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ANNUAL REPORT

OF THE

Directors and Chief Engineer

OF THE

ASHTABULA & NEW LISBON RAIL ROAD CO.;

ALSO THE

Geological Report of its Mineral Resources,

BY

PROF. J. S. NEWBERRY.

CLEVELAND :

PRINTED BY E. COWLES & CO., LEADER STEAM PRESS.

1857.

LAKE ERIE
ASHTABULA

HAMILTON GROUP

PORTAGE & CHEMUNG GROUPS

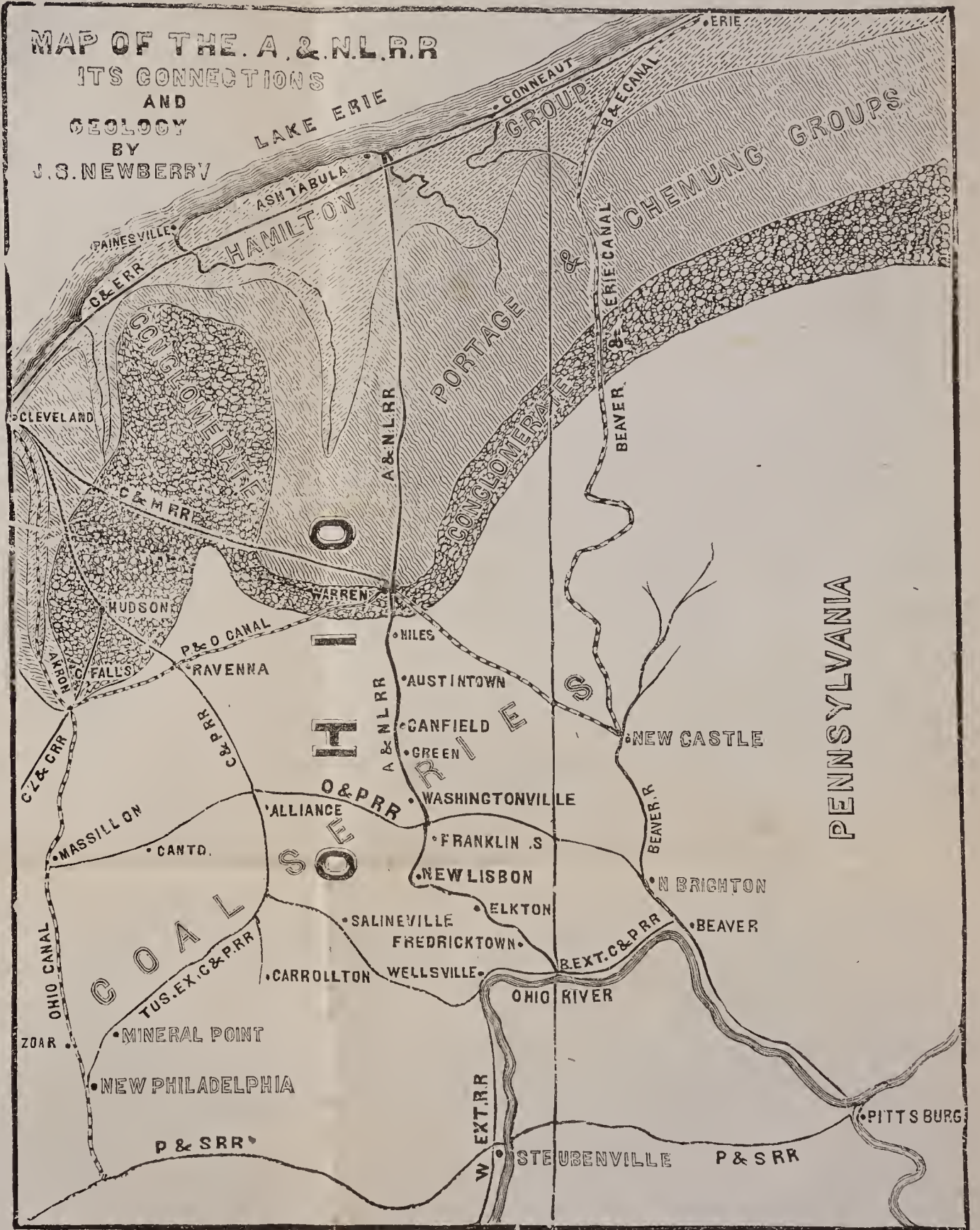
CONGLOMERATE

COAL MEASURES, SANDSTONES, SHALES, COAL, LIMESTONES, IRON-ORES, FIRE CLAYS

700
600
500
400
300
200
100

Feet above Lake Erie.

MAP OF THE A. & N. L. R. R.
ITS CONNECTIONS
AND
GEOLOGY
BY
J. S. NEWBERRY



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OFFICERS.

DIRECTORS.

EBEN NEWTON, President.
HENRY HUBBARD, Vice President.
HENRY FASSETT, Secretary.
JAMES STONE,
WILLIAM H. HOWE,
GEORGE C. REIS,
JOHN McCLYMONDS.

O. H. FITCH, Treasurer.
WM. HALE, Chief Engineer.
Prof. JOHN S. NEWBERRY, Geologist.

6-22001

REPORT OF THE DIRECTORS.

To the Stockholders of the Ashtabula and New Lisbon Rail Road Co.

GENTLEMEN:—I will attempt to give you a short history of our proceedings for the past year, and present position and prospects.

Last year you had a very full and able report from my predecessor, of our history after the organization, embracing the contract we had made for our work, and the progress under it, also a statement of our funds and expectations.

It will not be necessary or desirable to repeat what was then said. The only portion of the road then under contract was from the Lake to Bristol, thirty-six miles. Our confidence in the Contractors, then expressed, is fully sustained. Although as much of the job is not completed as was then hoped would be, yet the work has constantly and substantially progressed as fast as prudence and sound discretion would dictate, during the most extraordinary and unpropitious year we have had for the last twenty.

It is but a little over three years since our first organization. The first year there was a great failure of crops from an unprecedented drouth; the second, continued rains in the spring and harvest destroyed and cut short a large proportion of the crops, followed by the most severe and long continued winter our oldest inhabitants can call to mind, and again followed by a season in which the drouth and insects the whole extent of the road, for a breadth of ten miles on each side, have cut short and destroyed enough of the products and income of the inhabitants, to have built the road, and placed it in running order.

We have been seriously affected by these causes, having heretofore almost entirely relied upon domestic stock owned by those living near the road.

Our road passes through a rich and flourishing part of the country. The counties of Ashtabula, Trumbull, Mahoning and Columbiana, in productive industry cannot be excelled by any four connected agricultural counties in Ohio, and notwithstanding these unpropitious seasons, the inhabitants as a general thing are wealthy, and out of debt, and have paid their stock as promptly, as their circumstances will admit.

The ultimate object of the road is to connect Lake Erie with the Ohio River in a direct line.

The road has been surveyed and located (except a short distance between Bristol and Niles) to New Lisbon, from fifteen to twenty

miles from the river, depending upon the course taken to reach it, and it will find its terminus at the river, as naturally as rivulets find their way to rivers. Commerce will and does demand it, and enterprise will build it.

Since our last annual meeting, your directors in May and June, as early as the long continued winter would permit, caused the road to be surveyed and located from Niles to New Lisbon, but from a steep and long grade from the centre of Canfield to the centre road at Greene, and also from Washingtonville to the Ohio and Pennsylvania Railroad; and also from the further consideration, that in grading a long hill, almost invariably a few feet from the surface we meet with blue clay, almost as difficult to excavate as rock, and our stock upon this part of the line being too small for so large a job, we have surveyed a new line from Canfield to Greene, by going a short distance East, and avoiding nearly the whole hill, and only increasing the distance twenty-four feet, and saving in the estimate \$25,569 83.

