GEOLOGICAL SURVEY OF KENTUCKY.

JOHN R. PROCTER, DIRECTOR

RESOURCES

OF THE

NORTH CUMBERLAND VALLEY

COMPRISING PARTS OF

WHITLEY, KNOX, BELL, HARLAN, AND LETCHER COUNTIES.

BY JOHN R. PROCTER.

PART IV. VOL. VI. SECOND SERIES.

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INTRODUCTORY LETTER.

OFFICE OF THE KENTUCKY GEOLOGICAL SURVEY
AND BUREAU OF IMMIGRATION,
FRANKFORT, KY., October 26, 1880.

To His Excellency, LUKE P. BLACKBURN,
Governor of Kentucky:

SIR: I have the honor to submit herewith for your approval a Report on the Resources of the North Cumberland Valley, hoping that the information therein contained may call attention to the great natural advantages of that section, and aid in its development and in the securing of transportation facilities necessary to make these resources available.

I remain, sir, most respectfully,

Your obedient servant,

JOHN R. PROCTER,
State Geologist.

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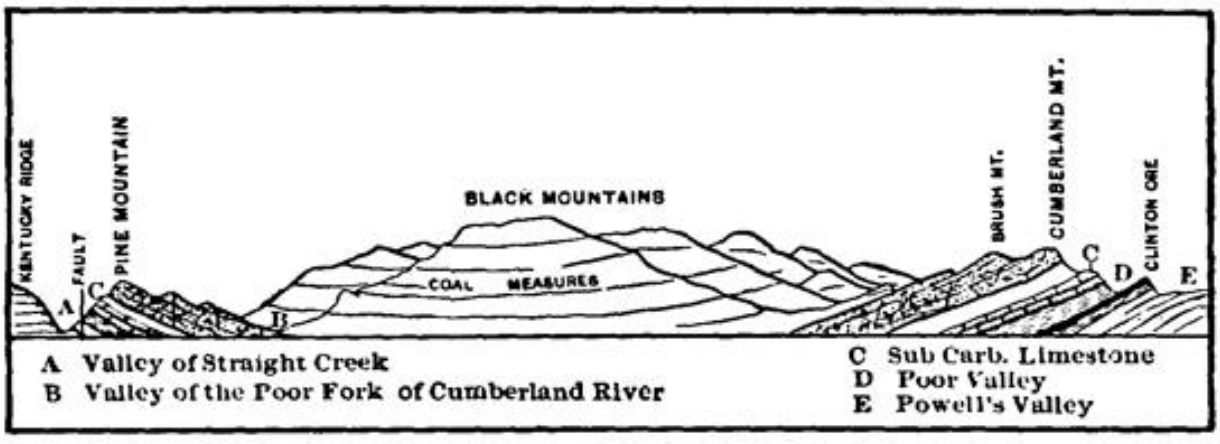
THE RESOURCES OF THE NORTH CUMBERLAND VALLEY.

The topography and geology of this region will be understood by a study of the section given below and the accompanying maps. The Cumberland Mountain to the eastward forms the eastern boundary of the great Apalachian coal-field. The line between Kentucky and Virginia follows the top of Cumberland Mountain from Cumberland Gap to a point near Crank's Gap, about forty miles to the northeast, where the mountain bends to the eastward and extends into Virginia. From this point the line follows the top of the Black Mountains until it reaches the Pine Mountain near Pound Gap. Pine Mountain, caused by a recent fault, extends from the Virginia line near Pound Gap to a point on the Kentucky-Tennessee line in Whitley county, where it is broken through by the Clear Fork of the Cumberland river, and continues in Tennessee past Elk Creek Gap It will be seen from the following section that the region to be described,



lying between these mountains, is composed of carboniferous rocks of great thickness resting in a broad synclinal valley.* This great valley is drained by the waters of the North Cum-

*The massive sandstone capping Pine and Cumberland Mountains is the conglomerate at the base of the coal measures.

berland, the stream passing through a gap in Pine Mountain at Pineville, the county seat of Bell county. The valleys have an elevation of from 1,100 feet to 1,500 feet, and the mountains an elevation of from 2,000 to 3,500 feet above the sea. The accompanying photograph of Yellow Creek Valley well represents the character of this region. The view is taken from Cumberland Gap, looking northwest. It will be observed that the slopes of these mountains are gentle, often not too steep for cultivation, and that on the uplands are broad, fertile plateaus many miles in extent. There is less waste land than in any mountain region with which I am acquainted. The mountains in this region are known by various local names, such as Canada Mountain, Log Mountain, Little and Big Black Mountain. In this report they will all be called the Black Mountains. This region possesses such a remarkable combination of soil, climate, water, timber resources, coal and iron, that it needs but to be known to receive proper attention from persons seeking desirable homes and a field for profitable investments. I hazard nothing in saying it is a region of unsurpassed resources.

SOIL.

I believe the name Black Mountains was given to designate the deep, rich soil with which these mountains are covered. The soils of this entire region surpass any coal-measure soils within my knowledge. Dr. David Dale Owen, Director of the first Geological Survey, says:*

"The richness of the soil on the slopes, and even on the summit of the Log Mountain, is a matter of surprise, supporting a heavy growth of walnut, cherry, oak, poplar, locust, and chestnut. The black, rich mold of the Log Mountains is owing to prevalence of dark carbonaceous shales, which no doubt contain more or less lime, either in the substance of the shale itself, or derived from the calcareous segregations therein imbedded. The Log Mountain and its peculiar formation extends into Harlan county, and is continued under

* Volume I, old series, pages 222-3.

the name of the 'Big and Little Black Mountains' from southwest to northeast, until it reaches the Virginia line."

The above attests the fertility of the soil on the uplands. Dr. Robert Peter, Chemist of the Geological Survey, and widely known for his great abilities as an agricultural chemist, after an examination of these soils, says:* "The soil from the plateau and summit is much richer than might have been expected. Its large proportion of organic and volatile matters, as well as alkalies in the insoluble silicates, indicate the influence of the primeval forest growth, with which it is covered, in retaining the elements of fertility on the surface. The unusually large proportion of silicates, rich in alkalies, in the rock material from which the soil was derived, may have been another cause."

Mr. L. H. DeFriese, in his report on the forests of the North Cumberland, after describing the depth of soil on the slopes of the mountains, says:† "The consequence is, that in the parts of the Black Mountains familiar to me, even on the steepest slopes, there is a rich soil of from two to four feet in depth. For this reason there is a growth of chestnut, yellow poplar, black walnut, white and blue ash, birch, linden, and white hickory that I have never seen surpassed."

TIMBERS.

As Mr. L. H. DeFriese has made the study of timbers a specialty, the following extracts from his report on the timbers of the North Cumberland‡ well attest the peculiar richness of that section in valuable timbers.

