

**Maps and Charts for Kentucky Geological Survey  
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1-2**

Map of the Paris, Georgetown & Frankfort Railway and Connections is filmed at the end of John R. Proctor's *Report on the Resources of the Region Adjacent to the Paris, Georgetown and Frankfort Railway*.

Map of the Paris, Georgetown & Frankfort Railway and Connections by Rand McNally & Co., Engrs, Chicago is filmed at the end of John R. Proctor's *Report on the Resources of the Region Adjacent to the Kentucky Union Railway Company*.

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REPORT

ON THE

RESOURCES OF THE REGION

ADJACENT TO THE

PARIS, GEORGETOWN AND FRANKFORT RAILWAY.

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By JOHN R. PROCTER,  
STATE GEOLOGIST OF KENTUCKY.

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OFFICE OF THE PARIS, GEORGETOWN AND  
FRANKFORT RAILWAY COMPANY,  
FRANKFORT, KY., 1880. }

JOHN R. PROCTER, ESQ., *Director of the Kentucky Geological Survey:*

DEAR SIR: On behalf of the Directors of the Paris, Georgetown and Frankfort Railway Company, I request of you a report on the resources of the region which would justify the building of the proposed railway from Frankfort through Georgetown to Paris, and beyond into the coal-fields of Eastern Kentucky, with connections to Louisville and Cincinnati. The Company also wish your views respecting an extension of the road to form connections on the southeast with a system of roads extending to the sea-board.

Respectfully yours,

D. W. LINDSEY,

*President Paris, Georgetown and Frankfort Railway Company.*

# PARIS, GEORGETOWN AND FRANKFORT RAILWAY.

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OFFICE OF THE KENTUCKY GEOLOGICAL SURVEY, }  
FRANKFORT, KY., December 4, 1880. }

GEN. D. W. LINDSEY, *President of the Paris, Georgetown and Frankfort  
Railway :*

DEAR SIR: I comply with your request the more readily because of the important interests to be advanced by the construction of a railway on the route indicated by you. To any one who has given study to the resources of Central and Eastern Kentucky, the importance of such a line, giving the shortest possible route from Cincinnati and the most fertile portion of Kentucky to the eastern coal-field, is apparent. A glance at the accompanying railway map of this State will show how curiously the important railway lines have avoided the coal area. The Cincinnati Southern Railway skirts along almost parallel with the western border of the eastern coal-field, and only enters it south of the Cumberland river, and the Lexington and Big Sandy appears to enter the coal-field reluctantly on the north, whilst the Louisville and Nashville has made a long detour as if to avoid the coal-fields of Western Kentucky.

It is evident that a railway from Paris, entering the eastern coal-field at right angles to its outcrop, will afford the shortest and cheapest means for supplying a large area with coal. No shorter road can be constructed from Cincinnati to workable coal of good quality than the one under consideration.

It only remains, therefore, to examine the quantity and quality of the coal reached by this proposed road to decide whether such a road would justify the expenditure necessary for its construction.

Independent of the coal, iron ores, and timber, this road will pass through a region abounding in other varied resources, sufficient to insure to it a profitable and ever-increasing freightage. From Frankfort to Paris, and for a distance of 25 miles beyond that point, the road will pass through a portion of the Blue Grass Region equal in fertility to any por-

tion of that celebrated section. In this region there are no waste lands; even the woodlands are in pasture, and every acre is made available for production. The country is thickly settled, and that portion of your road can depend on a profitable local freight and passenger traffic from its completion. The scarcity of timber in this region forces the inhabitants to use coal; they also require a large amount of lumber for buildings, fencing, &c. The amount of coal and lumber used at Paris and other towns is now considerable—enough to insure profitable freighting to this road. The facilities afforded by this road to obtain cheaply a superior quality of the above articles will greatly increase the consumption, independent of the increased population which may be expected in the near future.

Between the borders of the Blue Grass Region and the outcrop of the coal, your road will pass over, in a few miles, quite a variety of geological formations; from the Upper Silurian to the Lower Carboniferous inclusive, giving in a short distance quite a variety of soil and timbers, and consequently a variety of agricultural products. In these various groups are to be had in abundance hydraulic limestone, superior building stones, pottery and fire-clays, iron ores, and valuable timbers.