The estimates on the first line as made by the Engineer, amount to \$43,984 50, and upon the newly surveyed route, to \$18,414 97. Upon the first route it was impossible to estimate what it would cost without knowing what earth would be found. Upon the last surveyed route there is no uncertainty about it, for it is almost an entire plain. The same remarks hold good in relation to the proposed change at Washingtonville.

The first estimate was \$27,623 20, the last is only \$15,377 58, a saving of \$12,145 62, Saving in both changes \$37,715 45.

The road is let from New Lisbon to the Ohio and Pennsylvania Road, to Messrs. BRITTON, who began work on the 13th day of August, and have progressed from that time until the present successfully, and have performed a large amount of work for the number of hands employed. We have the utmost confidence in their ability to perform the work. The estimates of their work from the 13th of August to the 1st of January is \$7,317 16.

They have performed more than double the amount of work they were required to do in the time, yet the whole amount has been promptly paid by the Stockholders at New Lisbon, under the efficient management of Director McClymonds, and from present prospects, that section from New Lisbon to the Ohio and Pennsylvania Road, a distance of ten miles, will probably all be graded before our next annual meeting.

The Road is also let from the Ohio & Pennsylvania Road to the centre of Austintown, to O. BALDWIN & Co., and they have commenced work at Washingtonville with a small force, and from the character of the earth, they have been able to progress with great success, and by making the proposed change we are now able to progress with the whole distance to the centre of Canfield, which will be immediately begun, unless the winter is unfavorable for work, and we have strong confidence that the road from New Lisbon to the center of Canfield will all be graded during the present year.

The right of way from New Lisbon to the Ohio & Pennsylvania Road has all been obtained, except three or four farms, and in almost

every instance has been given without pay. All that has been agreed to be paid is about seven hundred dollars.

A very considerable portion also has been obtained from Niles, South to the Ohio & Pennsylvania Road on fair terms. We think we can safely say from what has already been done upon this branch of the business, our road will compare favorably with any other road in Ohio.

From Austintown to Niles the contract to let the work is not fully completed. At our last annual meeting our expectation was to let that portion first, and immediately begin the work and prosecute it to completion, and commence business upon it; but upon further reflection we changed our policy, and deferred that portion for the year, to let business and capital be a little more developed, which is fast being done.

The progress of the work North and South of Niles, and in that immediate neighborhood together with the additional uses that are being made of coal and ore upon the ground, must, from the nature of business, in the course of the coming year, bring a large number of people and amount of business capital upon the immediate line of the road, to be there employed and expended in the erection of furnaces, opening of coal banks, and all that appertains to it, will grade that section of the road the coming year in all probability.

Messrs. PORTER & Co. now have an extensive and very commodious coal opening, and are making extensive preparations for the erection of a large furnace early in the coming spring upon the immediate line of the road.

Your Directors, in the month of October last, procured the services of Prof. NEWBERRY, an eminent geologist from Washington City, of great skill and science in his profession, and in no way connected with our road, to make a geological survey of the road from Niles to the Ohio River.

Earlier in October than Mr. NEWBERRY came upon the road, we were informed by a wealthy and reliable individual, that as soon as we would extend our charter from New Lisbon to the Ohio River, there were individuals (giving names) who stood ready to furnish all the means necessary to grade the road and prepare it for the iron from New Lisbon to the river. We had Mr. NEWBERRY prosecute his examination to the river, and his report is here appended, and made a part of our report, and with this geological report it is unnecessary to say more about the minerals upon the road, than that no other road in the State of Ohio, or elsewhere, for a distance of fifty miles, one half its whole length, does more richly abound in highly valuable minerals. Indeed, in addition to the mineral resources, the whole line of the road from Ashtabula to New Lisbon, passes through a highly cultivated country, rich in agricultural products. The county of Ashtabula is the greatest dairy county in the State. They have not heretofore turned their attention much to the raising of grain.

Columbiana county is among the best grain growing counties in the State, and the people from the lake counties, for years past, have been in the habit of drawing large quantities of grain from there over our

mud roads, and this will continue, as it is more profitable for the people of Ashtabula, Lake and Geauga counties to graze their lands, rather than raise grain. The counties of Trumbull and Mahoning are large producing counties, and abound with cattle, sheep and hogs, equal or nearly so, to any in the State.

There has been expended in work upon the North Section of our road from the lake to Bristol, the past year, fifty-three thousand seven hundred and eighty-one dollars.

The country north of Niles is entirely destitute of coal, lime, and hydraulic cement, and, to a great extent, of building stone. The Southern part of our line abounds in great abundance in these articles and of the best quality, and their use is greatly increasing every year.

All the Railroads leading into Cincinnati are not able to bring coal into that market and furnish it at a reasonable price. So great was the demand for it above the supply, that in the month of November last, it rose to ninety cents a bushel.

This may be said to be owing to low water in the river, but the same difficulty exists nearly every year, for our streams are diminishing as the timber is being used up. Yet in view of these facts, Railroads as yet, to a great extent, are not able to keep the markets fully supplied at a fair price. Coal can be furnished and pay well, cheaper than wood, costing nothing standing in the forest.

Coal lands in this country are not so abundant as ever to become of small value, but on the contrary will be increasing and will be worked. Coal is to be the great article of fuel. We are fast reaching that period.

In a country where fuel is abundant and cheap, and ores of the best quality abound in the same neighborhood, there will the manufacturing of iron be done. We claim these two elements in the manufacturing of iron abound upon the line of our road. It is one great point to bring out and develop this fact.

Lake Superior will never be a great manufacturing country. It does not combine the elements to support a dense population. The winters are too long and severe, and fuel will cost too much, and their ores are not as various and easy of access and well adapted to the manufacture of all varieties of iron, as they are in this country.

In Connecticut and Massachusetts, where the best wrought tire bars and Railroad iron and car wheels are manufactured, they are fast running out of fuel, and it will cost too much to obtain it. They have heretofore used charcoal.

In a short time they must turn their attention to the manufacturing of anthracite iron, and we of the West must manufacture all the varieties of iron used upon Rail Roads, and in the construction of their cars.

It is said there has been no ores yet discovered in the West that will make car wheels. That these ores do here exist we cannot for a moment doubt, and they must be found and used. We think we have them upon the line of our road, and all that is wanting is capitalists to use them.

Heretofore we have not been able to compete successfully with Eu

rope for want of capital, skill, and cheap labor, in the manufacture of iron.

We have overcome the advantages they had over us in these particulars. We have all the raw materials that go to make up the composition of metals as abundant and good as they.

We have not that dense population, which are compelled, in order to obtain a livelihood, to explore every acre and analyse every rock and pebble to discover their hidden treasures; but once discover the rich ore, and we have the energy and the capital to penetrate every granite rock, and mould it to the uses of man, and transport it upon the channels of commerce.

Let each one of us use all fair means to bring the public attention to the resources that exist upon the line of our road, and cannot now be advantageously used without it, and the road can then be speedily built.

The question is often asked, will this road ever be built? This is as certain as any event that is not now accomplished. We have already expended upon it eighty thousand dollars, and have made contracts that amount to three hundred and fifty thousand dollars, in which the contractors are bound to work no faster than we can pay, and we have paid for all that is done, except a few thousand, which is provided for and will be paid in a few days.

We have now stock and land enough to grade sixty miles out of the eighty-five. More than twenty miles are now graded. The right of way is obtained for more than half the distance of the whole road;—and will any say, because we have not funds enough on hand to finish the whole, it will never be accomplished?

What road ever had in its early commencement funds enough to finish? I say unhesitatingly, not one. Or what association, or corporation, to build a church or college, or perform any other enterprise of a public character, ever had funds at the beginning, or in its early history, to complete its undertaking? Very few, indeed, if any.

How few individuals, when they undertake a new enterprise, have funds to complete it; or how few farmers, when they undertake to build a house, have funds to complete it. No, it is not the way such things are accomplished.

