GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

NOTES ON THE

COAL AND IRON ORES

OF

WESTERN KENTUCKY.

BY WM. B. CALDWELL, JR.,

METALLURGIST OF THE KENTUCKY GEOLOGICAL SURVEY.

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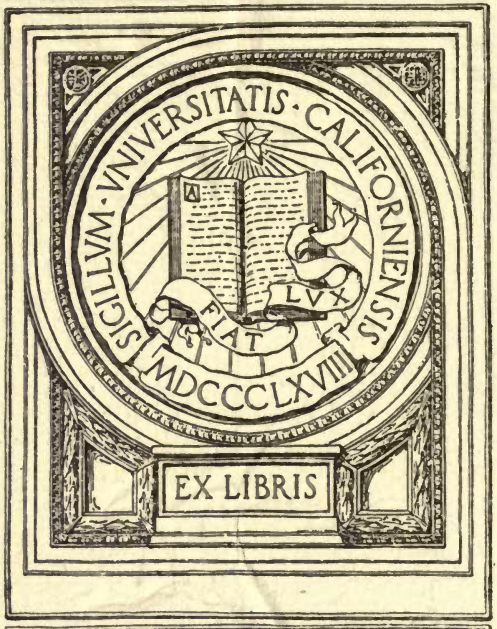
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IRON ORES AND COALS—ADVANTAGES OF WESTERN KENTUCKY FOR THE MANUFACTURE OF IRON.

BY W. B. CALDWELL, JR.

[From the Courier-Journal, March 9, 1878.]

"The Report of W. B. Caldwell, Jr., Metallurgist of the Kentucky Geological Survey, will be found elsewhere in this issue. We bespeak for this exceedingly valuable paper a very attentive perusal. It furnishes an exhibit of some of our most important resources (coal and iron), which, coming from the source it does, can not fail to attract attention abroad. It is a document which should be printed in pamphlet form and scattered far and wide, in the United States and Europe. Mr. Caldwell is a thoroughly accomplished and experienced metallurgist, his theoretical knowledge having been acquired at the great schools of science and art in Berlin, and his practical knowledge having been obtained in the iron-works of Silesia. He has been engaged by the Chattanooga Steel and Iron Works as the chemist of the establishment, and he will make his headquarters there upon the completion of the steel furnace of the company. This change will not, however, deprive the Geological Survey of Kentucky of Mr. Caldwell's valuable services. In the Northwestern States they trumpet throughout the world their great resources in wheat-producing lands, and keep them ever before the public by means of pamphlets, newspapers, and circulars. We have in Kentucky more durable and valuable resources than those States, and they can only be developed by letting the world know what they are. Our coal and iron region is immense and exhaustless. The facilities for working it are remarkable. We have only to force the facts relating to their abundance upon the attention of capitalists, and our State will be put forward half a century in progress."

Professor N. S. SHALER,

Director of Kentucky Geological Survey:

DEAR SIR: I desire to submit the following preliminary report upon the iron ores and coals of Western Kentucky, in regard to their value, more especially for the production of iron. My aim has been to bring into notice what must be an exceedingly important iron district, when once the industry is started. The previously published reports of the Survey have been of the greatest service in preparing this paper, and my thanks are due the writers; but I must especially acknowledge the kindness of Mr. Jno. R. Procter for valuable information and assistance.

Respectfully,

W. B. CALDWELL, JR., *Metallurgist.*

In view of the fact that iron is down to a point at which furnaces, running with the brightest prospects five years since, can no longer clear expenses, and that capital and skill interested in the industry have been looking for new localities, where the main point may be secured, viz: a profit, however small, I wish to call attention to a deposit of coal and iron undeveloped, and, indeed unknown, except in so far as it has already been brought to notice by the Reports of the Kentucky Geological Survey. These Reports have been the result of careful study of the region by the Survey officers, especially Mr. P. N. Moore, Mr. C. J. Norwood, and J. R. Procter, who have located the ores and coals, and sent samples to the chemists, Dr. Robert Peter and Mr. J. H. Talbutt, the result of the investigations being undoubted evidence that the State of Kentucky possesses, in her western iron and coal field, an amount of undeveloped wealth of too great importance to be overlooked. There remains, however, much work to be done in Western as well as in the rich coal and iron regions of Eastern and Southeastern Kentucky, and just at this time it is of especial importance; for these districts should be brought to the notice of capital seeking such investment. A few thousand dollars spent by the State in proving her wealth and advantages, is insignificant in comparison with the hundreds of

thousands which should come from the East to develop the iron and coal.