#### RED RIVER IRON ORES.

The excellent quality of the charcoal iron known as the "Red River Car-wheel Iron" is so well known as to need no description. The ore, from which this iron is made is a limonite, resting on top of the St. Louis Group of the Subcarboniferous Limestone, and is very persistent, with a varying thickness of from a few inches to several feet along the eastern outcrop of the coal-field in the counties of Estill, Lee, Powell, Wolfe, Montgomery, Menifee, and Bath.\* In Estill county, three furnaces have been erected; two of them large and well constructed. The product of these furnaces must now be hauled 17 miles over mud roads to reach railway transportation. The construction of the proposed road would give an outlet to the existing furnaces, and would insure the building of others using coal. The iron ores of this region range from 39 to 52 per cent of metallic iron, and the pure coals to be obtained convenient to these ores will insure the manufacture of a superior iron at small cost.

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\* For further description, see "The Iron Ores of the Red River Iron Region," by P. N. Moore, Part III, vol. IV (second series) Kentucky Geological Reports; Report on the Geology of Menifee County, by A. R. Crandall, Part II, vol. IV (new series); Report of Joseph Lesley, jr., vol. IV (old series), pages 462 to 480.

## COALS OF THE RED RIVER VALLEY.

The scope of this brief statement precludes a discussion of the geology of the district beyond the briefest mention, the object being only to give a summary of the resources. The first coals to be reached by this road are the two workable coals in the shales beneath the conglomerate sandstone. These coals are well up in the hills above drainage in this valley, and are well situated for cheap mining.

The following are analyses of Subconglomerate coals of Menifee county from averaged samples "carefully taken, representing the whole thickness of the bed," by Prof. Crandall, from beds ranging from thirty-two inches to forty-eight inches in thickness, analyzed by Dr. Robert Peter, Chemist of the Geological Survey :

	No. 1.	No. 2.	No. 3.	No. 4.
Specific gravity . . . . .	1.300	1.319	1.301	1.300
Moisture . . . . .	5.00	2.94	3.80	5.00
Volatile combustible matter. . . . .	32.40	33.06	38.60	39.06
Fixed carbon . . . . .	58.40	56.60	52.00	55.94
Ash. . . . .	4.20	7.40	5.60	2.76
Sulphur. . . . .	.614	.997	not det.	1.300

Dr. Robert Peter says of these coals: \* "These are all remarkably good coals, containing less than the average of earthy matters, as well as of sulphur." Nos. 3 and 4 would bear shipment to Cincinnati and beyond, to be used in the manufacture of gas. These coals stand exposure, and bear transshipment and yarding well. A similar coal is sometimes brought down the Kentucky river in small boats during high water, and it always commands from one to two cents more per bushel than the best Pittsburg coal. From this coal to the Ohio river, by the proposed road, it is all down grade, which should be a guarantee of cheap freights, enabling this coal to compete successfully with Pittsburg coal in the Cincinnati market, and to monopolize the market of a large part of Central Kentucky. In the valley of the Red river, towards the heads of the streams, there are but two coal seams above the Conglomerate. Coal No. 1, the first above the Conglomerate, is a fat caking coal, and will doubtless make an excellent coke. It is probably the equivalent of the excellent caking coal described on page 13. On the upper portion of Red river, on Stillwater, Gilmore, Glaidie, and other streams, an excellent cannel coal is to be had of workable thickness. Little search

\* Page 121, Vol. IV (new series) Kentucky Geological Reports.

has been made on these streams, but enough to justify the assertion that there is a large area of valuable cannel coal in the Red River Valley.

The following analysis from one of these beds shows the quality:\*

Volatile matter . . . . .	51.70
Coke . . . . .	48.30
Ash . . . . .	5.10
Sulphur . . . . .	0.955

These cannel coals will afford to any railway penetrating this valley a large and constantly growing freighting. The timber resources of this valley are valuable. The only considerable area of white pine timber in the State is in this valley. In addition, there are extensive forests of yellow pine, white oak, yellow poplar, and other valuable timbers. On the ridges and uplands, near the border of the coal-field, are extensive forests of chestnut oak—enough to yield, for years to come, a large supply of tan-bark.

The valleys of this region are fertile, and will support a dense agricultural population. There is a broad, high table land, held up by the Conglomerate sandstone. On this table land the lands are level and gently rolling, similar to the "Plateau Lands" of Tennessee, about which so much has been recently written.