Public enterprises are carried on and accomplished by creating public confidence, and enlisting public energy by individual enterprise. A prosperous and influential individual can scarcely tell you how he increases his possessions and influence from year to year. It is by a uniform and consistent forward course, and constant exertions. So with a Rail Road correctly carried on. Every mile graded adds to the probability that another will be.

Too great anxiety to press a road too rapidly forward by borrowing money, regardless of the domestic reputation it has, is bad policy. The time the road shall be completed and ready for the iron is not so important as that it should then have a reputation and be entirely out of debt, and then there will be no more difficulty in equipping it, by buying the iron on time, than for a successful business man to buy goods on time.

We wish this fact more than any other fully fixed in the mind of each stockholder, and also the farther important fact, that this road must be built by the stockholders, and not by your Directors pledging their individual responsibility for borrowed money, or in any other way. Another fact is our fixed policy, not to encumber your road by any pledging of it until we are prepared to set it running, or portions of it.

Our road does not now owe but \$3,000, except as above stated, borrowed on a mortgage of a piece of land, in order to give us an opportunity to sell when land is in better demand than this year. As we have heretofore said, we are substantially and prosperously at work on both ends of our road, with a full and fixed determination never to suspend work until it is all finished.

After our last annual meeting, until the middle of April, very little business could be successfully done, owing to deep snows and severe cold weather, either in work upon the road or in obtaining stock.

Since then our time has been taken up in locating the road, obtaining the right of way, and new stock in those locations where we wished to begin the work, and in prosecuting it.

We have obtained in New Lisbon sixteen thousand dollars in new stock, and in Canfield six thousand dollars, and north of Bristol eight thousand dollars.

We have now in available unexpended stocks, lands, and other assets, on the north division of the road, \$127,677, and on the southern, \$121,461.

All of which is respectfully submitted.

EBEN NEWTON,
President of the Company

REPORT OF THE ENGINEER.



*To the President and Directors of the Ashtabula and New Lisbon
Rail Road Company.*

GENTLEMEN: By your directions I commenced a permanent location of your road in the Spring of 1854, from Ashtabula Harbor south to the Clinton Line Rail Road, in Bristol, Trumbull county, a distance of 36 miles. In September following, the work was let to O. BALDWIN & Co., of Pennsylvania. In November following, the work was commenced and prosecuted to a limited extent, until May following, when a suspension took place till October, 1855; when the work was resumed and pushed forward quite rapidly to January, 1857. Nearly or quite 18 miles are graded, ready for the superstructure, including about three-fifths of the heavy work from the Cleveland, Painesville & Ashtabula Rail Road south. The two heavy sections near the Lake are not in quite as forward a state as those south, but can be finished in six months, with a little extra exertion. From Bristol to Warren we shall probably locate on or near the preliminary survey, which is sufficiently accurate and reliable for the following table of grades and curvatures.

In going south from the Lake, our grades are necessarily heavier than coming north from New Lisbon.

Distance from the Lake to Warren,	-	-	-	47.30 miles.
Straight Line,	-	-	-	41.12 "
Curved Line, viz:				
Via 11,460 feet radius	-	-	-	4.37 "
" 5,730 "	-	-	-	40 "
" 2,644 "	-	-	-	24 "
" 1,910 "	-	-	-	41 "
" 1,432 "	-	-	-	43 "
" 915 "	-	-	-	15 "
" 716 "	-	-	-	18 47.30 "

The two last curvatures occur at the Depot grounds at the Lake on a level grade.

Grade going North from Warren to the Lake.

Level grade, - - - - -	16.32 miles.
“ to 5 feet per mile, - - - - -	2.61 “
5 to 15 “ “ “ - - - - -	2.31 “
15 to 21 “ “ “ - - - - -	1.78 “
21 to 26.4 “ “ “ - - - - -	2.12 “
26.4 to 31.7 “ “ “ - - - - -	2.40 “
Descending grade from Warren to Lake, - - - - -	19.76 “
<hr/>	
Total distance, - - - - -	47.30 “
Longest continuous grade of 31.7 feet, - - - - -	1.21 “

Elevation above Lake Erie.

Plymouth Ridge in Saybrook, - - - - -	287 Feet
Clinton Line Rail Road Crossing, - - - - -	353 “
Cleveland & Mahoning Rail Road Crossing, - - - - -	338 “
Niles, - - - - -	300 “
Canfield, - - - - -	585 “
Pittsburg, Ft. Wayne & Chicago Rail Road Crossing, - - - - -	440 “
New Lisbon, - - - - -	393 “

Distances.

Ashtabula Harbor to Plymouth Ridge, - - - - -	8.3 miles.
Plymouth Ridge to C. L. R. R. Crossing, - - - - -	27.7 “
C. L. R. R. Crossing to C. & M. R. R. Crossing, - - - - -	11.3 “
C. & M. R. R. Crossing to Niles, - - - - -	4.0 “
Niles to Canfield, - - - - -	12.6 “
Canfield to P., Ft. W. & C. R. R. Crossing, - - - - -	11.0 “
P., Ft. W. & C. R. R. Crossing to New Lisbon, - - - - -	9.7 “
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Making a total distance of - - - - -	84.6 “

In April last, by your order, I commenced the location of the southern portion of your road from Niles to New Lisbon. In June that portion from Niles to the Pittsburg, Ft. Wayne & Chicago Rail Road was let to Messrs. BALDWIN, WILLIAMS & HASKELL, of Penna., and the remaining part to New Lisbon to Messrs. BRITTON's, of Cleveland. Soon after crossing the Mahoning River at Niles, we reach the Coal Fields of south eastern Ohio, and for a distance of thirty miles, we traverse the best mineral region in the State. Our line is necessarily more circuitous than on the northern portion, as the surface is more broken and uneven; still our grades will not exceed 31.7 feet per mile on any part of the road going north from New Lisbon to the Lake.

That portion of the line from Bristol to Niles is left for future consideration, and can at any time be built as cheap and with as easy grades and curvatures as will favorably compare with any portion of the road.

Distance from Niles to New Lisbon, - - - - -	33.33	miles.
Straight line, - - - - -	26.53	"
Curved line, viz :		
Via 5,730 feet radius, - - - - -	1.30	"
" 2,865 " " - - - - -	2.97	"
" 1,910 " " - - - - -	78	"
" 1,432 " " - - - - -	62	"
" 1,146 " " - - - - -	71	"
" 955 " " - - - - -	42	33.33

The two last mentioned curves are on the New Lisbon Depot grounds, on a level grade.

Grades going North from New Lisbon to Niles.

Level grade, - - - - -	7.56	miles
" to 10.5 feet per mile, - - - - -	1.52	"
10.5 to 17.6 " " " - - - - -	1.08	"
17.6 to 26.4 " " " - - - - -	2.86	"
26.4 to 31.7 " " " - - - - -	9.47	"
Descending grade going north, - - - - -	10.84	"
Total distance, - - - - -	33.33	"
Total length of the road from the Lake to New Lisbon, -	84.63	"
Straight line 84 per cent. or - - - - -	71.65	"
Curved line 16 " " " - - - - -	12.98	84.63

Of the curved line 33 per cent. is with a radius of 11,460 ft., which for all practical purposes is nearly equivalent to a straight line.

On the Northern portion we shall be under the necessity of building structures of timber where masonry is required. At Niles, and South from there, good substantial masonry of the first class will be required, by the terms of the several contracts.

In the location of the road last spring from Canfield to the P. F. W. & C. Rail Road, we were confined to a point in the township of Greene, and also to a point on the P. F. W. & C. Rail Road, to secure a certain amount of subscription to the capital stock of the Company. Since then those objections have been obviated, and we have made a new location, by which we reduce the total estimates (before stated) \$37,715 45, and our grades nearly 25 per cent. At the same time we increase our distance 1024 feet, and our curves 10 per cent. of 2865 feet radius. I believe the more favorable grades on the new line will counterbalance the increased curvatures, leaving the sum of \$37,715 45 to offset the increased distance of 1024 feet.