Of a section made by him across the mountains, near the line between Bell and Harlan counties, he says: "About 500 feet below the crest of the mountain I found a remarkable belt of the *finest old forest walnut timber I have ever seen.* * * * The walnut is growing on a very rich, loamy soil, partly detritus and partly decayed vegetable matter, about two feet

* Page 35, Chemical Report, Part I, Vol. IV, new series.
† Page 5, Part IX, Vol. IV, new series, Kentucky Geological Survey.
‡ Part IX, Volume IV, new series, Kentucky Geological Reports.

deep, almost entirely devoid of undergrowth. * * * This walnut-bearing belt winds along the mountain as far as I had time to trace it. * * * On the northern exposure opposite, on the contrary, about thirty-five per cent. of the timber was massive yellow poplar, many trees of which were six and seven feet in diameter, with trunks sixty to eighty feet high. * * * * * The white hickory and blue and black ash rank next in value, and they all abound in the Black Mountains especially. * * * The red maple, which is growing into favor in cabinet work, also abounds in Bell and Harlan counties. The linden (*Tilia Americana*) is also found in large quantities through these mountains, and is very valuable in cabinet work," &c.

"After crossing (see page 15) into Harlan county, I made a section to the top of Black Mountain up Gray's branch, and came down a different way, so as to get two sections; the results are here given in detail." I copy only a few references from Mr. DeFriese's report. Ascending the hill at an elevation of 100 feet, he says: "The yellow poplars are five to seven feet in diameter, with trunks sixty to eighty feet long. The white ash is also extremely heavy, and the blue ash *as fine as I ever saw.*" At an elevation of 200 feet: "No perceptible change in the splendor of the forest." The timber remains of the same character, with such changes as are noticed up to an elevation of 1,050 feet, where he says: "The splendor of the forest can hardly be imagined; the belt of walnut before mentioned begins to show itself here, while the yellow poplar, the chestnut, and the white hickory are of the finest." "At this height (1,250 feet) crosses the curious belt, *twenty-five per cent.* of whose timber is old forest walnut. In size and quality these trees *have no superior in this country, so far as I know.*" Elsewhere, speaking of this walnut belt, Mr. DeFriese says: "One of the many magnificent walnut trees I found in this peculiar belt was fourteen feet six inches in circumference, with a curling, but straight and beautiful, trunk, sixty feet in length. In an area of twelve hundred and fifty square yards in this belt, the principal timbers were:

Black walnut	6;	average diameter	40 inches.
Buckeye	5;	average diameter	29 inches.
White ash	3;	one with diameter	34 inches.
Linden	6;	average diameter	23 inches."

In addition to the valuable timbers enumerated above, the region described abounds in valuable white walnut, cherry, elms, magnolias, sweet gum, beech, and other timbers. On the slopes of Pine Mountain to the west, and Cumberland Mountain on the east, are the timbers usually found on the conglomerate sandstone — hemlock along the base of the mountains, pitch pine (*Pinus rigida*), and the yellow pine (*Pinus mitis*), and chestnut oak, are very abundant and of the best quality. Excepting the clearings in the valleys, the timbers of this section remain almost untouched. The difficulty of running logs over the falls of the Cumberland and the Smith's shoals has been the cause of the preservation of this magnificent timber region. According to the best estimates I can make, at least ninety per cent. of this area is yet covered with primitive forest growth. Taking the population of Bell and Harlan counties as returned by the census of 1870, and the area as returned to the State Auditor, the population of these counties is 5.2 per square mile. The population of Massachusetts was, in 1875, 211.78 per square mile, and as this region is capable of supporting a larger population per square mile by agriculture than Massachusetts, and the manufacturing capabilities are as great, as will presently be shown, it is reasonable to expect a great development in the near future.

COAL.

The coal-measures have here a thickness of over two thousand feet above drainage—thicker than elsewhere in America. Thus far, only preliminary reconnoissance work has been done by the Geological Survey, and the densely wooded condition, with the depth of soil, is unfavorable for discovery of coal beds; but enough has been done to establish the existence of many beds of workable thickness and of very superior quality. In a report on a reconnoissance in the Upper Cumberland sec-

tion, Prof. A. R. Crandall says:* "The thickness of the coal-measures is *greater by many hundred feet* than in any other part of Kentucky. The number of the coals is also greater. * * * * The quality of the coals of this valley is most excellent. The proportion of ash and sulphur is very low in all that have been analyzed, with the exception of one cannel coal, and the fixed carbon is high."

The following are analyses of some of these coals from samples carefully averaged by members of the Geological Survey, representing the entire thickness of bed. It must be borne in mind that these samples were taken from imperfect openings, and cannot represent the coal at its best:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
Moisture	1.70	5.20	2.96	1.50	1.00	1.90	1.26	1.36
Volatile combustible matter	35.70	31.26	35.28	37.94	43.60	37.50	33.96	35.80
Fixed carbon	59.60	60.08	59.40	58.40	47.80	57.90	55.52	59.54
Ash	3.00	3.46	2.36	2.16	7 60	2.70	9.36	3.30
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Coke	62.60	65.54	61.76	60.56	55.60	60.60	64.58	62.84
Sulphur	0.750	0.618	0.736	1.038	0.590	1.519	2.672	0.975
Specific gravity	1.289	1.356	1.277	1.262	1.202	1.276	1.344	1.282

No. 1. Clover Fork coal, Harlan county, 54 inches thick.
No. 2. Skidmore Bank, Martin's Fork.
No. 3. Hignite Branch, Bell county.
No. 4. Clear Fork of Yellow creek.
No. 5. Cannel coal, Fork Ridge.
No. 6. Straight Creek coal.
No. 7. Fork Ridge; a four-foot coal above the cannel.
No. 8. Clear Fork, four feet thick.

As indicated on page 5, the line between Kentucky and Virginia leaves the Cumberland Mountain about forty miles east from Cumberland Gap, and traverses the crest of one of the ridges of thé Black Mountain, the divide between the waters of the Upper Cumberland and Powell's river, so that there is an area of coal measures in Southwestern Virginia. A portion of this region was explored by Prof. J. P. Lesley

* Part XII, Vol. IV, second series, Kentucky Geological Reports.

in 1871, and his report* attests the value of the coals of that section. He says, speaking of the six-foot bed: "At one place, where the bed had been dug a little into, it yields the best kind of bituminous coal, fat and caking, but friable, with no appearance of sulphur, and making no clinker. It is a good blacksmith coal, and no doubt will make a good coke. A piece of ill-made coke shows that the best coke can be got from it."

Prof. John J. Stevenson has recently made explorations on the head waters of Roaring and Pigeon Fork of Powell's river, near the Kentucky line, and reports coal of great thickness and superior quality. The coals were analyzed by Mr. A. S. McCreath, Chemist to the Geological Survey of Pennsylvania. Referring to these analyses, Mr. McCreath says:† "The above analyses speak for themselves, and indicate coals of remarkable purity."