These table lands have an elevation of from 1,200 to 1,400 feet above sea level, and are admirably adapted to fruit-growing. They will produce excellent grass. The climate, water, healthfulness, and ease with which they may be cleared of timber and brought under cultivation, will, when transportation is afforded, cause them to be rapidly settled by immigrants.

#### KENTUCKY RIVER VALLEY.

The rocks dip from Central Kentucky to the southeast, and the height of the hills also increases in that direction, so that, penetrating the eastern coal-field in the direction of the proposed road, there is a steady increase of the thickness of coal-measure rocks, and also in the number of coals. A section from Red river to the mouth of Troublesome creek, in Breathitt county, shows this very plainly, and establishes the existence, up to that point, of at least five workable seams of coal above the Conglomerate sandstone and above the drainage level of the country. These coals are thick and admirably situated for cheap mining, and are of excellent quality, as the following analyses, by the Chemists of the Survey, from samples carefully averaged by officers of the Geological

\* See page 116, Vol. IV (new series), Kentucky Geological Reports.

Survey, will show, though these samples were, for the most part, taken from imperfect openings near the outcrop, thus showing the coal at a disadvantage :

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Specific gravity . . . . .	1.300	1.294	1.297	1.290	1.289
Moisture . . . . .	2.50	3.50	3.56	2.76	2.10
Volatile combustible matter . . . . .	41.10	35.20	33.59	36.60	36.20
Fixed carbon . . . . .	49.22	56.70	58.38	56.50	58.20
Ash . . . . .	7.18	4.60	4.50	4.06	3.50
Coke . . . . .	56.40	61.30	62.88	60.56	61.70
Sulphur . . . . .	0.818	1.189	1.381	0.865	0.836

- No. 1. Coal from Frozen creek, Breathitt county.
- No. 2. Coal, 5 feet 7 inches thick, from Devil creek, Wolfe county.
- No. 3. Spencer's coal, Breathitt county, 4 feet thick.
- No. 4. Coal, 6 feet to 7 feet thick, Wolfe creek, Breathitt county.
- No. 5. Coal from near Hazard, Perry county, over 5 feet thick.

	No. 6.	No. 7.
Specific gravity . . . . .	1.289	1.274
Moisture . . . . .	2.10	1.80
Volatile combustible matter . . . . .	36.20	40.90
Fixed carbon . . . . .	58.20	53.70
Ash . . . . .	3.50	3.60
Coke . . . . .	61.70	57.30
Sulphur . . . . .	0.836	1.339

- No. 6. "Cobb's" coal, near Hazard, Perry county.
- No. 7. Grigsby's Bank, Lot's Creek, Perry county, coal above the Cannel coal.

The above analyses of some of the bituminous coals of this valley show what a variety of excellent coals can be depended upon. The sample of No. 5 was taken from a pile of coal at the mouth of the mine which had been exposed to the weather for over twelve months. From the appearance of this coal, after so long exposure, and its freedom from slack, it is evident that it will stand long shipment, handling, and yarding. The detailed survey of this region will doubtless bring to knowledge the existence of other valuable coals.

In addition to the above-mentioned bituminous coals, the Valley of the Upper Kentucky abounds in cannel coal of great value. The



demand for cannel coal for the purposes of enriching gas is large and increasing, and the supply convenient to existing transportation is nearly exhausted. In addition to this, there is an increasing demand for this coal for open fires. One great objection to cannel coal for this purpose is its manner of "popping" when first placed on the fire. The Kentucky river cannel coal is remarkably free from this objection.

The following are analyses of some of the cannel coals from this region, from averaged samples taken by officers of the Survey, and analyzed by the Chemists of the Survey:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Specific gravity . . . . .	1.280	1.265	1.219	1.180	1.290	1.280
Moisture . . . . .	0.94	1.30	0.30	1.20	1.20	3.40
Volatile combustible matter . .	52.38	47.00	56.70	58.80	40.86	43.40
Fixed carbon . . . . .	35.54	44.40	38.10	35.30	48.44	46.96
Ash . . . . .	11.14	7.30	4.90	4.70	9.50	6.24
Coke . . . . .	46.68	51.70	43.00	40.00	57.94	53.20
Sulphur . . . . .	1.423	1.574	1.513	not est.	0.634	0.634

No. 1. George's Branch cannel coal, Breathitt county.