Work was commenced at New Lisbon the last of August, and prosecuted steadily to date, and will be continued during the winter.

In November the work was commenced at Washingtonville and will be carried forward to a limited extent during the present winter, and in the course of a few weeks we expect to break ground at Canfield.

The Directors have adopted the only true and safe policy, of driving the work ahead as fast as they can meet the monthly estimates with their own means, without resorting to the ruinous mode of hiring money at 10 to 20 per cent.

I have the utmost confidence in the several contractors, that they will perform their engagements with the company, as they are experienced men—have for many years been engaged on Public Works in the Eastern States, and have a high reputation as contractors.

In conclusion I would remark, the Company were fortunate in securing the services of J. G. CHAMBERLAIN Esq., my principal assistant, to whom I am under many obligations for the faithful and prompt manner in which he has discharged all the duties pertaining to him, and to all others engaged in the Engineering department, my thanks are due for the faithful manner in which they have performed their several duties.

Respectfully submitted,

WILLIAM HALE, *Chief Engineer.*

Engineer's Office, Ashtabula, Jan. 1, 1857.

REPORT

On the Economical Geology of the Route of the Ashtabula and New Lisbon Rail Road, by J. S. Newberry, M. D., Prof. of Geology and Natural History, in Columbia College, Washington, D. C.; made Nov. 1, 1856.

HON. EBEN NEWTON,

PRES'T. A. & N. L. R. R.

SIR: In compliance with your request, I have made a somewhat careful examination of the country traversed by your road, with special reference to its mineral resources; and have submitted a series of its useful minerals to such chemical tests as would, in some degree, determine their value.

In the application of these tests, through the kindness of Prof. HENRY, I have been permitted to avail myself of the varied appliances of the Smithsonian Laboratory.

The results of my observations and experiments I beg leave to submit in the following report; trusting that it may be the means of hastening the time when the immense resources of the region I have visited, shall be more fully appreciated and developed.

Very Respectfully,

Your ob'd't Servt,

JOHN S. NEWBERRY.

WASHINGTON, D. C., Dec. 25, 1856.

Character of the Surface.

The Agricultural capabilities of the entire region lying between the Lake and the Ohio, on the line of the A. & N. L. R. R. are of the first class. Nearly every portion of it is already occupied by a dense and wealthy population, and is in a high

state of cultivation ; the price of farming lands varying from thirty to seventy-five dollars per acre.

Here, as elsewhere, the character of the soil is determined by the nature of the geological sub-strata from which it has been derived ; and as the number and character of the manufacturing establishments of a country are directly dependent on the mineral character of its rocky basis, no less directly are the nature and success of the system of agriculture pursued dependent on the same cause. The different departments of industry resting on this common foundation, the numbers, the avocations, the wealth, and, we may almost say, the manners and morals of the inhabitants of a district, are determined by its geological structure.

The shore of Lake Erie, in the greater part of the Western Reserve, is formed of the equivalents of the Hamilton, Portage and Chemung groups of the New York geologists. The first and lowest consists of dark bituminous shales with little admixture of silicious matter : the others, of a series of fine-grained sandstones and bluish argillaceous shales. These strata have offered little resistance to the powerful denuding action to which the whole surface of the northern part of Ohio has been subjected ; as a consequence, they have been extensively but uniformly eroded, and the detritus carried over by a northern current and deposited in thick beds of bluish clay on the conglomerate and sandstones of the coal measures. The surface left by this process, though not entirely level, presents few great inequalities. and the soil having the composition of the parent rocks, is highly argillaceous. It is inclined to be cold and wet ; was originally occupied by a forest of beech, maple, elm, ash, linden, poplar, and hickory, and is agriculturally peculiarly adapted to grazing. This, and no preference of its inhabitants, has made the Western Reserve the dairy of the west. Happily this soil, somewhat difficult of subjugation, and not especially attractive to the immigrant, fell into good hands,—hands which have by industry and intelligence, made it yield more certain and larger returns than are derived from any other equal portion of the State.

In north-eastern Ohio, except where covered by out-liers of the carboniferous conglomerate, these argillaceous rocks extend nearly forty miles southward, when we rise on to the hills of the coal series. The northern slope of these hills is, as I have said, covered with drift, which has given a mixed character to the agriculture of the region, and has made drovers and dairy-men of a large part of the farmers of Wethersfield, Austintown and Canfield on the line of the A. & N. L. R. R. South of this point the drift influence becomes less apparent,—the landscape is marked by the graceful curves of the rounded hills characteristic of the coal region—the air is pure and salubrious, the water gushing from every hill side, clear and sparkling, in perennial springs, soft or hard, as it is above or below some band of limestone. The forest is composed of white, black and red oak, with here and there a poplar and black-walnut, and, on the sandy ridges, the chestnut, which shuns the clay. The farmers are grain-growers, and Columbiana unites with Stark and Wayne to form the centre of the great wheat-producing district of the State.

As we approach the Ohio, we find the water courses cutting deep down into the original plateau of the coal strata, opening all their riches in sections of two and even three hundred feet. Between the streams the country is not broken but rolling, and when I visited it, was everywhere covered with the vivid verdure of the springing grain.

By a peculiar provision of nature, these lands, though so deeply furrowed by the draining valleys, are generally well watered by copious and perpetual springs. Each hill contains one or more seams of coal running through it horizontally, or nearly so, and under every coal seam is a bed of potter's clay. This clay, impervious to water, bears on its surface the falling showers which have percolated through the porous strata above, and distributes them at its out-cropping edge in never failing springs. These springs serve the double purpose to point out the position of valuable minerals, and to irrigate the land below. The soil produced by the decomposition of limestone,

sandstone, clay and coal, possesses great fertility even to the hill tops.

Geology.

NORTHERN DIVISION—ASHTABULA TO NILES.

The geology of the country along the line of the Rail Road, from the lake shore, forty miles southward, has already been alluded to. It contains few valuable minerals, and as I had formerly traversed nearly all of it, I did not think it advisable to go over the ground a second time.

PORTAGE AND CHEMUNG GROUPS.

The shore of the Lake, at Ashtabula, is composed of black shales, the prolongation of those underlying the Chemung and Portage Groups of New York. Beneath this rock, at the depth of from 200 to 300 feet below the Lake level, would be found the white limestone of Sandusky; at too great a depth to be at present available.

The *Portage Sandstone* affords in some localities a very fair building stone, and frequently furnishes an excellent material for grindstones. Along the line of the A. & N. L. R. R., it is nearly destitute of fossils.

The *Chemung Group* consists of alternations of bluish, argillaceous shales, with thin bands of fine-grained, bluish sandstone. This sandstone will sometimes furnish a good grindstone grit, but generally the layers are too thin to make good building stone, and contain protoxide of iron, which becoming peroxidized by exposure, injures both its color and texture.

The upper part of this formation contains bands of fine sandstone which is very refractory, and forms an excellent material for the construction of coke ovens, and for similar purposes, where the wall is to be exposed to great heat. The fossils of this group, though found in some localities, are not abundant. The most characteristic are a *Lingula*, *Orbicula*, and *Conularia*, yet undescribed, which frequently occur together.

The Mahoning at Niles has cut through the overlying strata, and the bed of the stream is excavated in the Chemung Group. As this is below all beds of coal, the boring which has been carried to the depth of 150 feet in the trough of the river, has, of course, not resulted in the discovery of any workable bed.

Lenticular masses of iron ore of great purity are frequently intercalated among the beds of shale and sandstone forming the Portage and Chemung Groups, but, usually, in too small quantities to be of great practical value. Still, the erosion of the strata by the streams running over them has, in some localities, exposed a sufficient quantity to be worth collecting.

CONGLOMERATE.