After giving a short account of the coals and ores, which are fully described, with analyses, in the Survey Reports, I will consider two or three points in the Western coal field, possessing unusual advantages for the iron industry; but there are others which may be found to possess as great or greater.

It will be acknowledged by all that the following are the essential points for the production of cheap iron: a good coking coal, which can be cheaply mined and handled; abundant supply of iron ore, sufficiently rich and pure, lying contiguous to the coal, or which can be brought to it at very low rates; pure limestone; cheap labor of a good class; abundant water supply; and low freight to a good and near iron market. These advantages are possessed, to an unusual degree, by Western Kentucky, as the following facts and figures will show, and comparison with some other localities claiming to be the cheapest iron regions in the world.

COALS.

An outline description of the coal field is given by Mr. Norwood in the Survey Reports, with numerous analyses by Dr. Peter and Mr. Talbutt; but our Survey officers have been, in many cases, strict in taking samples; for in many of the coal veins the sulphur occurs (as pyrites) in heavy partings, and would be thrown out in mining; whereas, they have taken the entire vein as it comes, thus making the percentage of sulphur strictly correct as it lies in the bed, but higher than it would be in the coal with ordinarily good mining. For this reason the analyses show more sulphur than is given by other Geological Survey analyses of similar coals, which, when sampled by the same person who sampled Kentucky coals, showed as much sulphur.

The Kentucky coals give an excellent coke, bright and firm, and even those highest sulphur would give, when washed, as good coke as the celebrated Connellsville. Coal washing is now so generally practiced, and can be done so cheaply—less than ten cents per ton—washing three or four hundred tons per day,

that it will certainly be done in Western Kentucky, and the coke will then be unexcelled.

The Western coal field embraces about 4,000 square miles, and contains twelve veins, mostly workable, some at one part of the basin, others at another. Perhaps it would give a better idea of the extent of the coal field to say that it takes in nine counties entirely, and parts of five others. The coal can be mined along the railroads by shallow shafting, striking Nos. 11 and 9; but at a short distance from the road the hills allow drifting, as at the Crabtree, Paradise, and many other mines.

The industry is growing rapidly, and the city of Louisville already uses large quantities of this coal, thus keeping in the State thousands of dollars which would go to Pennsylvania; but, what is vastly more important, the price of coal is kept at a low figure, enabling our manufactories to live, and the mines employ hundreds of men, to whom at least half a million dollars yearly are paid out.

The old Reports by D. D. Owen used numbers to designate the veins, beginning with the lowest in the series; but the new Reports, by Professor N. S. Shaler, begin at the highest coal, and use letters; thus Coal *A*, of the new Reports, corresponds to No. 12 of the old series.

The most important of the upper coals, so far as experience would indicate, are A, B, and D, or, by Owen's numbering, 12, 11, and 9.

Of these, No. 12, or A, the highest workable coal in the series, was worked by Mr. Alexander at Paradise, on Green river, twenty years ago, but is not mined now. It is a bright, hard, bituminous coal, which gives an excellent coke. A sample of coke made at Airdrie Furnace twenty years ago, and exposed to the weather ever since (see Mr. P. N. Moore's Report of Airdrie Furnace Property, vol. 2, new series), gave the following analysis:

	Per cent.
Moisture at 212°	7.50
Moisture at redness	4.20
Fixed carbon	82 90
Ash	5.40
	100.00
Sulphur	0.64

This is probably as pure as any coal in the basin, and compares favorably with any soft coal in the country. A sample taken, as usual, the entire thickness of the vein, including everything, gave—

	Per cent.
Moisture	4.15
Volatile combustible matter	33.14
Fixed carbon	55.71
Ash	7.00
	100.00
Sulphur	1.87

The vein can be mined at Airdrie by drifting.