No. 2. Haddock cannel coal, mouth of Troublesome creek, Breathitt county.

No. 3. Cannel coal, near Jackson, Breathitt county.

No. 4. Frozen Creek cannel coal, Breathitt county.

No. 5. Lot's Creek cannel coal, Perry county.

No. 6. Roberts' bank, Troublesome creek.

The value of these coals is best shown by comparison with the following analyses of well known cannel coals. These represent four of the best gas coals of Great Britain: No. 1, Lesmahago cannel; No. 2, Ramsay's Newcastle cannel; No. 3, Weyms' cannel coal; No. 4, Boghead cannel; and No. 5, the cannel coal from Kanawha, West Virginia:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Specific gravity . . . . .	1.228	1.29	1.183	. . . . .	1.27
Volatile matter* . . . . .	49.6	36.8	58.52	70.10	43.37
Fixed carbon . . . . .	41.3	56.6	25.28	10.30	46.50
Ash . . . . .	9.1	6.6	14.25	19.60	10.13

\* Including moisture. Sulphur not determined.

There are no cannel coals superior to those of the Kentucky Valley, and on the line of the proposed road—the beds are thick; above drainage, and the coal can be cheaply mined. The very high price for a superior article of cannel will justify long shipments of these coals by rail; and if there were nothing else to be shipped from that region, I believe the freights to be had by the shipment of this coal would alone justify the building of a railway to reach it.

The dip of the rocks is continued until Pine Mountain is reached, and consequently the coal-measures thicken, and the number of coals increases to the southeast.

Little search has been made for ores, but the numerous fragments found along the streams indicate the existence of iron ores of good quality in this portion of the eastern coal-field. The iron ores will be discussed more at length further on, when enumerating the resources of the Valley of the Upper Cumberland river.

#### TIMBERS.

The timber resources of this valley are very great—unsurpassed by any part of the State, unless it be the Upper Cumberland. Mr. L. H. DeFriese has made a careful study of the timbers along this valley to the Virginia line. The following extracts from his report\* will show the value of the timbers of the country between the Middle and North Fork. He says:

“The forests of white oak are as fine along the rich hill-sides as I ever saw. Hickories are splendid also; and walnut, yellow poplar, chestnut, and linden are unsurpassed along all the ravines whose waters head in the rich woods below the brows of the high hills. The tops of the hills are crowned with black oak, scarlet oak, chestnut oak, rock maple, scrub hickories, and pines. \* \* \* \* \* A considerable amount of fine old forest walnut, black birch, and cherry still stands in these fastnesses, and gigantic yellow poplar, white oaks, ashes, lindens, locusts, chestnuts, elms, buckeyes, magnolias, and maples have so far bid defiance to the axe that has laid waste these timbers in other parts of the State. \* \* \* \* \* A list of timbers noted in the Troublesome creek region includes white, black, and pig hickory, white oak, holly, black and blue ash, black walnut, yellow poplar, chestnut, black gum, black and grey birch, winged elm, white, rock, black, and mountain maple, redbud, mulberry, chestnut oak, beeches, black cherry, big buckeye, black locust, linden, water beech, cucumber and umbrella trees, chestnut oak, sycamore, bartram oak, pines, cedar, hemlock, elm

\* Part X, Vol. V (second series), Kentucky Geological Reports.