Prof. Stevenson adds: "This eight-foot seam will yield a coke with considerably less than *three per cent. of ash*, and with but little more than five-tenths of a per cent. of sulphur. Such would be a marvelously rich coke, the percentage of fixed carbon being somewhat more than ninety-six. The Connellsville coke has somewhat less than ninety per cent. of fixed carbon, the ash is between nine and ten per cent., whilst the average sulphur is about eight-tenths of a per cent." I have a sample of coke carelessly made from this coal which is excellent and of great strength.

An examination of the iron ores contiguous to the above-mentioned coals will convey an appreciation of their value. For purposes of comparison I give below analyses of the *best* coals from neighboring States. These coals were sampled by members of the Kentucky Survey in the same manner as were the Kentucky coals, and were analyzed by the Chemists of the Kentucky Survey. Dr. Robert Peter says:‡ "Seven of the best coals from the State of Ohio, two of the best of those

* Read before the American Philosophical Society April 21, 1871.

† Page 18, report to the Tinsalia Iron and Coal Company.

‡ Page 146, Vol. I, new series, Kentucky Geological Reports.

of Illinois, and three of the celebrated 'Black Coals' of Indiana, used there for iron smelting, &c., were submitted to similar processes of analysis with our Kentucky coals. We give results as follows:"

States.	No. analyzed.	Volatile comb. matter	Fixed carbon in coke.	Per cent. of ash.	Per cent. of sulphur.
Ohio	7	34.59	55.17	6.43	1.494
Illinois	2	31.95	59.06	5.96	1.924
Indiana	3	35.93	54.24	7.23	1.946
General average .	12	34.13	56.12	6.54	1.768

Iron ores not so rich as can be had near the Upper Cumberland coals are carried hundreds of miles to be smelted by the above coals in the three neighboring States.

Taking for comparison analyses of five celebrated coals from the reports of the Second Geological Survey of Pennsylvania (Report "H. H."), as follows: "Cambria Iron Company's Mines," "Coal A, Woodcock Mine," "Kittanning Coal E," "Cambria Coal and Coke Company," and the celebrated "coking coal near Johnstown," as analyzed by the Chemist of the Pennsylvania Survey, gave respectively of ash, 6.930, 5.750, 4.750, 6.163, and 8.83, and of sulphur, 2.843, 0.567, 2.728, 2.352, and 2.78. The coals of the Upper Cumberland Valley are not only very thick, but are above drainage, and can be opened at small cost and mined very cheaply.

IRON ORES.

The position of the rocks, and the relation of the Clinton Group, in which this ore, known as "Clinton," "Dyestone," and "Fossil" ore is situated, to this region is shown in the section on page 5. This Clinton ore extends irregularly along the eastern escarpment of the Alleghenies from Canada to Alabama. It is the principal source of local supply for the furnaces of Pennsylvania, and is the source of supply for the furnaces of the Roan Iron Company, Tennessee; the furnaces in the Sequatchie Valley, and most of the furnaces in Eastern Alabama. This ore is very persistent, and of good workable

thickness along the entire eastern edge of the region under consideration, from Elk Gap in Tennessee to and beyond Big Stone Gap in southwestern Virginia. The ore at Elk Gap can find easy access to the coals of this region by way of the proposed extension of the Knoxville and Ohio Railway down the Elk Fork of the Cumberland. There has been a development of this ore near Speedwell, in Tennessee, where it has been smelted in a charcoal furnace. The ore can be brought to the coal by tunnelling the Cumberland Mountain at one of the gaps near that place. At Cumberland Gap and eastward there is a large deposit of this ore, well shown in the accompanying plate, taken from Mr. P. N. Moore's report on "The Iron Ores in the Vicinity of Cumberland Gap."* The several beds of ore in this section, near the Gap, range in thickness at from 22 inches to 27 inches. Eighteen miles east from the Gap it is found 52 inches thick; at Pennington Gap, yet further east, 35 inches thick, and at or near Big Stone Gap the several beds range in thickness from 25 inches to 7 feet 2 inches.†

The quantity of this ore along the eastern outcrop of this coal is unlimited. In quality an examination of the following analysis will show that it is superior to the Clinton ores of other localities.

SAMPLES AVERAGED BY MR. P. N. MOORE AND ANALYZED BY DR. ROBERT PETER AND MR. JOHN H. TALBUTT, CHEMISTS OF THE SURVEY.

Specific gravity	3.942	3.914
Iron peroxide	77.380	73.935
Alumina, Manganese oxide	3.941	5.776
Lime carbonate	.420	4.510
Magnesia	tr.	.266
Combined water	2.500	3.850
Silica and silicates	15.960	11.730
Percentage of iron	54.166	51.750
Percentage of phosphorus	.140	.140
Percentage of sulphur	tr.	tr.

* Part V, Volume IV, second series, Kentucky Geological Reports.

† Report of Prof. J. J. Stevenson, page 13.

The following are analyses of ores from the Big Stone Gap district—No. 1 the Clinton ore, and No. 2 a brown hematite—by Mr. McCreath:

	No. 1.	No. 2.
Metallic iron	52.600	52.556
Sulphur	0.018	0.037
Phosphorus	0.116	0.051
Insoluble residue	18.140	7.840

For purposes of comparison, the reader is referred to the analyses of the Clinton ores in Pennsylvania, in volume "F," "Second Survey of Pennsylvania."

During the high price of iron in 1872 the Clinton ores were carried from Alabama to Louisville by rail, carted from the railway through that city, and loaded on boats, and carried to furnaces in Ohio and Western Pennsylvania.

The excellent ores described above can be delivered to furnaces along the Eastern border of the Kentucky coal-field at prices ranging from 50 cents to $1.50 a ton. Prof. Stevenson estimates that pig iron can be made at Big Stone Gap at $8.25 per ton. The above is but a small part of the ore supply to be relied on by this region. The writer, in a report made to the Kentucky Legislature in the winter of 1875, says: "The great Pine Mountain fault, extending across the State from Pound Gap to the eastern portion of Whitley county, brings the level of this ore (Clinton) above the drainage, but it is so covered by the talus from the mountain that the ore has not yet been seen. If this ore extends so far west, we can reasonably expect to find it by drifting for it near the base of Pine Mountain. The dislocation of the rocks in Elk Fork, Tennessee, and the Sequatchie Valley anticlinal bring up this ore and prove its westward extension, and as these disturbances are but an extension of the Pine Mountain dislocation, the evidence is strong that the ore is in place along the base of Pine Mountain." Fragments of this ore have been found in the valley of Straight creek, along the base of Pine Mountain.