Next below this coal comes B, or No. 11, a very persistent vein, six feet thick; a good, bright coal, but containing slightly more sulphur than No. 12. It is the coal mined by Gen. Buell at Airdrie, on Green river, and also by several companies along the railroads.

An average of samples, taken the entire thickness of the vein at Paradise, gave—

	Per cent.
Moisture	2.25
Volatile combustible matter	41.54
Fixed carbon	50.62
Ash	5.64
Sulphur	2.98

A lot of slack from St. Bernard mines, Earlington, Kentucky, No. 11 coal, washed and coked, gave a good, bright coke, with 1.06 per cent. sulphur, showing that even the refuse, when washed, makes a good coke.

The next coal of importance is D, or No. 9. This is probably the most persistent and uniform coal of the series; is from four to six feet thick, averaging five feet, but contains more sulphur than 12 or 11. It is, however, an excellent coal for grate and furnace, and gives a good coke. A lot of slack from this vein, from St. Bernard mines, Earlington, Kentucky, washed and coked, gave a bright, firm coke, with only 1 per cent. sulphur. In some places coals 8 and 7, or E and F, are from four to five feet thick, and of unusually good quality; but, generally speaking, the coals below 9 are not important in regard to the subject of this paper, until we come down to L (or No. 1 B, of

Owen), a hard, bright coal, resembling somewhat the Indiana "block coal" in appearance, and giving a very similar analysis:

Coaltown Bank, Christian county, gave—

	Per cent.
Moisture	4.85
Volatile combustible matter	32.22
Fixed carbon	55.03
Ash	7.90
	100.00
Sulphur	1.37

Sample of Indiana block coal gave—

	Per cent.
Moisture	2.68
Volatile combustible matter	36 32
Fixed carbon	53.58
Ash	7.42
	100.00
Sulphur	1.80

Sample from Edmonson county—

	Per cent.
Moisture	4.06
Volatile combustible matter	33.24
Fixed carbon	51.70
Ash	11 06
Sulphur	1.67

With an unlimited supply of coal of excellent quality for iron-making, and as cheaply mined and handled as this may be, with transportation facilities by rail and river unequaled by any iron region, it only requires, to prove the existence of abundant supplies of iron ore of sufficient richness and purity, to show that this must inevitably be a great iron-producing region in the future; for its nearness to several markets, especially Louisville, gives it great advantages over more distant points, where iron might even be made at a lower figure.

IRON ORES.

The ores are exceedingly numerous and varied in character, from material almost too lean to be called ore, up to rich, pure, brown hematites or limonites.

They may be divided into two clas es:

First. Coal-measure ores, which occur in the coal-bearing

formations, either stratified with them, and having great extent, or confined to one locality as local deposits or pockets.

Second. Limestone ores, occurring below the coal, in the limestone of the Sub-carboniferous, as in Caldwell, Lyon, and Trigg counties, along the Cumberland river, where a very pure, rich, brown hematite occurs in the form of pot-ore. A brown hematite ore of good quality occurs in the Chester Group in Edmonson county.

COAL-MEASURE ORES.

The coal-measure ores are so numerous that it would be useless to attempt a full description of them here (as they are fully described in the Survey Reports), so I will only describe a few prominent ones, stating, however, that those mentioned are not necessarily the best, but they happen to be convenient for transportation to points which will be mentioned later as good locations for furnaces.

These ores occur principally in Muhlenberg and Edmonson counties.

In Edmonson, between the Nolin river and Bear creek, a ridge about fifteen miles long and five miles wide, carries several beds of good ore, altered carbonates probably, which appear as limonites on the outcrop, but may run into carbonates when sufficiently under cover. There was a charcoal furnace in this locality formerly, and samples from two of their old mines or banks show the good quality of the ore:

	First per cent.	Second per cent.
Metallic iron	40.48	36.50
Water	12.18	8.90
Silica	14.36	17.82
Phosphorus	0.41	0.21
Roasted ore gives metallic iron	46.10	40.00

An excellent ore, occurring between two branches of Sycamore creek, in the same locality, but a limited deposit, gives—

	Per cent.
Metallic iron	53.40
Silica	7.66
Phosphorus	0.46

A bed of ore, called "Federic Bank," is very similar to first and second old Nolin Furnace banks, in composition and character, except that it is much higher in silica, on the outcrop at least:

	Per cent.
Metallic iron	42.31
Silica	22.40
Water	10.29
Lime	1.21
Alumina	4 83
Phosphorus	0.28

This being over three feet in thickness, could be mined very cheaply, and is only a short distance from water.