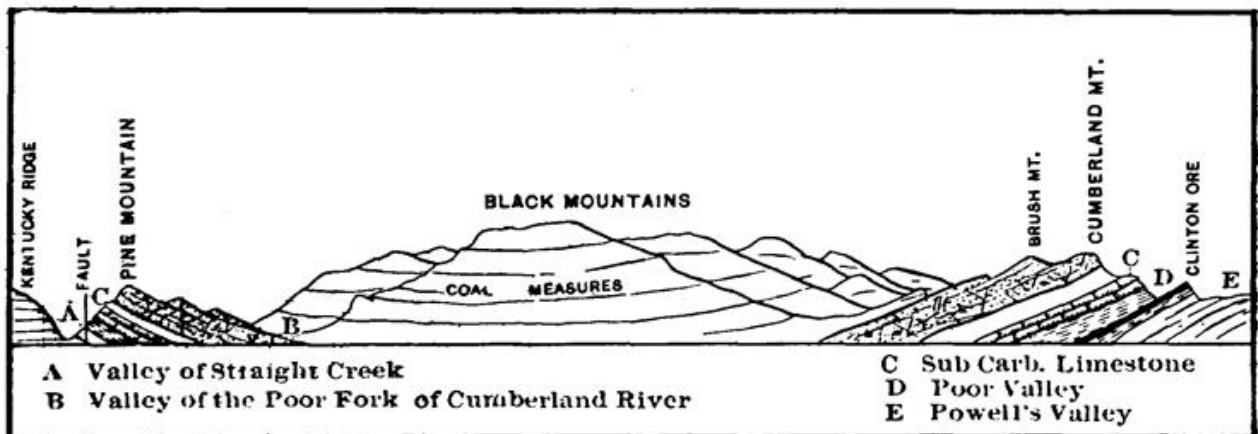
(*racemosa*), dogwood, &c. \* \* \* \* *The great variety, and the richness in valuable timbers, of these forests, I think, can scarcely be surpassed.*"

This richness in valuable timbers is continued to the Virginia line.

### VALLEY OF THE UPPER CUMBERLAND RIVER.

The proposed line, after passing Pine Mountain, if it were designed to connect with the system of roads to be described hereafter, will pass through Big Stone Gap or Pennington Gap, in the Cumberland Mountain. The following section across the Valley of the Upper Cumberland will explain the geology of this region.\*

It will be seen from the accompanying cross-section that the region to be described—lying between the Pine Mountain on the west and the Cumberland on the east—which latter forms the eastern boundary of the coal-field—is composed of Carboniferous rocks of great thickness, resting in a broad synclinal valley. The valleys of the region through which this road would pass have an elevation above the sea of from 1,150 to 1,500 feet, and the mountains an elevation of from 2,000 to 3,500 feet. The slopes of these mountains are gentle, often not too steep for cultivation, and there are on the tops of the mountains broad, fertile plateaus, whilst the valleys are generally level, and afford excellent farming lands.



The soils of this region are superior to any coal-measure soils with which I am acquainted. Dr. David Dale Owen, Director of the first Geological Survey, says of this region: "The richness of the soil on the slopes, and even on the summit, is a matter of surprise, supporting a heavy growth of a walnut, cherry, oak, poplar, locust, and chestnut."

Mr. L. H. DeFreise, in his report on the forests of the North Cumberland, after describing the depth of soil on the slopes of the moun-

\* The description of the resources of this valley is mainly taken from the 'Report on the Resources of the North Cumberland Valley,' by John R. Procter, recently published.

tains, 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."

The following brief extracts from the above mentioned report show the great value of the timbers of this region: "About 500 feet below the crest of the mountains I found a remarkable belt of the *finest old forest walnut timber I have ever seen.* \* \* \* This walnut-bearing belt winds along the mountain as far as I had time to trace it. \* \* \* On the northern exposure, on the contrary, about thirty-five per cent. of the timber was massive yellow poplar, many of the 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 for cabinet work, also abounds."

Of another section made across these mountains 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 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.*"

Excepting on the cleared farms in the valleys, the timbers of this section remain almost untouched. The difficulty of running logs and rafts over the great falls of the Cumberland and the shoals below is a reason for the preservation of this timber.

### 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 to the discovery of coal-beds, but enough has been done to establish the existence of many beds of workable thickness and of very superior quality.

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\* Part IX, Vol. IV (new series), Kentucky Geological Survey.

In a report on the reconnoissance in the Upper Cumberland section, 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 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, except one cannel coal, and the fixed carbon is high."

The following are analyses of some of these coals, sampled by officers of the Geological Survey, so as to represent the entire thickness of the bed. It must be borne in mind that the samples were taken from imperfect openings near the outcrop, and cannot represent the coal at its best:

	No. 1.	No. 2.	No. 3.	No. 4.
Moisture . . . . .	1.70	1.20	1.90	1.00
Volatile combustible matter. . . . .	35.70	31.26	37.50	43.60
Fixed carbon . . . . .	59.60	60.08	52.90	47.80
Ash . . . . .	3.00	3.46	2.70	7.60
Coke . . . . .	62.60	65.54	60.60	55.60
Sulphur. . . . .	0.750	0.618	1.519	0.590

No. 1. Clover Fork coal, Harlan county, fifty-four inches thick.