In addition to the above ores, the great thickness of coal-measure rocks will undoubtedly yield a large supply of carbonate ores. Little search has been made for iron ores in this region, and the rocks are so covered with the deep soil and luxuriant forest growth that outcrops of such ore would seldom be seen. The fragments of such ores are numerous in the streams, and some workable beds have been discovered. The following are analyses of ores from the western part of the region under discussion, made by Dr. Robert Peter for the first Geological Survey:*

	A	B	C	D	E
Carbonate of iron	73.35	73.13	....	67.72	63.60
Oxide of iron	3.36	4.94	80.50	6.99	.....
Carbonate of lime	.88	1.15	.18	3.38	.....
Carbonate of magnesia	2.67	1.59	....	10.15	.. ..
Carbonate of manganese	1.49	3.74	.....	.70	.....
Alumina	.58	.79	1.88	1.58	2.98
Phosphoric acid	.63	.16	....	.76	.31
Bituminous matter	....	3.25	.....	.....	.....
Silex and insoluble silicates	9.88	9.95	2.48	8.48	17.25
Moisture and loss	1.16	.63	12.66	0.56	13.75
Percentage of iron	39.20	38.81	56.37	37.60	44.53

A. Carbonate of iron, Log Mountain, Whitley county, Ky.
B. Carbonate of iron, under Cumberland Falls, Whitley county, Ky.
C. Limonite, headwaters of Mud Creek, Whitley county, Ky.
D. Carbonate of iron, mouth of Poplar Creek, Whitley county, Ky.
E. Limonite, south part of Pine Mountain, Whitley county, Ky.

There are good carbonates and limonites in Pulaski county, Ky., near the head of Indian and other creeks, which can be brought into this valley by the proposed railway (to be discussed hereafter) connecting the Cincinnati Southern with the Cumberland river above the falls.

It is evident that this region has an abundant supply of ores, and that only transportation to the markets of the country is needed to insure the building up of an extensive iron industry. In no region in the United States can iron be produced cheaper than in this area between the Pine and Cumberland Mountains.

* Second Chemical Report, page 276, Vol. II, old series, Kentucky Geological Reports.

A discussion of the advantages as an iron-manufacturing center would be incomplete without reference to the very rich and pure ores of the East Tennessee and Western North Carolina section. I believe it will be found that no ores of like richness and purity are to be found so convenient to pure, cheap coals as are these ores.

The imports of iron ore to meet the extraordinary demands for Bessemer pig-iron was, for the year ending December 31, 1879,* 284,141 tons, mostly from Spain and the Mediterranean ports.

It is estimated that the furnaces of Western Pennsylvania will this year draw 500,000 tons of ore from abroad,† mostly from Spain and Algeria. The Lake Superior region produced 1,414,182 tons last year, nearly all of which was carried to the furnaces in the Apalachian coal-field, as was the product from Iron Mountain, Missouri.

The production of steel in this country is not sufficient for the increasing demands, and the importation of steel and steel-making ores from abroad is largely on the increase.

In 1879 thirty-four per cent. of all the iron produced in this country was made into steel. The nearness of the very pure ores of East Tennessee and Western North Carolina to the pure coals in the Upper Cumberland region are an assurance that, with transportation secured, that region will be one of the great iron and steel-producing centers of the world. As it requires about five tons of coke to produce a ton of finished bar iron or steel, it is evident that these ores will be brought to the coal, and for this reason we have an interest in the quality, quantity, and future development of these ores.

The scope of this report will not permit anything beyond a mere mention of some of the principal ores of the Unaka and Blue Ridge section. The ore of most importance is probably the celebrated magnetite ore near Cranberry, North Carolina, and the extension of same ore in Carter county, Tennessee. Prof. W. C. Kerr, State Geologist of North Carolina, says

* Annual report of Secretary American Iron and Steel Association for 1879, page 17.

† Report of Prof. W. C. Kerr, on visit to Pittsburgh, made to the Governer of North Carolina April, 1880.

of this ore:* "In quality this ore is unsurpassed by any iron in the world, and in regard to quantity, the bed much exceeds the great deposits of Missouri and Michigan, and at least equals anything in the Champlain region, so that it has not probably an equal in this country."

The quality of the ore will be seen from the following analyses:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Magnetic oxide of iron	94.37	91.45	85.59	80.77	91.89
Oxide of manganese	0.29	0.06	0.24	1.42	0.32
Alumina	0.42	0.77	0.11	0.52	1.03
Lime	0.43	1.01	0.72	.....	1.06
Magnesia	0.36	0.53	0.33	.....	0.23
Water	.....	0.44	1.53	8.21	1.15
Silica, pyroxene, &c	4.16	5.74	11.48	9.08	4.02
Metallic iron	68.34	66.22	61.98	58.49	66.58

The first four of these analyses are by Dr. Genth, who says: "The first three samples contain neither titanic acid nor phosphorus and sulphur. The fourth contains a trace of phosphoric acid." No. 5 was analyzed by Prof. Chandler, of the Columbia College School of Mines, New York City, who says: "*This is the best iron ore I have ever analyzed.* It is very rich in iron, and very free from sulphur and phosphorus."

In Carter county, Tennessee, near the State line, is an extension of this wonderful deposit. There are also in Johnson and Carter counties other valuable iron ores. The following are analyses of some of these ores:†

	No. 1.	No. 2.	No. 3.
Combined oxygen	25.60	22.07	24.29
Water	0.22	5.41	0.67
Silica	2.17	10.32	6.30
Sulphur	0.06	0.03	0.06
Phosphorus	0.003	0.09	0.07
Metallic iron	59.75	51.50	63.72

* Geology of North Carolina, Vol. I, 1875, page 266.

† See description of these ores, "Tennessee, Its Agricultural and Mineral Wealth," Nashville, 1876; Dr. Safford's Geology of Tennessee, Nashville, 1869.

A system of railway already under contract will, within the following year, bring the above-mentioned ores of Tennessee and North Carolina in connection with the coal under discussion. In Greene, Cocke, Blount, and other counties of East Tennessee are high grade ores, which will be briefly referred to in discussing the railway system of this region. The fine deposits of ore in Bompass creek, Washington county, are described in a paper read by Prof. J. P. Lesley before the American Philosophical Society, May 3, 1872.

A remarkable deposit of iron ore is found in Rockingham and Guilford counties, North Carolina. This ore is not only valuable for the manufacture of high grade iron and steel, but is highly prized as a lining for puddling furnaces. Five tons were sent to the works of Mr. Nathan Rowland, Kensington, near Philadelphia, and, upon trial, this ore stood up three times as long as the Champlain ore. Prof. J. P. Lesley, in summing up the results of his investigations of this ore belt, says:* "It is an advantage, therefore, that while many Canada ores hold 25 and 30 and 35 per cent. of titanic acid, your company's ore has less than 15, leaving the percentage of metallic iron over 50. At the same time you have all the advantages which the presence of titanium affords: 1st. Making the *ore* so firm that it is the best possible for lining puddling furnaces; 2d. Making the *iron* tougher and harder, like the best Sweden iron; and, 3d. Imparting a certain quality (the cause of which is not yet understood) which adapts the *iron* especially for the manufacture of *steel*. * * * * The quality of ore, although various, and suited to at least two branches of the iron manufacture, is of the very first rate; none better in the world.