In Muhlenberg county there are many ores of excellent quality, accessible by rail or river, and easily mined.

On the farm of J. M. Hope, on Mud river, is an outcrop several feet in thickness, running through a ridge and cropping out on the other side, about a mile distant. Leaving out the upper two or three feet of the bed, which is most silicious, the other part, some four or five feet thick, gives—

	Per cent.
Metallic iron	45.10
Alumina	6.98
Water	12.31
Silica	14 20
Phosphorus	0.39

This is probably the same ore as the Federic Bank, Edmonson county, and the indications are that this ore extends over a very wide area, cropping out wherever its geological position would bring it to the surface.

Near Greenville, about three miles from the Elizabethtown and Paducah Railroad, is a deposit some eight inches thick of an excellent ore, which could be easily mined for $1.25 per ton, as it would have to be done by stripping. Most of the ores in the celebrated Hocking Valley, Ohio, region are mined in that way at that price; indeed, few ores in that region are of greater thickness, and scarcely any of them so good as this ore near Greenville, which gives—

	Per cent.
Metallic iron	48.88
Alumina	3.91
Water	11,25
Insoluble	12.73

Over No. 12 coal occurs an ore called Blackbank, about 12 inches thick, which is a slightly bituminous carbonate, giving a limonite on the outcrop. A sample taken from the bed (analysis 1) and a sample from roasted stock-pile, at Airdrie Furnace, weathered twenty years (analysis 2), gave as follows:

	First per cent.	Second per cent.
Metallic iron	44.13	43.12
Alumina	5.29	3.10
Water	12.43	. . . . .
Insoluble	17.25	25.40
Lime	. . . . .	3.01
Magnesia	. . . . .	4.58
Phosphorus	. . . . .	0 23

There are very many other coal-measure ores which are valuable and accessible; but enough has been mentioned to show their number and good quality. Silica is rather high, but they fortunately carry considerable alumina and lime.

The Cumberland river or limestone ore is the most valuable and important in the region, as there is an inexhaustible supply accessible by rail and river, and the quality such as to have already given it a high reputation. The amount of phosphorus varies from 0.065 per cent. up to 0.19 per cent., the variation apparently not dependent on other impurities. The percentage of iron also varies somewhat, as some of the beds contain considerable chert; but this can be largely separated by careful mining, and give an ore with fifty per cent. metallic iron. The ore occurs as broken masses of "pot" and "kidney" mixed with chert rock, in immense beds or masses, and is mined by quarrying very cheaply. Such a deposit is cut by the railroad at Kuttawa, and a sample taken by Mr. Moore, an average of the bed, gave analysis (1). A sample taken by myself, of the ore as it would be mined, leaving out lumps of chert, gave analysis (2). Samples 3 and 4 were taken from an old bank used by the old furnace—3 taken by Moore, an average of bed; 4 by myself, showing ore as it should be mined; 5, analysis by Otto Wuth, of Pittsburg, of same ore from near Princeton, Caldwell county.

ELEMENTS.	PER CENT.				
	First.	Second.	Third.	Fourth.	Fifth.
Iron oxide	66.12	69.80	. . . . .	71 20	69.46
Alumina	1.06	2.98	. . . . .	3 01	3.75
Lime	. . . . .	2.12	. . . . .	2.87	4.16
Magnesia	. . . . .	1.72	. . . .	65	1.54
Water	9 80	10 83	. . . . .	9 83	10.98
Silica	22.33	11.98	18.91	12.10	8.97
Metallic iron	46.28	48 86	49.36	49 84	48.62
Phosphorus	0.18	0 09	0.12	0.09	0.07

In Trigg county, near the old Center Furnace, a sample taken from one of the old banks gave—

	Per cent.
Metallic iron	50.195
Water	9.630
Silica	16.960
Phosphorus	0.095

Several other analyses, made by myself for phosphorus, show that this *bete noir* of the iron industry varies in these ores from different parts of the bed, but no analysis gave over 0.2 of 1 per cent.