Passing south-west from Ashtabula, in the vicinity of Niles, Trumbull county, at an altitude of about 280 feet above Lake Erie, we strike the Carboniferous Conglomerate which lies at the base of the productive coal measures. This is a coarse, yellowish sand-rock, not readily distinguishable by its color or consistence from some of the sandstones of the coal series above, except that it contains, generally in great abundance, always in considerable numbers, quartz pebbles—rolled and rounded fragments of massive quartz, from the size of a pea to that of an egg, which serve to identify the rock wherever found, and to distinguish it from all similar sandstones lying above it.

The importance of this character will be readily appreciated when it is remembered that this pebble-rock lies at the base of the coal series, and no workable vein of coal is found in, or below it, in the State of Ohio. A knowledge of this fact would have prevented the expenditure of much labor and money in searching for coal below this rock. As will be seen in a subsequent part of this report, high up in the coal series, and above several seams of coal, a second conglomerate occurs, but in it the pebbles are comparatively small, not generally exceeding the size of a grain of wheat.

The fossils of the Conglomerate are plants, (*Calamites*, *Lepidodendra*, *Trigonocarpa*, &c.) The thickness of this rock in different parts of the State varies from 25 to 250 feet, being thick-

est in Portage and Geauga counties, and thinning out toward the Ohio river. It is thinner also in Mahoning county than either west or east, being less than 100 feet in thickness. The Conglomerate furnishes a massive and durable building stone, though less hard and homogeneous than some of the excellent freestones found further south. It is used in the foundations of the C. & M. R. R. bridge at Niles, and as a silicious flux in the iron works at the same place. It is found on both sides of the Mahoning at Niles, but removed by the excavation of the valley from the immediate vicinity of the stream. South of the Mahoning it dips rapidly southward, and disappears beneath the hills of the coal measures, emerging again on the opposite side of the coal basin in Virginia.

MIDDLE DIVISION—NILES TO NEW LISBON.

THE COAL MEASURES.

In crossing the Mahoning at Niles, the Rail Road passes from a region agriculturally rich, but nearly destitute of valuable minerals, into a district uniting to great agricultural resources an amount of mineral wealth unsurpassed, if, indeed, it is equalled by that of any other portion of our favored country; and which, if properly developed, must sustain and enrich a large population, and give to your Road a permanent and profitable business.

WETHERSFIELD, AUSTINTOWN, CANFIELD.

COAL SEAM NO. I.—“BRIAR HILL COAL.”

At a somewhat variable distance above the conglomerate, but generally within 50 feet, we find the first or lowest bed of coal, which, from its peculiar qualities and its proximity to the lake market, is, perhaps, the most important and valuable of the series. This seam of coal is traceable throughout nearly the entire line of outcrop of the coal basin in Ohio, and has everywhere certain characteristics which distinguish it from all others, though possessing them in a pre-eminent degree in the Mahoning Valley in the vicinity of the line of the A. & N. L. R. R.

This stratum is worked at Tallmadge, in Summit county, at

Clinton and Massilon, Stark county, in the vicinity of Sharon, Pa., and still more extensively in the Mahoning Valley—where it is known as the “ Briar Hill” or “ Mahoning Valley” coal—and from whence it has been largely exported to Cleveland, commanding the highest price of any coal sold in that market.

The value of the Mahoning Valley coal is dependent on both its physical and chemical characters. It may be thus described :

Specimens from Youngstown and Mt. Nebo, remarkably compact, coming from the mine in large tabular masses, and bearing transportation well. Color dull bluish black in the mass, freshly broken surface of a brilliant resinous lustre ; fracture splintery and rough.

CHEMICAL COMPOSITION.

Fixed Carbon,	-	-	-	-	61.244
Bitumen,	-	-	-	-	35.966
Ashes,	-	-	-	-	2.790

Specific Gravity, 1.2695

Coke, 64.034 per cent. ; hard and bright, retaining to some extent the form of the coal. Ash light yellow, aluminous ; contains very little iron ; will not readily clinker. This coal yields $3\frac{1}{2}$ cubic feet good gas per pound.

This enjoys the honor of being the only western coal as yet successfully employed, in the raw state, in the reduction of iron by means of the hot blast ; and many thousands of tons of iron are annually manufactured through its agency by this process.

Aside from the manufacture of metals, to which this coal is peculiarly adapted, it answers well for the generation of steam, especially where the draft is not strong ; its open-burning quality giving free passage to the air, and preventing the clogging of the grates. It is therefore preferred as a steam coal on the lakes to any other variety. Where the draft is strong a more adhesive coal will be found more economical, and should be used ; such coals are universally preferred on the Ohio.

The quantity of Mahoning Valley coal sold in the Cleve-

land market, may be safely estimated at 100,000 tons per annum, and the average price by the cargo at \$4 per ton.

The average thickness of this coal seam is $4\frac{1}{2}$ feet, but it is liable to considerable variation. It lies in basins of greater or less extent, the coal being thickest and best in the bottom of the basin, and at the edges thinning out and sometimes entirely disappearing. It should make its first appearance on the line of the Rail Road in the hills south of Niles, and at a less elevation than the "Shaft Coal," though in that vicinity it has not yet been found and may be wanting. It has been opened in the bed of the Meander on the farm of Mr. John Ewing, in the corner of Ellsworth, being there of good thickness and excellent quality, and may perhaps be found over a large area in that vicinity.

The disturbances which the rocks of Mahoning county have suffered; the extreme and sudden changes of level, thickness and character which the strata exhibit, with the few exposures of the geology which are offered by a rolling and nearly unbroken surface, rendered it impossible, in the time at my command, to determine with certainty all the local details of geological structure.

The coal lies in detached basins, each of which possesses peculiarities which are not shared by the others. The limits and structure of these basins can only be determined by patient and careful study. The series of strata, which I have given, will serve as a general guide, but in the explorations of the deposits of coal, in the construction of the Rail Road, facts will doubtless be brought to light, which will require additions and modifications to be made to the section which I have constructed. South of Canfield the strata are less disturbed, and the geology of the country traversed by the Rail Road is fully exposed in the gorges of the streams.

Those more immediately interested in the geology of Mahoning county will find some of its problems discussed more at length in the Appendix.

Two analyses of Ewing's coal give—

NO. I.—UPPER PART.		NO. II. LOWER PART.
Fixed Carbon, - - -	58.14	58.10
Bitumen, - - -	39.50	36.70
Ashes, - - - - -	2.36	5.20
	60.50	63.30
Coke per cent., 60.50		
retaining form of coal, hard and bright.		
Ash. aluminous.		Ash silicious.
Gas c. ft. per lb., $3\frac{3}{4}$	- - -	$3\frac{1}{2}$

Lying upon coal No. 1 is a bed of shale, usually blue, or cream-colored, but sometimes nearly black, of from 20 to 30 feet in thickness. The lower part of this shale bed is filled with the impressions of plants, some of which are peculiar to the coal seam on which they repose, and are found no where else. Of these the most characteristic are *Whittleseya elegans*, *Sphenopteris Lesquereuxii*, *Sph. Kirtlandiana*, *Sph. simplex*, *Sph. parvifolia*, *Sph. uncinata*, *Alethopteris grandifolia*, *Neuropteris lancifera*, and several other plants heretofore described by me as peculiar to the lowest coal seam in Ohio. It contains also a great abundance of *Alethopteris lonchitidis*, *Pecopteris plumosa*, and several other well known European species. The lower portion of this shale bed also includes nodules of kidney ore, each of which sometimes contains a fern-frond as a nucleus about which it has formed. This ore is of good quality, and in some localities may be sufficiently rich to pay for working.

SANDSTONE NO. I.