No. 2. Skidmore Bank, Martin's Fork.

No. 3. Straight Creek coal.

No. 4. Cannel coal, Fork Ridge.

Dr. Robert Peter, Chemist of the Geological Survey, says that these coals "yield less than the average quantity of ash, and give a large proportion of coke, and are superior coals, especially for the manufacture of iron." Some of these coals will make excellent coke, whilst others could be used to smelt iron without the preliminary process of coking.†

The line between Kentucky and Virginia leaves the Cumberland Mountain about forty miles east from Cumberland Gap, and traverses one of the ridges of the Black Mountains, the divide between the waters of the Upper Cumberland and Powell's river, until near Pound Gap, where the line follows Pine Mountain.

Thus there is an area of coal-measures in Southwest Virginia. A portion of this area was explored by Prof. J. P. Lesley in 1871, and his report attests the value of the coals of that section. Speaking of the

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

† See Chemical Report, pages 26 and 85, Vol. IV (new series), Kentucky Geological Survey.

six-foot bed, he says : \* " At one place, where the bed has 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." The North Fork of Powell's river cuts through the Cumberland or Big Stone Mountain, at Pennington's Gap, and the Roaring Fork at Big Stone Gap, thus giving easy access to the coals of the Black Mountains from the southeast.

Prof. John J. Stevenson, Professor of Geology in the University of the City of New York, has recently made explorations behind Big Stone Gap, and reports coal of great thickness and of superior quality. These 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 considerable less than *three per cent. of ash*, and with 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 of sulphur is about eight tenths of a per cent."

I have a sample of coke made from this coal which is excellent, and of great strength.

It will thus be seen that the entire route of the proposed line from a few miles southeast of Winchester, Kentucky, to a few miles beyond the Virginia line, will be in a region abounding in coals of great excellence—probably of greater variety and excellence than is traversed by any other railway in America.

For the purpose of comparison, I give below analyses of the *best* coals from neighboring States. These coals were sampled by officers of the Kentucky Survey in the same manner as were the Kentucky coals above mentioned, 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 of Illinois, and three of the celebrated 'block coals' of Indiana, used there for iron smelting, were sub-

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

† Page 146, Vol. I (new series), Kentucky Geological Reports.

mitted to similar processes of analyses with our Kentucky coals. We give results as follows: "

States.	No. analyzed.	Volatile com. matter.	Fixed carbon in coke.	Per cent. of ash.	Per cent. of sulphur.
Ohio. . . . .	7	34.59	55.17	6.43	1.494
Indiana. . . . .	2	31.95	59.06	5.96	1.924
Illinois. . . . .	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 nor so pure as can be had near the coals of the Upper Cumberland and Kentucky river valleys, are carried hundreds of miles to be smelted by the above coals in the three neighboring States.

### IRON ORES.

The position of the rocks and the relation of the Clinton Group, in which this ore is situated, known as "Clinton," "Dyestone," and "Fossil ore," is shown in the section on page 10. This Clinton ore extends irregularly along the eastern escarpment of the Alleghenies from Canada to Alabama. It is the principal source for local supply for the furnaces of Pennsylvania and the furnaces of Middle Tennessee and Eastern Alabama. This ore is persistent and of good workable thickness along the entire eastern edge of the coal-field under consideration. At Pennington's Gap it is thirty-five inches thick, and at or near Big Stone Gap the several beds range in thickness from twenty-five inches to seven feet two inches.\* The quantity along the eastern outcrop of this coal is unlimited.

In quality, analyses show it to be superior to the same class of ores in Pennsylvania and Alabama. The following are analyses of some of the ores convenient to coal:

	No. 1.	No. 2.	No. 3.	No. 4.
Metallic iron. . . . .	52.600	52.556	54.166	51.750
Sulphur. . . . .	0.018	0.037	trace.	trace.
Phosphorus. . . . .	0.116	0.051	.140	.140
Insoluble residue. . . . .	18.140	7.840	15.960	11.730

No. 1 Clinton ore, and No. 2, a brown hematite from near Big Stone Gap. Analyzed by Mr. McCreath. Other analyses by Dr. Robert Peter.

\* Report of Prof. J. J. Stevenson, page 13.