In regard to locations well adapted for furnace sites, there are many which promise well; but I will only consider two or three, the advantage of which can be easily shown.

One of the most prominent of these, Airdrie Furnace, on the bank of Green river, three miles above Rockport, the crossing of the E. and P. R. R., has been described by Mr. P. N. Moore in his report on Airdrie Furnace Property, vol. II, Kentucky Geological Reports. The furnace was built and properly improved by Mr. Alexander, twenty years ago, at great cost, and has been a serious injury to the region, as the enterprise was an utter failure. This was, however, owing to the ignorance and mismanagement of the superintendent, who attempted the use of raw coal with the silicious ore overlying No. 12 coal, and failure was almost inevitable on a hot blast. Having made one attempt and failed, the next step should have been to coke

the coal, and mix some better ore with his black band; but the furnace was blown in three times on raw coal and black band ore, and, after a total run of six weeks (in all, three campaigns), the proprietor closed the works. The iron made was silver-gray, with from 5 to 10 per cent. silicon, and about 0.40 per cent. phosphorus.

This would be an admirable starting point for the iron industry of the region, as it would require comparatively little capital to put the entire plant in running order. The improvements are: a stack (blast furnace) in good condition, of the following dimensions: height, fifty feet; diameter bosh, seventeen feet; open top, no down takes for gases; pipes, still in good condition, of old hot-blast stoves; four steam boilers, twenty-eight feet by forty inches; blowing engine, vertical, steam cylinder below, twenty inches in diameter, nine foot stroke; blast cylinder, six feet ten inches in diameter, nine-foot stroke, all in good condition in a good stone building; four hundred feet shaft, with engine for raising material, coal or ore, the shaft cutting through No. 9 and No. 5 coals—No. 9 being five feet thick, and No. 5 3½ feet—and said to strike a four-foot vein of ore, supposed to be same as Hope ore, of Edmonson county. The top of the furnace is on a level with the No. 11 coal, and No. 12 was brought, by a short tunnel, to the same mine entrance, the entry being within thirty yards of tunnel-head. To put the plant in running order, and make some modern improvements, should not cost over $40,000, if so much, and a company starting here could obtain the use of furnace plant and mineral rights on the most reasonable terms from General Buell.

They would start with the great advantage of having, already for use, roads, laborers' houses, etc.; mines, being worked, producing four or five thousand bushels of coal per day; a stock pile of several thousand bushels of coke and roasted ore, etc.

The situation on the river bank opens the entire Green River Valley to it, and the E. and P. R. R. crossing, only three miles distant, at Rockport, gives every facility for transportation.

Thus we see that the location has a great extent of ore-bearing country tributary to it, and, as the ores are very varied,

the furnace could receive any mixture desired. Of course, experience and the market demand would show whether it would be more profitable to use impure coke and cheaper, poorer ores, and produce a cheaper grade of iron, or to wash the coal before coking and select better ores, although more expensive, and produce a higher grade of iron. Certain ores are adapted for certain grades of pig metal, and it is generally a great mistake to attempt to use them for anything else; but it is a mistake which is only too frequently made.

As regards the cost per ton of iron which could be made at this point, running on several different mixtures, the following figures will show that profit can certainly be made. Assuming that No. 12 coal would be used, which would be best, unless No. 11 were washed, the coal and ten-inch carbonate ore above it could be mined together—say, coal 75 cents per ton as it comes, and ore the same price.

Three tons coal to two tons coke would make $1.12½ per ton; 25 cents per ton for coking, $1.37½ per ton; then, assuming the use of two tons coke, which is higher than it should be, the coke would cost $2.75 per ton of iron produced.

The carbonate ore should be roasted, which could be done for 25 cents per ton, with 75 cents for mining; this would make $1 per ton.