Upon the shale last described rests a yellowish sandstone, which, along the line of the Rail Road in Wethersfield, Austintown, and Canfield, is from 30 to 40 feet in thickness, and is generally in thin layers. To the westward, as at Tallmadge, Clinton, and Massilon, it becomes very thick and massive, and is one of the most prominent geological landmarks. This rock makes its last appearance in Saw Mill Run in Canfield, and the "Briar Hill" or "Block" coal may be sought by boring below it. South of this point it dips under the overlying strata and disappears.

COAL SEAM NO. II.—“BLACK BAND VEIN.”

Upon the sandstone last mentioned, with an intervening stratum of blue shale of variable thickness, but probably not over from 10 to 15 feet, lies a collocation of minerals which, from their proximity and individual value, demand special notice. It should be premised, however, that these deposits are not equally developed in different localities, but by a system of compensation, often brought to the notice of the geologist, where the iron is richest the coal is least valuable, and vice versa.

This group consists of—				ft.	in.	ft.	in.
Iron ore,	-	-	-	0	6	to	1 6
Limestone,	-	-	-	0	0	to	3
Shale,	-	-	-				10
Coal,	-	-	-	2		to	3
Black-band ore,		-	-	0	8	to	2
Coal,	-	-	-	0	4	to	1

Fire clay—to the shale before mentioned.

The “Black-band vein,” with its associated strata, is exposed in many places in the townships of Wethersfield, Austintown, Canfield, Ellsworth and Jackson, but all the members of the group are found to exhibit somewhat varied characters in different localities.

At the “*Shaft Mine*,” (Rice, French & Co’s,) within two miles of Niles—and the most northerly point where this stratum is worked—the limestone is so argillaceous in its character that it scarcely deserves the name of limestone; the ore associated with it is in kidney-shaped or botryoidal masses, very pure, but in small quantity. The coal is 3 feet 2 inches thick, very black and brilliant, and among the handsomest varieties of coal I have ever seen. A description of this coal taken from my note book, is as follows:

“*Shaft Coal*.”—(Rice, French & Co., Wethersfield.) Physical character. Hardness medium; color brilliant jet black, with a highly resinous lustre; fracture of some portions tangled and splintery, of others cubical with smooth surfaces; works large and contains but a moderate amount of sulphuret of iron, which occurs

in masses, and may be mined out, leaving the coal very free from this impurity.

CHEMICAL COMPOSITION.

	Var. A.	Var. B.
Fixed Carbon,	57.10	52.12
Bitumen,	38.80	44.19
Ashes,	4.10	3.69
	—	—
Per ct. coke,	61.20	55.81
Specific gravity,	1.297	1.283
C. ft. gas per lb.,	$3\frac{3}{4}$	$4\frac{1}{4}$

The coke is highly cellular, but tolerably bright and hard. The gas is good. The ashes are light yellowish brown, aluminous, and will make but little clinker.

This is evidently one of the most valuable coals in the country. It is peculiarly bright and handsome, bears transportation well, and will serve the common purposes of coal in generating steam and as a household fuel. If properly mined and sorted, it may be coked and applied to the reduction and manufacture of iron, and the purer portions to the manufacture of gas.

At the "Shaft Mine" the coal is divided into two parts, the upper being 2 feet 10 inches, and the lower 4 inches in thickness. Between them is the

BLACK-BAND ORE.

This stratum of ore at the "Shaft Mine" is about eight inches in thickness, and is mined with the coal. It is of excellent quality, and from its proximity to the coal and to the market, is of great value. It contains a large amount of bituminous matter, which, when burned off, leaves the ore very rich, and in the furnace, when used raw, diminishes very sensibly the quantity of fuel necessary for its reduction. The specimens which I took from the Shaft Mine contain 27 to 30 per cent. metallic iron. (See letter of J. Ward & Co., in Appendix.)

This stratum of ore contains, as characteristic fossils, *Posidonomyæ*, which I have noticed wherever I have examined it.

These are in some instances so numerous as to cover the surfaces of the laminæ.

As we go toward the south from the Shaft Mine along the line of the Rail Road, we find the "Black-band coal vein," opened in several localities; appearing last in "Saw Mill Run" in Canfield. Thence southward it is covered and concealed by the overlying rocks.

Along the western base of "Mineral ridge"—which is formed by a thick bed of sandstone overlying the group just described—this seam is extensively worked

James Ward & Co. have an excellent opening, from which they are taking large quantities of ore and coal to their furnace and rolling mill. (See Appendix.)

Morris' Bank is the next, and is also largely worked. Here, as at *J. W. & Co.*'s mine, the coal has much the same character as at the Shaft, and analyses of hand specimens would probably indicate no appreciable difference. On the whole, however, it is somewhat less compact and contains more bi-sulphuret of iron.

Still farther south, in Austintown, this "vein" is also extensively worked by *Mr. S. Ohl, Wm. Porter, Esq., &c.*

At Porter's mine, as in most other localities which I examined, (Shaft, *J. Ward & Co.*'s, *Ripple's*, and *Danl. Beardsley's*, in Ellsworth, and *Curtis Beardsley's* in Canfield,) the Black-band coal vein is divided into two parts, the Black-band ore lying between them. A section at Porter's, including both portions, is as follows :

Coal,	-	-	-	-	-	3 feet 6 inches.
Black-band, good,	-	-	-	-	-	1 "
do poor,	-	-	-	-	-	0 8 "
do good,	-	-	-	-	-	0 8 "
Coal,	-	-	-	-	-	1 "

The Coal.—The upper bench is a bright handsome coal, a large portion of which consists of layers of cannel, interstratified with those of brilliant bitumen. Its chemical composition is as follows :

Fixed carbon,	-	-	50.983
Bitumen,	-	-	43.317
Ash.,	-	-	5.700

Coke 56.683 per cent., bright but rather soft; Ash reddish-brown; contains some silex and iron, and will form clinker to some extent.

The amount of gas produced is $4\frac{1}{4}$ cubic feet per lb, but requires considerable purification.

This coal burns freely and is well adapted to all common purposes, but in its raw state is not suitable for making iron.

Below the black band a stratum of coal is found, about 12 inches in thickness of superior quality. It is a very hard and homogeneous, having very much the structure and appearance of the Briar Hill coal.

My analyses give for its composition

Fixed Carbon,	-	-	-	-	50.90
Bitumen,	-	-	-	-	46.30
Ash	-	-	-	-	2.80

Coke 53.70 per cent; hard, bright and good but not closely cemented. This coal contains scarce any bi-sulph. iron—is open-burning, and in the raw state is well adapted for making iron by hot blast. The ash is light yellow and aluminous.

The *Black-band ore* as seen by the section given, is of unequal quality, and indeed a part of it is not regarded as ore by the proprietor; yet it contains 15 to 16 per cent. iron, and when a furnace is constructed on the spot, it will probably be used.

The upper ten inches of the black-band ore, and the lower eight inches are of peculiarly good quality, and the specimens procured, as indicated by my analyses, contained 33.866 per cent. iron; the richest black-band ore that I have yet met with. Still, it is probable that the average yield would be somewhat less.

Mr. Porter's mine is directly on the line of the R. R., and combines many advantages for the coal trade and manufacture of iron. (See Appendix.)

Going south from Porter's mine, the "Black band vein" is found on the farm of Frank Henry, having the black band ore

under it, but of poor quality. The coal itself has also deteriorated, and though of good thickness, is slaty in structure and earthy. Above the coal the limestone is found; on the south side of the farm, hard, blue and highly calcareous, on the north side as a bastard limestone and scarcely recognizable. Above it, however, the iron ore occupies its normal position, and is of excellent quality. This ore is here about eight inches in thickness, and contains over 40 per cent. metallic iron.