"The soft ores will smelt easily and make magnificent iron; absolutely the very best—perfectly malleable, tough, and strong.

"The hard ores will command a high price for puddlers' linings; will be in demand for mixing with poorer ores of other regions in the blast furnace, to increase the quantity

* "The Tuscarora Iron Ore Belt in North Carolina:" Philadelphia, 1871.

and quality of their pig metal, and will have an especial value for the Siemens and Bessemer processes and the steel manufactures generally. The quantity of the ore is limitless."

In Chatham and Orange counties is another remarkable deposit of iron ores. The Chapel Hill ore, a dense, steel-grey hematite, specular in part, slightly magnetic, is from 7 to 30 feet thick, has 65.77 per cent. of metallic iron, with 2.63 silica, 1.68 per cent. of alumina, and but 0.04 per cent. of phosphoric acid. In Caldwell county is a large deposit of "martite" a schist of specular ore, resembling the ore from the "New York Mine," of the Lake Superior region. Reference has been made to but a few of the ores of this favored region.

Nearly all of the magnetic and specular ores of the United States are smelted by furnaces in the Apalachian coal-field, or by coke furnished from that region. Assuming Connellsville to be the centre of the iron manufacturing region of the Northern States, we find the distance by straight line (the available railway lines will be of course much greater) from Marquette iron region to Connellsville, 700 miles; from Iron Mountain, Missouri, to Connellsville, 650 miles; from the Champlain region to Connellsville, 450 miles. From the celebrated Cranberry ore of North Carolina to the coals of Southeastern Kentucky, by an available railway route, it is less than one hundred miles.

TRANSPORTATION ROUTES.

At present this district is without railway transportation. From Cumberland Gap to Morristown, the nearest station on the East Tennessee and Virginia Railway, it is thirty miles, and to Livingston, the present terminus of the Knoxville Division of the Louisville and Nashville Railway, it is seventy miles. From Big Stone Gap to Bristol, Tennessee, it is sixty-five miles, and from Pennington Gap to the railroad at Rogersville, Tennessee, it is about thirty miles. The present northern terminus of the Knoxville and Ohio Railway, near Careyville, Tennessee, is the nearest existing railway to the southwestern portion of this region, and the Cincinnati South-

ern is within twenty-five miles. It will be observed by a glance at a railway map of the United States that the area of Southeastern Kentucky and Southwestern Virginia comprises a portion of the largest district barren of railways to be found east of the Mississippi river. A knowledge of the peculiar topography of the Apalachian Mountains, partially shown by the accompanying map, will explain the cause of this. South of the Potomac the Chesapeake and Ohio Railway is the only road crossing this entire mountain system until we reach the Western and Atlantic Railway, in Georgia. Some of the roads in Western North Carolina have penetrated beyond the outward barriers of the Blue Ridge, and from the Valley of East Tennessee two roads have gone to the foot of the Unaka Mountains. Realizing the importance to Kentucky of a road crossing these mountains at right angles to the axis of uplift, for reasons which will be apparent to all who will study the geology and the variety of productions from the eastern slope of the Blue Ridge to the coal-field of Central Kentucky, the writer has taken a deep interest in the railway developments progressing in North and South Carolina and East Tennessee, and was partially instrumental in bringing the parties interested in perfecting a system of narrow-gauge roads in these States into communication. A conference was held at Bristol, in September of this year, and the reports from the various roads are so encouraging that hopes may be expressed of the completion of a through system of narrow-gauge from the Kentucky coal-fields to the Atlantic sea-board at an early date. The projected road from Big Stone Gap to Bristol, Tennessee, the present terminus of the East Tennessee, Virginia and Georgia Railroad and of the Atlantic, Mississippi and Ohio Railroad, has been put under contract, to be completed by September 1, 1881. A narrow-gauge road from Johnson's City, on the E. T., Va. & G., 23 miles west of Bristol, to the Cranberry ore bank, in Western North Carolina, is under contract, to be completed at the same time. The Chester and Lenoir, narrow-gauge, is completed and running from Chester, S. C., to the Catawba river, north of

Dallas, N. C., and is graded to Lenoir, and work will be pushed north towards the Cranberry ore. A narrow-gauge is completed east from Chester, S. C., to Lancaster, and it is believed that the road from Lancaster through Sumter to the sea-board at Georgetown will be soon under contract and pushed to completion. A narrow-gauge is in process of construction from Fayetteville through Greensboro, N. C., and will unite with the Chester and Lenoir on the Blue Ridge plateau, and use a common track, uniting at Cranberry ore bed with the road to Johnson's City, and probably making short connection with the Big Stone Gap road. This system of roads will bring the North Carolina ores to the Kentucky and Southwest Virginia coals, and will open up an immense market to the Southwest for these coals. A road chartered by the Legislatures of Kentucky and Virginia, known as the Richmond and Southwestern, is now engaged in surveying a route for a narrow-gauge road from Central Kentucky to the Virginia line, somewhere between Pound and Pennington Gaps, and on to Richmond, Va. This road will give a northern connection to the narrow-gauge road from North Carolina, and when built will certainly be as favorably located to get an immense business as any new road in America. There are no serious engineering difficulties to be encountered in the construction of a railway through the above-mentioned gaps. The valleys of the streams in the coal-measures of Eastern Kentucky are favorable to the construction of railways.*

The Kentucky Central Railway is now looking to an extension. Three routes are under consideration:

1. Up the valley of the Kentucky river, crossing at Pound, Pennington, or Big Stone Gaps, and forming connection towards North Carolina.

2. From Paris or Lexington to London, and uniting with the L. and N. Knoxville Branch, via Barboursville, Pineville, Cumberland Gap, to Morristown, where connection will be made with the railway from that place to Wolf Creek, on the

* For additional information on this subject, see Prof. N. S. Shaler's report on "The Transportation Routes of Kentucky," Part V, Vol. III, second series, Kentucky Geological Reports.

French Broad, and finally connecting with the North Carolina system of roads at Ashville.

