper below the surface. By the section added it will be seen that the Hawes' main coal should be 300 feet below the "Lewisport coal," or two hundred and sixty feet below the surface at the foot of the Lewisport coal mine hill, and it is doubtless much nearer the surface along the line of the railroad from the mine to Lewisport, as the rocks gradually rise in the direction of the Ohio river from the mines. The extent of the hills between Blackford and Yellow creeks forbids the idea that a very extended field of the bed, known as the Lewisport coal, especially as the limestone in the upper part of the section, on page 458-9, is generally cut in the valleys, leaving quite narrow ridges, containing this bed between them. In fact, the main Hawesville coal is brought above the drainage, about two miles northwest of Knotsville, where it is worked by Mr. Weisel. The same coal bed can be seen in out-crop at several places near Mr. Weisel's on Pup-

py creek. This bed is also opened on the northwest side of the ridge half a mile above Mr. J. V. Wathen's. The coal dips rapidly to the northwest from this last opening, bringing the coal down to the branch bottom in a short distance. On Puppy creek no complete section could be obtained, but it is evident that the sandstone covering the main Hawes' coal is much thinner here than at the Hawes' mine, or, that another limestone has been intercalated. About sixty feet above the coal, on both sides of the ridge, a limestone occurs having the general characters of the lower limestone of the section referred to above, especially in the character of the fossils contained in it.

The following section was obtained on the south side of the ridge, when the dip was to the southeast.

*Section of Weisel's Coal Mines, on the head waters of Puppy creek.*

| Feet. | Inches. | | Feet. | Inches. | |
|---|---|---|---|---|---|
| 148 | 8 | | | | Top of hill. |
| | | | 26 | | Covered space. |
| 122 | 8 | | | | |
| | | | 15 | | Sandstone. |
| 107 | 8 | | | | |
| | | | 40 | | Covered space. |
| 67 | 8 | | | | |
| | | | 4 | | Limestone. |
| 63 | 8 | | | | |
| | | | 20 | | Covered space. |
| 33 | 8 | | | | |
| | | | 10 | | Sandstone, weathering into holes. |
| 23 | 8 | | | | |
| | | | 13 | | Soft, yellow sandstone. |
| 10 | 8 | | | | |
| | | | 5 | | Sandstone, soft, of a greyish white color. |
| 5 | 8 | | | | |
| | | | | 8 | Bituminous shale, containing lingulæ. |
| 5 | | | | | |
| | | | 3 | | Coal, the top part containing thin layers of shale. |
| 2 | | | | | |
| | | | 2 | | Under clay. |
| | | | | 0 | Bed of branch. |

To the northwest in Daviess county, on the tract of land known as the Mason lands, or Spice ridge, a cannel coal was seen. This coal is certainly above the beds seen on Puppy creek, and is probably the equivalent of the shale bed into which openings have been made on the farm of Mrs. Bell, near the Yelvington and Owens boro' road. At Spice ridge the opening presents the following section:

| *Heighth.* Ft. In. | *Thickness.* In. | |
|---|---|---|
| 1.10 | .4 | Slatey cannel coal. |
| 1.6 | .7 | Blackish-grey argillaceous shales. |
| .11 | .6 | Firm blocks of Cannel coal. |
| .5 | .5 | Clay shale. |
| .0 | .0 | Water line in pit. |

Under the water the coal is said to be thicker than above it. By sounding the pit appears to have been sunk two feet ten inches below the water lime now in it; the soundings show fire or under clay at the bottom.

The physical appearance of the upper 4 inches is very like the coal of the Breckinridge mine. Near the spring at Mrs. Bell's farm a pit has been sunk eighteen feet deep which presents the following section:

| Ft. In. | |
|---|---|
| 14.0 | Surface clay. |
| 2.0 | Waste of shale. |
| 2.0 | Under clay, similar to under clay of coal. |

On a more elevated part of the same point a pit has been sunk into the same bed as last section above; a section of this pit is as follows:

| *Feet.* | |
|---|---|
| 15. | Surface clay. |
| 5. | Soft sandstone. |
| 0. | Water. |

From the shales raised from below the water lime, fragments of fish were obtained, broken and scattered in the shales; no coal was seen, nor the appearance of coal. The coal has thinned out and disappeared. The distance between the Spice ridge and Mrs. Bell's is about 2 miles in a northwestwardly direction, and nearly parallel with the course of the Ohio river.