For purposes of comparison, the reader is referred to the analyses of Clinton ores of 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 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 and Southeast Virginia 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 upon by this region:

There are strong reasons for believing that the Clinton ore is to be had by drifting at the base of Pine Mountain, thus giving a supply of this ore through the southeastern part of the coal-field.\* In addition to these, search will undoubtedly bring to light the existence of a number of carbonate iron ores in the Cumberland Valley.

In no region of America can iron be manufactured cheaper than in this valley. A discussion of the advantages as an iron-making centre would be incomplete without reference to the very rich and pure ores of East Tennessee, Southwest Virginia, and Western North Carolina. I believe 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 were, for the year ending December 31, 1879, 284,141 tons. It is estimated that the furnaces of Western Pennsylvania will this year draw 500,000 tons 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 of the Appalachian coal-field, as was also the bulk of the product from the Iron Mountain, Missouri. The production of steel and steel-making ores in this country is not sufficient for the large and increasing demands, and the importation 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 scope of this report will permit only a 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 the same ore in Carter county,

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\* The reasons for this supposition are given on page 24, Part IV, Vol. VI, Kentucky Geological Survey.



Tennessee. Prof. W. C. Kerr, State Geologist of North Carolina, says 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 this ore will be seen by 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
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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 titanitic 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.*"

This same quality of ore is abundant near the State line in Carter county, Tennessee.

In Rutherford and Guilford counties, North Carolina, is another remarkable iron ore deposit. Prof. J. P. Lesley, in summing up the results of his investigations of this ore belt, says†: "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 puddler's linings; will be in demand for mixing with poorer ores of other regions in the blast furnace, to increase the quantity and quality of their pig metal, and will have an especial value for the Siemens and Bressemer processes and the steel manufacturers generally. The quantity of ore is limitless." In Chatham and Orange counties is another remarkable deposit of iron

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

† The Tuscarora Iron Ore Belt. North Carolina: Philadelphia, 1871.

ores. The Chapel Hill ore, a dense steel grey hematite, specular in part, slightly magnetic, is from seven to thirty feet thick, has 65.77 per cent. of metallic iron, with 2.63 silica, 1.68 per cent. 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 mines" of Lake Superior region.

Nearly all of the magnetic and specular ores of the United States are smelted by furnaces in the Appalachian 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 rail from the Marquette iron region to Connellsville to be 869 miles; from Iron Mountain, Missouri, 765 miles; and from the Champlain region 860 miles. From the celebrated Cranberry ores of North Carolina to the coals of Southeastern Kentucky, by an available railway route, it is less than 100 miles.

Realizing the importance to Kentucky of a railway crossing the Appalachian 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 resources, and products from the eastern slope of the Blue Ridge to the coal-field of Eastern Kentucky, the writer has taken a deep interest in the railway developments progressing in North and South Carolina, East Tennessee, and Southwest Virginia, and was partially instrumental in bringing the parties interested in perfecting a system of narrow-gauge roads in those 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 there is every assurance of the completion of a thorough system of narrow-gauge railways from the Kentucky coal-fields to the Atlantic sea-board.

The projected narrow-gauge road from Big Stone Gap, near the Kentucky line, to Bristol, Tennessee, the present terminus of the East Tennessee, Virginia, and Georgia Railway, and the Atlantic, Mississippi, and Ohio Railway, has been put under contract, to be completed by September, 1881. The company interested in this road will erect a large iron furnace at Big Stone Gap. The road, narrow-gauge, from Johnson's City, on the East Tennessee, Virginia, and Georgia Railroad, twenty-three miles west from 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, South Carolina, to the Catawba river, north of Dal-

las, North Carolina, and is graded to Lenoir and work will be pushed north towards the Cranberry ore. A narrow gauge road is completed east from Chester, South Carolina, to Lancaster, and it is believed that the road from Lancaster through Sumpter, South Carolina, to the seaport at Georgetown, will soon be under contract and pushed to completion. A narrow-gauge, the Cape Fear and Yadkin Valley, is under construction from Fayetteville, through Greensboro, North Carolina, and will unite on the Blue Ridge plateau with the Chester and Lenoir, and use a common track, uniting at Cranberry ore bed with the road to Johnson's City, and probably make a shorter 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 Southeast for these coals. A glance at the accompanying railway map will show the importance of this system.