On Saw-mill run, in Canfield, the Black band coal is seen for the last time; it has here a rapid dip to the north-west, and lies nearly 80 feet higher than at Porter's. The coal is thin and contains much iron pyrites. The black band is thick but not rich, and is here separated from the coal by several feet of shale. In this shale is seen a layer of nodules of kidney ore of great richness, containing, according to my analysis, 47,547 per cent. metallic iron, and also some sulphuret of zinc. Above the coal the limestone is seen, quite pure, and on it the same stratum of ore as on Henry's farm, said to be 18 inches in thickness, though not fully exposed. It contains 39,968 per cent. iron. The "Block Coal" (Coal-seam No. 1) is here due at no great depth, but the chances are not in favor of its excellence, lying so high as it probably does.

At Cornersburgh the Black-band Coal-seam makes its appearance, dipping south-east 40 feet in as many rods. In its rapid dip and the great differences of thickness and character which it exhibits within the limits of its exposure, the changes which so often surprise and disappoint the miner are strikingly illustrated.

On the farm of Daniel Beardsley, in Ellsworth, it is also seen, and though not fairly exposed, is apparently less valuable than northward. The shales associated with it are charged with iron, and may prove rich enough to pay for working.

This important seam of coal with its iron ore may be found, with occasional exceptions, from the north line of Canfield to Niles; Porter's mine being about the centre of the area over which it may be made tributary to your road. Wherever found

of good quality with its associated ores, it will, of course, be highly valuable.

LIMESTONE AND ORE.

In many places the limestone and ore lying over the Black-band coal are visible, and in several localities they have been worked together. Their appearance on the farms of Frank Henry and Curtis Beardsley has been mentioned. On the farms of Daniel Beardsley, in Ellsworth, and of Mr. Russel, in Austintown, they have been quite extensively worked.

The ore in these localities is from 6 to 18 inches in thickness, and contains from 38 to 45 per cent. metallic iron. This limestone is the first in the ascending series. It is distinguished by the ore which over-lies it, and by its fossils. It is $2\frac{1}{2}$ to 3 feet thick, dark blue in color, and sometimes contains considerable silex and becomes cherty. It is highly fossiliferous, and contains large numbers of *Spirifer*, *Productis*, *Terebratula* and of encrinal columns. At Cornersburgh it contains immense numbers of *Chonetes* and the little *Productus Wabashensis*.

SANDSTONE NO. 2.

Above the limestone last mentioned occurs a thick-bedded sandstone which is one of the most conspicuous and permanent members of the series. As compared with other sand-rocks it is generally harder and whiter, and furnishes an inexhaustible supply of the best of building stone over all the region where it is found. It forms the centre and substance of "Mineral Ridge," along the base of which your Road is located, from the Mahoning to Canfield. The railroad rises above it near the quarry on the land of Philo Beardsley. In this quarry it exhibits its characteristic features—a firm, rather fine-grained, bluish-white sand rock, which splits with facility and certainty, and forms a very durable and beautiful building stone. Of this stone large quantities will be needed on the lake shore, and in the stoneless region lying south of the lake.

COAL SEAM NO. 3—"BRUCE VEIN."

Above the sand rock last mentioned, having beds of fire-clay beneath them and a stratum of limestone between them, are

two seams of coal, which, dipping to the south-east with the fall of the streams, are exposed nearly the entire distance to the Ohio. Of these the first and lowest crops out on the line of the A. & N. L. R. R. near Curtis Beardsley's, in Canfield, and is worked in a great number of places in the central and southern parts of the township.

At Bruce's, on the west line of the town, it is more extensively and systematically worked than anywhere else in this vicinity. It is here three feet thick and appears well. It comes from the mine in blocks of cubical form and good size, the surface somewhat stained with clay, but internally bright, black and hard. It contains rather too much sulph. iron to be used in the raw state for the manufacture of iron, or the production of gas, but it may be converted into an excellent coke, and as a household fuel or for the generation of steam, it is scarcely inferior to any other variety.

ANALYSIS.

Fixed Carbon,	-	-	-	-	42.046
Volatile matter,	-	-	-	-	46.454
Ashes,	-	-	-	-	11,500

Coke 53.546 per cent.; hard, bright and well cemented. Ash reddish and sandy, and will form clinker. Gas $4\frac{1}{2}$ cubic feet per lb, requiring much purification.

The impurity which detracts from the value of the gas is sulphurous acid derived from the bi-sulph. iron, (iron pyrites) which, though not existing in the coal in conspicuous masses, is distributed in fine particles through all its substance. This is a character constantly exhibited by the coal of this seam wherever found.

Infelt's coal, mined east of the centre of Canfield, is derived from the same stratum and possesses in a degree the same excellencies and defects. It burns well in a grate or under a boiler, and makes good coke, but the quantity of sulph. iron is considerable; and it is liable to clinker.

Desmond's mine on the west line of Canfield is opened in the same coal seam, which is also visible on Indian creek, on the

lands of Mr. Church. At this point coal seam No. 2, with its overlying limestone, is seen in the bottom of the stream; No. 3 is above it in the top of the bluff, and may also be found in all the highlands in the southern part of Canfield. Farther south I shall have occasion to refer to it again.

LIMESTONE NO. 2.

Above coal seam No. 3 is a limestone, the second in the series, which, though less constant than the lower one, may generally be identified, and is an important guide in searching for this coal seam. It is sometimes a pure, bluish, compact limestone about $2\frac{1}{2}$ feet in thickness and furnishing lime of good quality. Such is its character on the lands of Judge E. Newton near the south line of Canfield, and in many places southward. In other localities it contains more clay, and forms water-lime, ("cement stone") or is so highly charged with iron as to become a valuable ore; and again, in still other localities, it exists only as a calcareous shale filled with fossil shells, forming the richest deposit of fossils in the series. At Bruce's, Infelt's and on Indian Run it has this character, and *Spirifer*, *Terebatula*, *Pleurotomaria*, *Goniatites*, *Bellerophon*, *Loxonema*, *Productus*, *Macrocheilus*, and indeed nearly all genera of carboniferous shells are to be found in it. Both this limestone and the one below occur in sufficient abundance in Austintown, Canfield and southward, to supply the want of flux that will arise in working the iron ores of this region.

COAL SEAM NO. 4—"CANNEL VEIN."

This stratum of coal makes its appearance in the highlands of the southern part of Canfield, nearly on the level of the R. R. summit, and about six hundred feet above Lake Erie, and is accessible from that point southward for many miles along the line of the Road. It is most extensively worked in Canfield at the mine of John & William Wetmore in the south-east part of the township, and at Ewing's, near the steam saw-mill, in the south-west corner.

At Wetmore's mine it is five feet thick, and with the exception of a layer of bituminous coal at the bottom, two inches in

thickness, is all cannel. It is bright and handsome, coming from the mine in quadrangular blocks, which have internally a somewhat conchoidal fracture. In its general appearance it closely resembles the English Wigan cannel. The surfaces of these blocks are somewhat stained with clay, but exhibit little of the iron rust discoloration so common in western cannel coals. Several analyses gave me for its composition the following formulæ :

UPPER PORTION.					
Fixed Carbon,	-	-	-	-	47.295
Volatile matter,	-	-	-	-	33.565
Ashes,	-	-	-	-	19.140

Specific Gravity, 1.4384.

Coke 66.435 per cent., retaining the form of coal. Ash light-yellowish-brown, aluminous.

Gas $3\frac{1}{2}$ cubic feet per lb, good.

LOWER PORTION.					
Fixed Carbon,	-	-	-	-	39.2809
Bitumen,	-	-	-	-	49.1358
Ashes,	-	-	-	-	11.5833

Specific Gravity, 1.295.

Coke 50.864 per cent. cemented, but showing form of coal.

Gas 5 cubic feet to the lb. of excellent quality.

This coal has all the characteristics of the cannels and will compare favorably with any other now mined in Ohio; the Darlington cannel being less attractive in appearance, and containing a larger amount of earthy matter. For the purposes of distillation it is evidently well adapted, and will profitably form the basis of extensive manufacturing operations.