From the Hawesville mines to the locality at Mrs. Bell's there appears to be a general thinning of all the beds composing the Hawesville section. On Puppy creek the first sandstone over the Hawes' coal has diminished in thickness from 85 to 33 feet. It would be in-

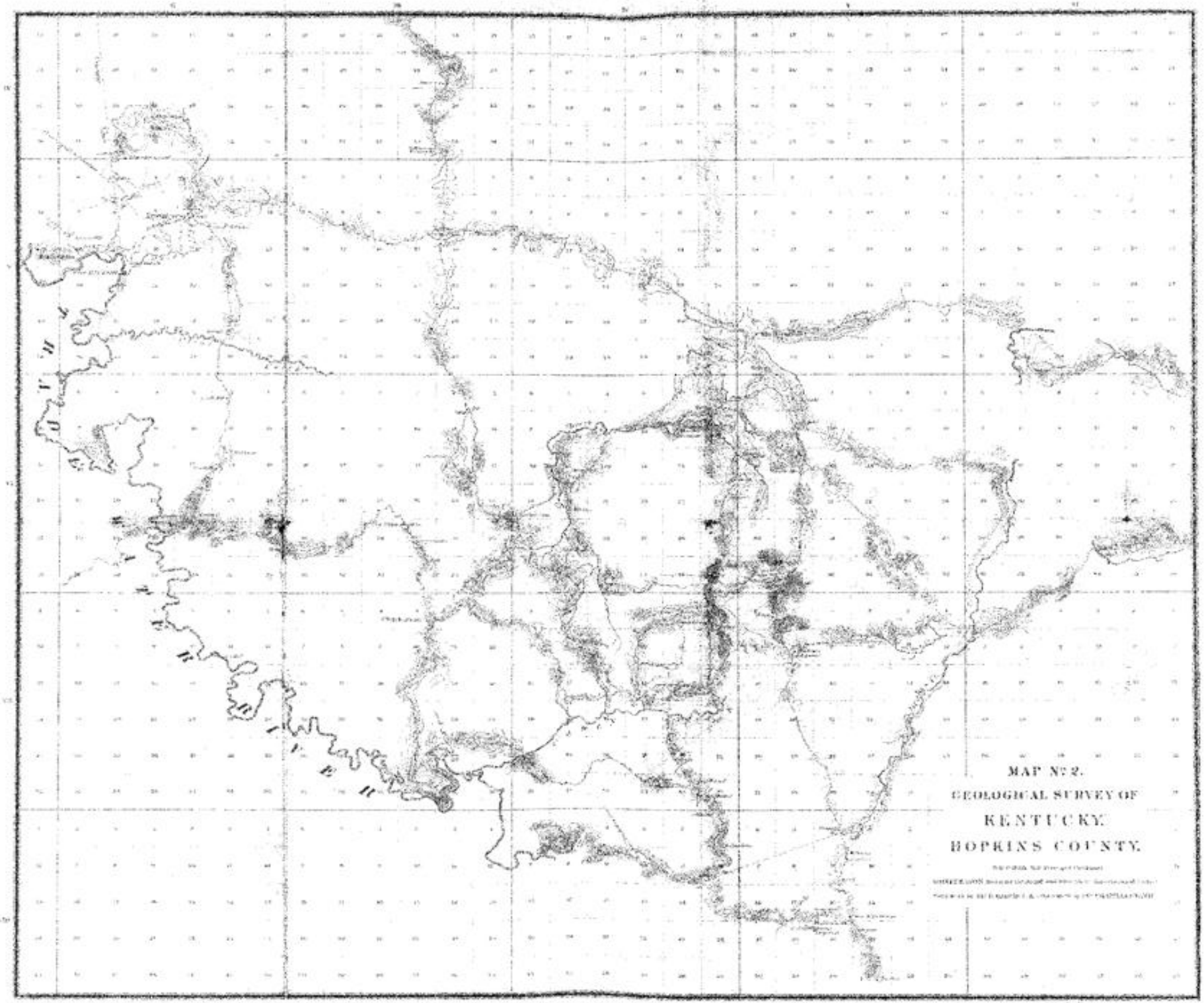
teresting to science to determine this precisely. If established it would bring the Hawes' coal that much nearer the surface than it has been supposed to be, and thus make the knowledge of the position of that coal of the greatest practical value to the people of Daviess county.