It is not unreasonable to suppose that all of the furnaces in the Ohio Valley will use ore from North Carolina when the proposed system connecting the Ohio river with these ores is completed. These ores could then be delivered on returning coal barges, so that the ore could be carried to Pittsburg at less cost than the Iron Mountain and Lake Superior ores, certainly at less cost than the 500,000 tons per annum from Spain and Algeria.

The accompanying map will also show the narrow-gauge system soon to be completed north of the Ohio. The advantages of the proposed line connecting these two systems, making the shortest possible road between the northwest and the region described above, is too apparent to require discussion, nor is it necessary to dwell upon the advantages to be derived by the cities and counties in Kentucky through which this line will pass.

I have dwelt briefly upon some of the most important resources along the line of this road. There are others which, with the development following the construction of such a road, may assume equal importance with those mentioned. Salt brine is found by boring in Perry, Breathitt, and Letcher counties, along the line of this road, and with transportation large developments of that industry will follow. I believe it is an established fact that the petroleum of this country is derived either directly or indirectly from the Devonian black shale. It will be seen by reference to the section on tenth page that this shale, which is quite thick along the eastern base of the Cumberland Mountain and the western base of Pine Mountain, is below the drainage in the valley of the Upper Cumberland, and the position of the rocks,

with the superincumbent weight of the mountains, is most favorable for the production of flowing wells. This shale is also quite thick—about 150 feet where this road will cross it before entering the coal-field in Central Kentucky—and dips under the coal-measure rocks to the southeast. The shale from that section has been analyzed, and found to contain from 15 to 20 per cent. of petroleum, which, in a thickness of 150 feet, would be equal to from 20 to 30 feet of oil under that region. The timber resources will bring immediate returns to this road. The large and increasing demands for timber in the region north and northwest of Kentucky will soon use all of the available timbers of that section. In addition to the home demands, the exports of timber are largely on the increase. The pine forests around the head waters of the Ohio are nearly exhausted. Dr. George B. Emerson, who has given the subject of our forest resources much study, stated a few years since that in twelve years the forests in the lake region of the northwest—the present source of supply for the Ohio Valley—would be all gone. It was then estimated that the mills in the three States of Minnesota, Wisconsin, and Michigan depleted the forests at the rate of 1,380 square miles per annum, and the demands upon that region are larger now than then. It is evident that a large area must obtain supplies of timber for the future from the region to be penetrated by the proposed railway, and the fine quality and large supply of timber will insure a heavy freightage.

In the first part of this report reference has been made to the freightage of bituminous coal to Central Kentucky, Cincinnati, and Louisville. The cannel coals from this region will find a profitable market in the entire Ohio Valley and in the Atlantic cities. Coke will be carried over the road to supply demands in the North and West. Connellsville coke is now carried to Colorado. Not only will there be a large freightage of the high grade ores referred to above, to supply the furnaces of the Ohio Valley, but the new mills and furnaces brought into existence by the completion of this road will insure a large freightage of manufactured iron. From Kentucky and the Northwest will be sent over this line to the Southeast, grain, live stock, breadstuffs, manufactured articles, and merchandise. From the cotton States will return cotton, rice, pine and hemlock timber, tropical fruits, &c. From North Carolina, in addition to the iron ores, will come copper, felspar, mica, corundum, &c. From Southwest Virginia, salt and gypsum, and from South Carolina, phosphates—all wanted at the North. In short, the proposed line possesses a combination of advantages unexcelled by any road in this coun-

try. It will be the great mineral road of the country. No other road can command such an area of excellent timber. The beauty of scenery and salubrity of climate is unexcelled, and the conditions are most favorable for a dense population. The completion of a direct line connecting the Northwest and Southeastern States through this great coal-field is demanded. A glance at the map will show that this line will give the shortest available route from Central Kentucky, and a large area to the Northwest, with all of the Atlantic ports from Norfolk to Savannah. I have not deemed it necessary to dwell upon the resources and the sources of profit to this road between Paris and Frankfort, for the reason that these must be apparent to persons along the line of the road, and it will be possible to publish statistics of freight shipments from the counties through which this part of the road will pass, and show the large increase in manufactures, and consequent freighting during the past few years, to convince any one unacquainted with the region.

JOHN R. PROCTER, *State Geologist.*

MAP OF THE  
**Paris, Georgetown & Frankfort**  
RAILWAY,

And Connections.