3. From London to Williamsburg, and up the Clear Fork of the Cumberland, passing through Pine Mountain at Elk Gap, and uniting with the Knoxville and Ohio Railway at Careyville. Either of the three proposed routes will give this North Cumberland region an outlet to the north and south. The Louisville and Nashville Knoxville Division will extend on one or two of the proposed routes (1 or 2), most probably through Cumberland Gap. There are three roads in the eastern part of Kentucky from which we may in the future expect an extension to the eastern portion of this region—the Chattaroi Railroad, now completed to Peach Orchard, the Eastern Kentucky Railway, now engaged in making a survey of line into Morgan county, and the Cincinnati and Southeastern, formerly known as the Licking Valley Railroad. A road has been chartered to start from a point on the Cincinnati Southern, in Kentucky, south of the Cumberland, and run to the Cumberland river at a point above the falls. This road would be of immense advantage to the Upper Cumberland, as navigation can be had for boats, rafts, &c., and an outlet will in that way be afforded. At present the falls and the shoals below are a barrier to navigation.

With railways crossing the Cumberland river at Williamsburg and Pineville, the navigation of the Upper Cumberland will be a question of some importance. There will be no obstruction to descending navigation for the greater portion of the year, and I believe small boats can ascend the Poor Fork of the Cumberland during several months in the year. The United States Government has expended money during the past few years in improving descending navigation over the shoals between the crossing of the Cincinnati Southern Railway at Point Burnside and the Falls of the Cumberland. The falls must remain for years to come an impediment to navigation, as the amount necessary to their canalization is large. A possible water-way connecting with the waters of

the Kentucky river, and giving a direct outlet to the Ohio river, is worthy of consideration.

The Cumberland river at Barboursville is 121 feet higher than the waters of the Kentucky river at Goose Creek Salt-works, near Manchester. The summit divide between Richland Creek (emptying at Barboursville), and Collins' Fork of Goose Creek (see map), is 78 feet higher than low water at Barboursville, and less than a mile through. A dam at Barboursville, and an open cut through this divide of less than a mile in length, will allow the waters of the Cumberland to flow through. The amount of water taken from the Cumberland would be inconsiderable, as it would only flow when boats were passing the locks, and the supply taken for the canal would be from the reserve held back by the dam at Barboursville, and would hardly affect the flow of the river below that point. This dam would afford slack-water to Pineville, and from there a canal could be carried along Yellow Creek to Cumberland Gap. It is possible to connect this system with the river system of Tennessee by a canal through Cumberland Gap and down Gap Creek to Powell's river, a distance of six miles from the Gap

I have in the foregoing report but glanced briefly at some of the most important resources of this valley. There are others which, with the development of the future, may assume equal importance with those mentioned. To the north, in Perry and Breathitt and Clay counties, salt brine is obtained from borings, and near Whitesburg brine was obtained at 300 and 400 feet depth. Favorable results may be anticipated from borings in this valley. I believe it is an established fact that the petroleum of this country is derived directly or indirectly from the Devonian Black Shale. It will be seen, by reference to the section on fifth page, that this shale, which is quite thick along the eastern base of the Cumberland Mountain and the western base of the Pine Mountain, is below the drainage in this valley, and the position of the rocks, with the superincumbent weight of the mountains, is most favorable for the production of flowing wells.

The massive conglomerate on the sides of this valley is a great storage reservoir of water, so that the springs are numerous, never failing, and bold, and the streams afford excellent water-power. The climate of this section and the varied beauties of scenery add much to its attractiveness. Here we have along the two sides of this valley the bold escarpments of conglomerate along some of the clear mountain streams, enriched with a profusion of rhododendrons, kalmias, azalias, cucumber magnolias, holly, &c. The central valleys, broad and fertile, are surrounded with gently sloping hills and mountains, covered with a grandeur of forest nowhere surpassed. There is no more grand or beautiful scenery elsewhere in the Alleghenies than in this valley. The mountains of the Big Black are probably the culmination of this entire range, as are the North Carolina Mountains opposite the culmination of the entire Apalachian range.; It will be observed that around these Black Mountains, on the line between Kentucky and Virginia, head the Sandy; the Kentucky the Cumberland, the Powell, and the Guest's rivers. The genial summer climate is due to the high elevation of this entire region above the sea level.

The summer rain-fall is greater than elsewhere in the Ohio Valley. This combination of advantages — healthfulness of climate, good soil, valuable timbers, abundance of coal and iron of excellent quality, so situated as to be cheaply mined, and the certainty of transportation facilities in the near future —certainly renders this country peculiarly adapted to persons seeking new homes. Lands can be purchased in large tracts at a low price, and the writer will take pleasure in giving additional information to persons desiring to investigate the resources of the Valley of the North Cumberland.

YELLOW CREEK VALLEY, BELL COUNTY

Kentucky Geological Survey

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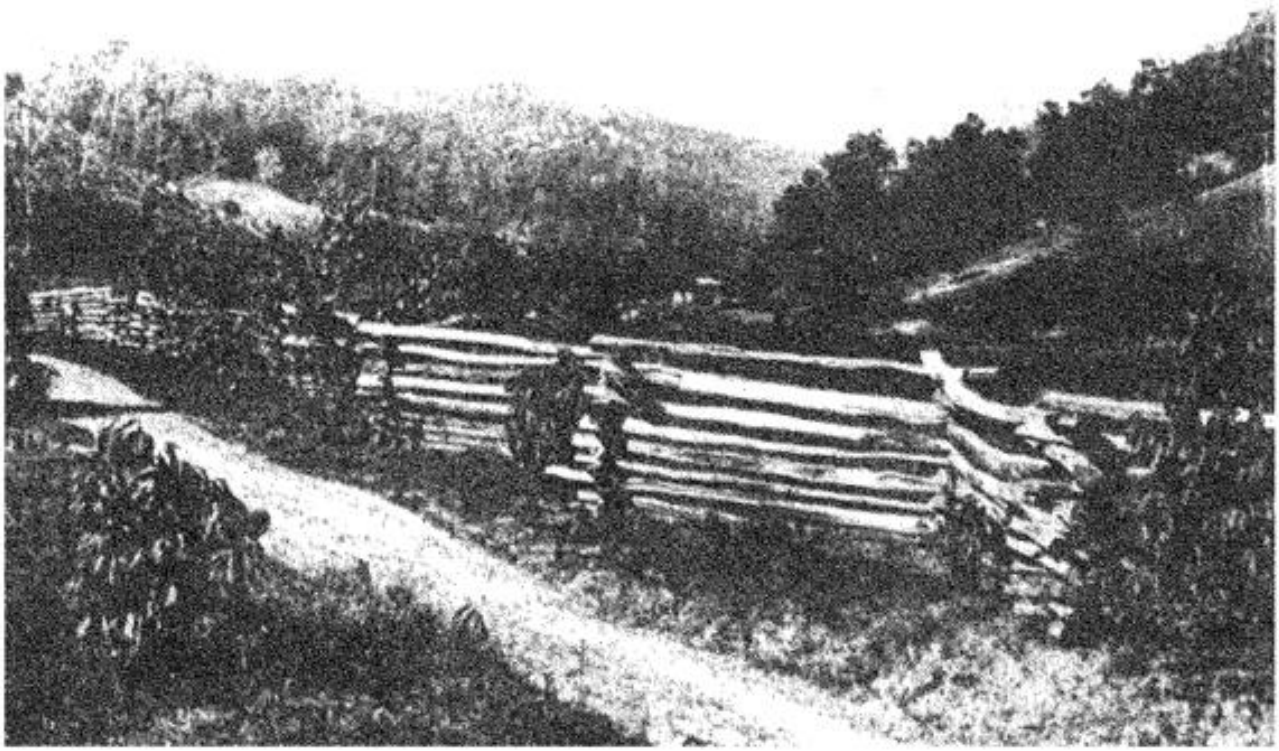

IN MARTIN FORK VALLEY, HARLAN COUNTY.