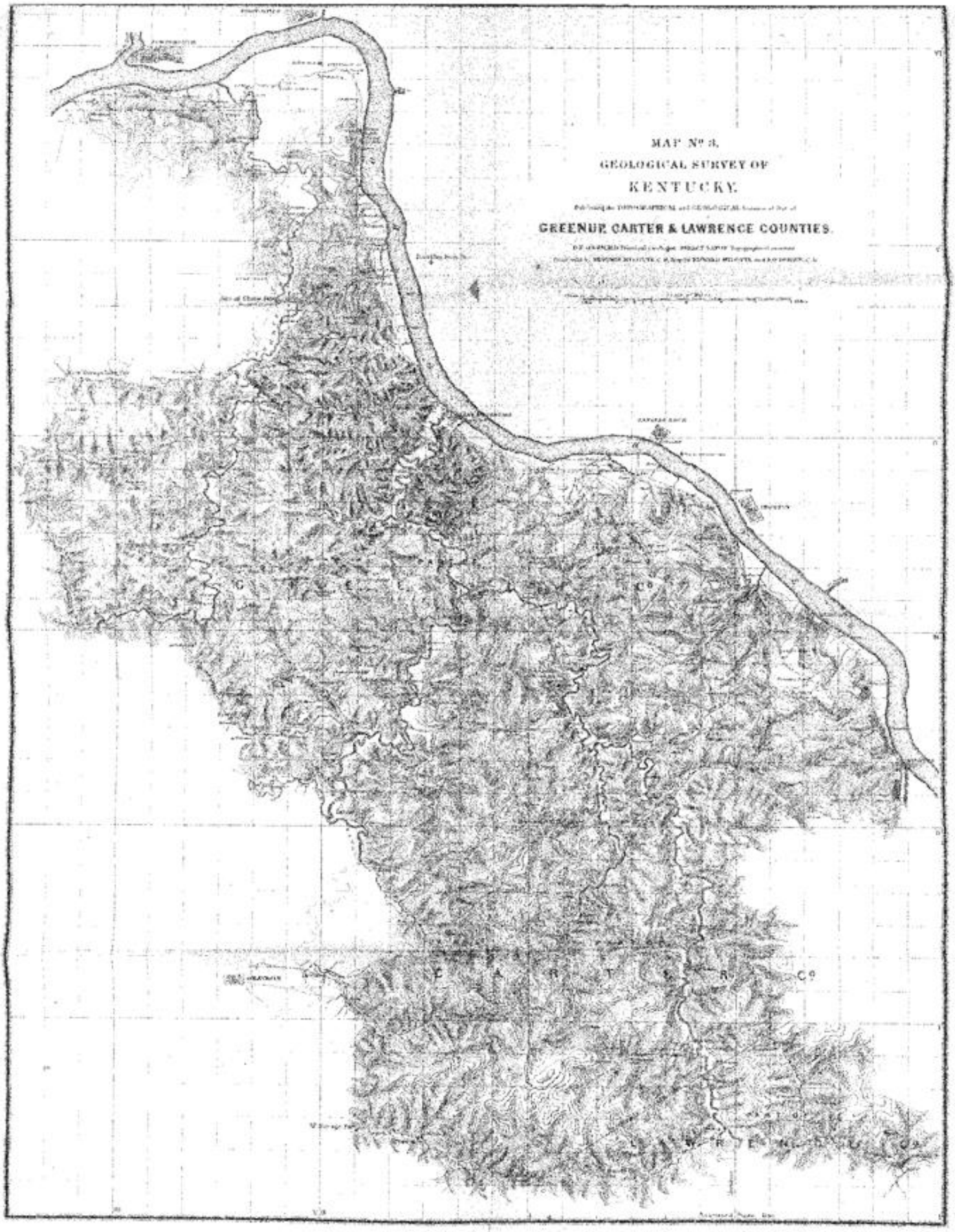
With a true map of the country the determination of this, as well as other questions of the greatest importance, would be rendered simple and easy. The geological examinations should go hand in hand with the Geographical and Topographical Survey. Between Hawesville and Lewisport and the bluff above Mr. Mason's a complete section of the rocks in the bluff at the Hawes' mine can be observed. The coal under the limestone near the top of section No. 4, Report of 1855, has not improved in quality or thickness. It has been opened and exposed on the land of Mr. Curtis, near Mr. Mason's. The limestone lying 25 or 30 feet above this coal would, judging from its appearance, produce good building lime, and will be of the greatest importance as a fertilizer of the soil—occurring as it does in the immediate vicinity of a coal sufficiently good for lime burning. Lime for manuring could be produced at a very low rate. The limestone (so-called) immediately above the coal is probably too silicious to be profitably used on a sandy soil with much advantage even if burnt. The upper bed is not so generally exposed as the lower one, its place is, however, well marked, where it is not exposed, by an abrupt ascent of 25 to 30 feet in the hillside above the level the lower limestone. The value of this bed can hardly be appreciated by the farmers of Hancock county now, but the time must come when its value will be fully realized. At some localities the coal in the section at 41 feet 8 inches may be found sufficiently thick for lime burning; this coal lays 14 feet above the limestone. A more detailed examination may bring to light the extent, and the various modifications of these beds.

It may not be considered improper, before closing this report, to express my obligations to the citizens of the different counties in which it has been my duty to operate, for the hospitality and kindness extended to all engaged in the parties under my direction. The great number of persons who have rendered assistance, given valuable information, or served as guides to the best localities, forbid a separate acknowledgment for the service or kindness rendered. They have my warmest thanks.

SIDNEY S. LYON,

*Assistant Geologist of Kentucky.*


MAP No 2.
GEOLOGICAL SURVEY OF
KENTUCKY.
HOPKINS COUNTY.


MAP No 3.
GEOLOGICAL SURVEY OF
KENTUCKY.
GREENUP, CARTER & LAWRENCE COUNTIES.