The J. M. Hope ore, Mud river, could be mined for seventy-five cents, as it would be the simplest mining possible, and a small lock and dam in Mud river would run slack-water to within a very short distance of the bank; the ore could then be taken by barges to Airdrie for seventy-five cents, handling again twenty-five cents, making cost per ton $1.75—say $2, to make it sure. Using a mixture, then, of one ton carbonate (or call it black band for distinction) and one and one half tons Hope ore, the cost per ton of iron would be—

Two tons coke	$2 75
One ton black band	1 00
One and one-half tons Hope ore	3 00
Three-quarters ton limestone	75
Labor and incidentals	3 00
Total	$10 50

To put this on the cars at Rockport at fifty cents per ton, and freight to Louisville, say $1.50, makes $12.50 at Louisville. The poorest mill iron would be profitable at this figure, whereas, the mixture used should give a very good grade of foundry or mill.

If this mixture did not work well, however, an expert furnace man would know what the trouble was, and would try other mixtures, of which he could have as many as desired from the Green River Valley, some costing less, others more, than the Hope ore.

The Cumberland river ores are only from fifty to sixty miles distant by rail, and the freight would not be over seventy-five cents per ton to Rockport; transfer to barges by chute and taken to furnace would cost about twenty-five cents, making $1; and, as they could be mined and put on the cars for $1.75 or $2, these ores would cost $3 at the furnace. They yield, at the lowest average, forty-six per cent. metallic iron, and, consequently, one and a half tons would suffice to mix with one ton black band ore; then two tons coke, $2.75; one ton black band, $1; one and a half tons Cumberland ore, $4.50; three-quarters of a ton limestone, seventy-five cents; labor and repairs, $3; cost at Louisville, $2; makes $14 per ton at Louisville for an iron which should bring a good price at Louisville.

Using all Cumberland river ore, an iron could be made low enough in phosphorus, if the ores were properly selected, to make such low grades of steel as are used for agricultural implements and many kinds of small articles. The cost per ton of such an iron would be: two tons Cumberland river ore, $6; two tons coke, $2.75; three-quarters of a ton of limestone, seventy-five cents; labor and repairs, etc., $3; freight to Louisville, $2; total, $14.50.

Three grades of iron have been mentioned, costing at Louisville $12.50, $14, and $14.50, respectively. Now, assuming that incidental expenses would run this cost up somewhat, as it invariably does—although I have tried to put it so that the estimates would be fair—suppose we add twenty per cent. to each figure; the iron would then cost at Louisville $15, $16.80, and $17.40.

These figures would insure a profit of at least $2 per ton, which very few furnaces in the United States can make to-day.

Assuming an output of thirty tons per day, this would give 10,900 tons per year, at $2 per ton; profit, $21,900 on an outlay of not over $50,000.

Referring to the Hocking Valley iron region of Ohio, described by Mr. Pechin in the Metallurgical Review for September, October, and November, the comparison with Western Kentucky is most favorable to the latter.

The iron world was apparently crazed in regard to this valley; for in a very short period—about three years—some ten or twelve furnaces have been built and projected, mines opened, etc., at enormous expense, and one need only read Mr. Pechin's article to see that they went too fast. In the first place, several of the furnaces were compelled to blow out during the past summer for lack of water for boilers and tuyeres, etc. The only real advantage which the valley has is an abundant supply of good coal, which is, however, no purer than that of Western Kentucky.

The ores are nearly all less than one foot thick, and analyses show them often very lean and quite high in phosphorus.

The two principal ores are the Baird and Shawnee, the Baird being only from six to fourteen inches thick, and varying very widely in quality in different localities—metallic iron from 30 to 45 per cent., silica running as high as 25 per cent., and phosphorus from 2 or 3-10 of 1 per cent. to 1 per cent. Shawnee is thicker but not better, and, as Mr. Pechin says, "its exhaustion by the four furnaces at Shawnee is a question of but few years." The cost of making iron in the Hocking Valley, at different points, as given by Mr. Pechin, is—

	Thomas Furnace.	Fannie Furnace.
Three tons coal, at 75 cents	$2 25	$2 25
Three tons ore, at $2 25	6 75	(at $2) 6 00
One ton limestone	1 25	($\frac{3}{4}$ ton) 60
Labor and repairs	4 00	4 00
Total	$14 25	$12 85

to which freight must be added.