Kentucky Geological Survey

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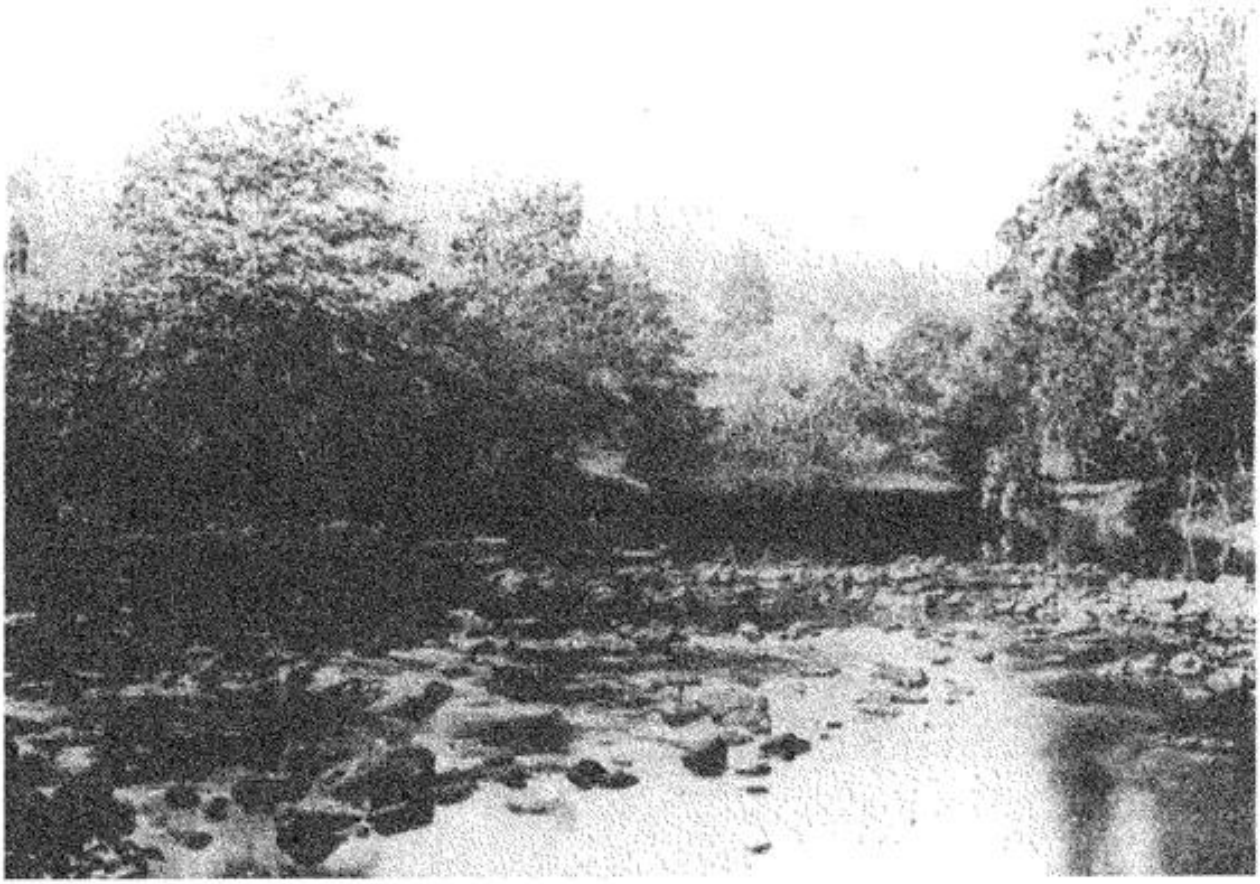

ON MARTIN'S FORK, HARLAN COUNTY

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CUMBERLAND VALLEY, NEAER BARBOURSVILLE KNOX COUNTY

Kentucky Geological Survey

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CUMBERLAND FALLS, WHITLEY COUNTY

Kentucky Geological Survey

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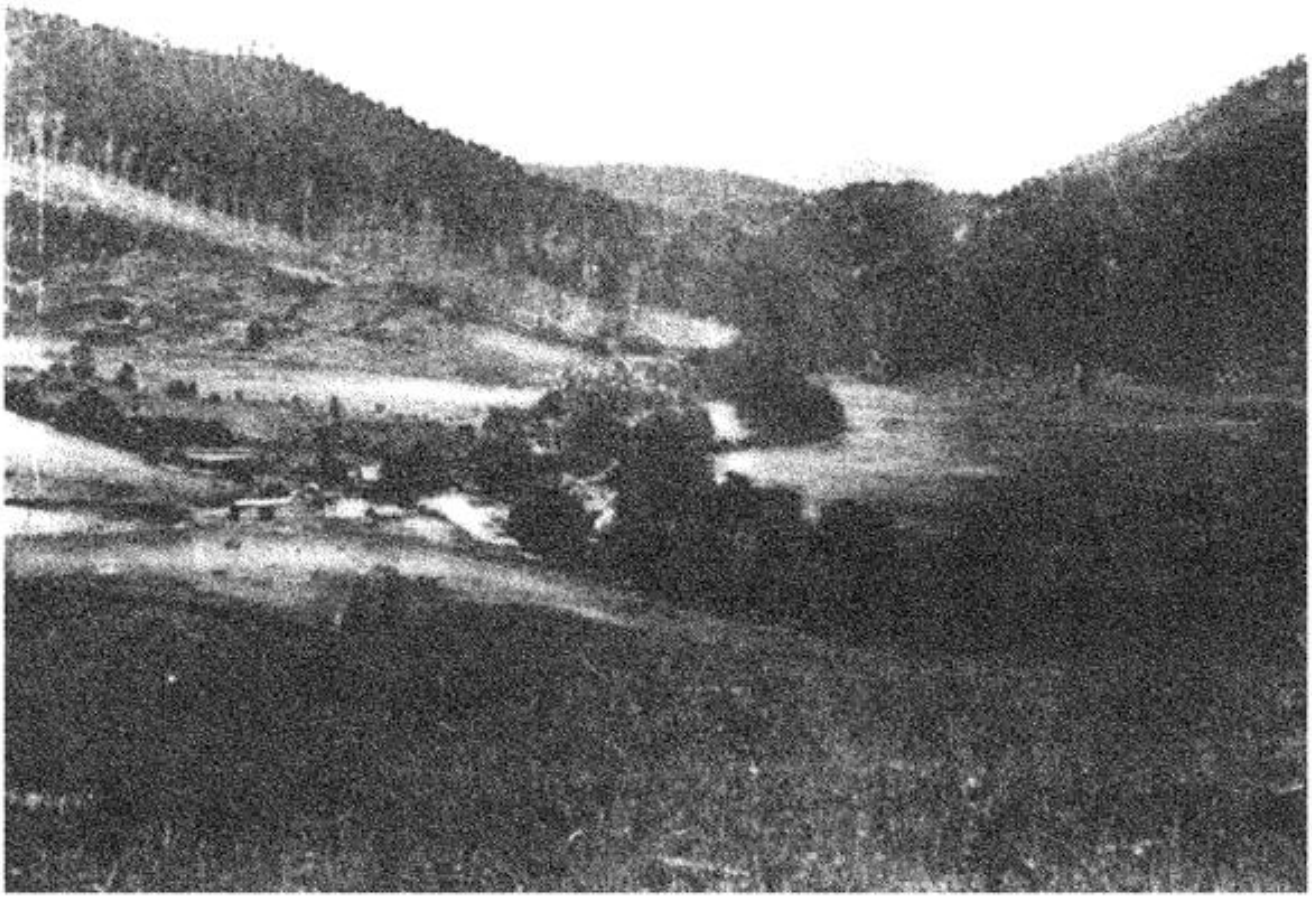