The Baird Furnace, with coal at the furnace and ore only half a mile distant, finds the iron to "cost $13 on paper, but really nearer $15 on the cars;" but the ore is only eight inches thick, and costs $1.25 to mine; then it must be loaded and hauled half a mile, and the iron must be hauled to the cars. There is not such an ore in the Hocking Valley as the Cumberland river, the Hope, or the ore of Edmonson county.

The coke furnaces of Alabama, Georgia, and Tennessee, making such grades of iron as I have mentioned, can not possibly make it for less than it could be made in Western Kentucky, and then the latter has the advantage of at least $1 per ton freight; and on an outlay such as would be necessary at Airdrie, $1 per ton would be a good profit.

Another locality which promises most favorably is the district between Nolin river and Bear creek. Here is every advantage for iron-making, except railroad transportation, and in these times of narrow-gauge roads, it would not be impossible to run a road through the region, say from Grayson Springs to some point on Green river; or extend the projected road from the L. and N. to Mammoth Cave, six or seven miles further, to these ores and coals. Leaving the railroads out of the question, however, very little expense on the water-courses—one lock and dam—would give good water transportation, and pig-iron could be taken to Rockport, Bowling Green, or Evansville, on the Ohio river, at a very low figure. Slack-water navigation can be reached by a tram-way of a few miles in length from the centre of this region.

Some of the most prominent ores of this locality have already been mentioned (page 6). They can be mined for less than one dollar, and by locating a furnace conveniently for both ore and coal, which could easily be done, iron could be made at a very low figure.

The coal, being unusually firm and hard, could be used raw to the extent of at least one third, and as the vein—Main Nolin coal or L—is 3½ feet thick at the least, mining could be done for seventy-five cents, as it would be on the drift.

COST PER TON.

Two tons coke	$2 75
Two and one half tons ore	3 00
Three fourths ton of limestone	75
Labor, repairs, &c.	3 00
Hauling to river and freight to Rockport	1 50
Freight to Louisville	1 50
Total	$12 50

This region abounds in the best timber for charcoal, and as the freights are a good part of the cost of this iron, a high-priced iron, such as a cold-blast charcoal, would probably be as profitable as anything that could be made in the region.

CUMBERLAND RIVER ORES.

These ores have already a high reputation, from the celebrated boiler-plate of D. Hillman & Sons. By locating a furnace at some one of the many banks on or near the line of the E. and P. R. R., between Princeton and Kuttawa, selecting an ore low in phosphorus, an iron could be made which should be very profitable. The coal mines are from twenty-five to forty miles from these ores; and by coking the coal at the mines, loading it on to cars and shipping to the furnace, it should not cost over $2 per ton for coke. The ore can easily be mined for one dollar. Then

Two tons coke	$4 00
Two and one-fourth tons ore	2 50
Three-fourths ton limestone	75
Labor and repairs, &c.	3 00
Freight to Louisville	2 00
Add 20 per cent. incidentals	2 45
Total	$14 70

cost per ton put down at Louisville for a grade of iron which ought to bring a high price, being very low in phosphorus.

Although these are paper estimates, I feel sure that they will be found reasonably correct, when the line of the Elizabethtown and Paducah Railroad is alive with the busy hum which is always found in districts producing iron, as this region will surely do at some time; and it would be wise in our State to

bring to notice as much as possible a source of wealth to those investing, and one which would be still more a stimulus to the prosperity of several counties. Blast furnaces require the opening of coal and iron mines, and these require the labor of many men; these men must be fed and clothed, houses must be built for them, and in various ways does the industry react advantageously upon the surrounding country. The Geological Survey is at present working to show the world what sources of mineral wealth our great State possesses, as well as to point out the quality of her soil, the character of timber which nature has so lavishly donated her, and in every way possible to produce an index, so to speak, which may be consulted and relied upon.