PENNINGTON GAP, LEE COUNTY, VIRGINIA

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CUMBERLAND VALLEY, NEAR MOUTH OF BRUSH CREEK, KNOX COUNTY

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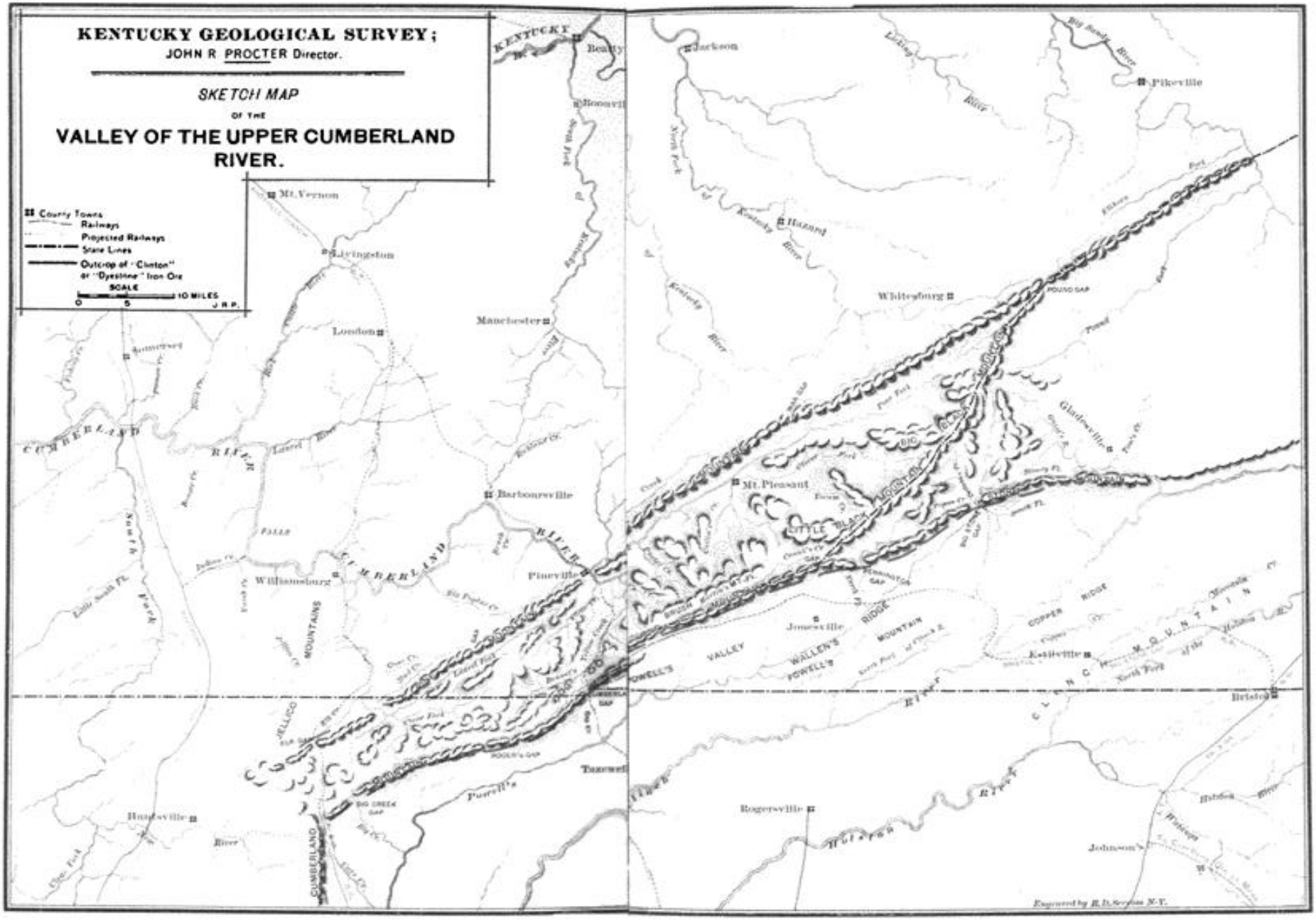
KENTUCKY GEOLOGICAL SURVEY;
JOHN R PROCTER Director.
SKETCH MAP
OF THE
VALLEY OF THE UPPER CUMBERLAND RIVER.
County Towns
Railways
Projected Railways
State Lines
Outcrop of "Clinton" or "Dyestone" Iron Ore
SCALE
0 5 10 MILES
J.R.P.
Mt. Vernon
Livingston
London
Manchester
Barbourville
Williamsburg
Pineville
Beattyville
Jackson
Pikeville
Hazard
Whitesburg
Gladeville
Mt. Pleasant
Jonesville
Estillville
Rogersville
Tazewell
Huntsville
Bristol
Johnson's
CUMBERLAND RIVER
POWELL'S VALLEY
WALLEN'S RIDGE
POWELL'S MOUNTAIN
COPPER RIDGE
CLINCH MOUNTAIN
LITTLE BLACK MOUNTAIN
POUND GAP
CUMBERLAND GAP
Engraved by R.D. Sessions N.Y.