West or south of Wetmore's mine this seam of coal in a great degree loses its cannel character, and becomes a bed of ordinary bituminous coal, considerably diminished in thickness. At Ewing's mine, near the steam saw-mill, in the south-west corner of Canfield, it is but $2\frac{1}{2}$ feet in thickness, the lower two feet being bituminous coal of good quality, and the upper six inches can-

nel. Six feet below this coal-seam is another, also bituminous, which is probably only a portion of the upper stratum separated by a subsidence during its deposition, and if traced for some distance the two would be found to unite.

The fossils characteristic of this coal seam are principally the remains of fishes and shells. At Wetmore's mine I discovered coprolites and the scales of *Elonichthys* and *Eurylepis*. Farther southward as it becomes more slaty, it contains large numbers of bivalve shells (*Solenemya*) and the teeth of sharks, (*Diplodus*.)

SANDSTONE NO. 3.

Above the cannel coal, and separated from it by a few feet of shale, lies another ledge of sandstone, the third in the ascending series above the conglomerate. This is a coarse, yellowish sand rock, generally, from its softness, inferior as a building stone to the one below it. It is the highest rock in Canfield, and caps the hill near the centre, as well as the high points southward.

FIRE CLAYS.

The Briar Hill coal, and also coal seams No. 3 and 4, and sometimes No. 2, are underlaid by strata of potter's clay which in many places is of good quality and may be successfully applied to the manufacture of pottery and fire brick. The value of these beds in a region so rich in coal and iron will be apparent.

SPRINGS.

There are in Canfield several copious medicinal springs which deserve notice. Among them may be mentioned the "Canfield Spring" near the centre, and another near the railroad summit on the land of Mr. Loveland, known as "the Pile Spring" from the fact that the spring issues from the summit of a mound formed by the deposit from its waters. Both these springs contain large quantities of carbonates of iron and lime in solution, and have tonic properties which may make them places of resort to invalids.

GREENE, BEAVER AND FRANKLIN.

GREENE VILLAGE.

Near the south line of Canfield the Rail Road crosses the summit, and begins to descend along the water courses tributary to the Ohio. Very little is therefore seen of the geology of the country till we reach the vicinity of Greene village. Here Green Creek on the east, and Middle Fork of Beaver on the west, have cut through the overlying sandstone, (No. 3,) which is here of a thickness of 50 feet or more, and have exposed coal seams No. 3 and 4. On the west side of the ridge they are opened, and have been considerably worked. On the east side they have not been opened, but doubtless may be at many different points.

At Barnes's mine, west of Greene village, coal vein No. 3 is actively worked. It is $3\frac{1}{2}$ feet in thickness, appears well, and has all the characteristics of the Bruce coal. In the language of the country, it is "strong" coal, and makes a very hot fire, but contains too much sulph. iron to be liked by smiths.

A few rods up the stream, at a level some 30 feet higher, No. 4, or the "Cannel vein," comes out, and has been worked by Mr. D. Wykart for some years. This is here a very bright, pure coal, containing but little sulphur, and is highly esteemed for working iron. It is about $2\frac{1}{2}$ feet thick, and is separated from the overlying sand-rock by a few feet of shale, which contains considerable iron, forming a meagre Black-band ore, scarcely rich enough to be worked.

Below the coal the fire-clay is of unusual thickness; some parts of it are very pure and would make excellent pottery or fire-brick.

Included in this fire-clay is an argillaceo-ferruginous limestone, (a portion of limestone No. 2, mentioned above,) which is composed of nearly equal parts of clay and lime, with an admixture of iron rendering some portions of it a rich ore.

COAL SEAM NO. V.

In various places in the vicinity of Greene village, near the top of the hill on which the town stands, is found a thin seam of

coal, cropping out perhaps 40 feet above Wykart's coal seam. This is a stratum not found further north, and is the fifth in the series. In all this region it is not more than $1\frac{1}{2}$ feet thick, and is not worth working; but southward it becomes one of the most valuable coal seams on the line of the Road.

Two miles above Washingtonville, on the farm of Gen. Roller, coal seam No. 4 appears on the bottom of a ravine, but has scarcely been opened sufficiently to test its character. At Roller's mill the same stratum is exposed in the face of the cliff, about $2\frac{1}{2}$ feet in thickness, and of medium quality. Above it, the black slate is somewhat ferruginous but of no economical value. Below it the limestone contains much clay and iron, and a rich band of nodular ore is associated with it.

WASHINGTONVILLE.

COAL.

At Washingtonville coal-seam No. 4, has been well opened and extensively worked, and exhibits a marked improvement in quality. At Walter's, Roller's, Whistler's and Carsh's mines it presents great similarity of character and nearly equal purity, but perhaps contains least bi-sulphuret of iron in the immediate vicinity of Washingtonville. It is here the purest coal on the line of the road, and, indeed, contains a less amount of ash than any coal I have examined in Ohio.

The entire thickness of the seam is $2\frac{1}{2}$ feet, the lower two feet being the best, and showing scarcely a trace of sulph. iron; the upper six inches contain more earthy matter and are somewhat slaty. The lower bench furnishes coal of moderate hardness, cubical fracture, a silvery, resinous lustre, and is composed of

		Whistler's.	Walter's.
Fixed Carbon,	- -	59.525	59.45
Bitumen,	- -	39.820	38.35
Ashes,	- -	1.655	2.20
Specific gravity,	1.270	<hr/>	<hr/> 1.287

Coke 60.18 per cent—peculiarly hard, brilliant and good.

Gas 4 cubic feet per lb., of good quality.

Ash light yellowish-brown, aluminous, will not clinker.

Coke is made from this coal by Messrs. Whistler, Roller, and Walter in considerable quantities, and is considered by foundry men who have used it, better than that made from the Pittsburgh coal.

Iron Ores.—Above the coal the shale is highly charged with iron, and a stratum of 4 feet in thickness, forming the roof of the coal seam, is black-band ore of fair quality, of which the lower part is richest. According to my analysis it contains from 21 to 28 pr. ct. metallic iron.

Above the slate ore, and separated from it by a few inches of black slate, lies a bed of nodular ore 3 to 5 feet in thickness. The nodules are small but closely set, and the ore is of superior quality. It is fine grained, brownish in color, contains both protoxide and peroxide of iron, has a specific gravity of 3.7547, and yields 49.80 pr. ct. metallic iron.

Below the coal and fireclay the limestone is seen about $1\frac{1}{2}$ feet in thickness, highly argillaceous in character, and would make a moderately good water lime. Below this stratum the shale for 15 feet is set with nodules of kidney ore. It is more arenaceous than that above the coal, but will make good and soft iron.

Its specific gravity is 3.180, and it contains 38.306 pr. ct. metallic iron.

On the land of Mr. Grimm, near the village, is a bed of bog ore which, in a region less rich in iron, would be regarded as highly valuable; here it is also of value, but less than the stratified ores.

About Washingtonville the "Bruce Coal vein" (No. 3,) lies below drainage and has not been tested. West of the town it is opened and exhibits the same general character as at Barnes' mine, near Greene village, and Bruce's in Canfield.

The abundance of ore in the vicinity of Washingtonville, and the excellence of the coal, should make this an important point in the business of the Road. It is to be regretted that the coal

is not of greater thickness, but the coal and the ore overlying it may perhaps be worked advantageously together.

Near Bozzart's mill, S. W. of Washingtonville, Coal-seam No. 4 has been opened near the level of the road, and No. 5 is seen cropping out on the hill-side, perhaps 50 feet above. It is here 18 inches in thickness.

About Franklin Square, Coal-seam No. 4 is found in a great number of localities, and apparently of good quality. It comes out just below the grade of the O. & P. R. R., near the station, also on the river-bank at the bridge: and may be found throughout the vicinity, at about the level of 25 feet above the stream.

From Mr. I. Dickson I learn that in the hill east of Franklin Square, at a distance of 80 to 100 feet above No. 4, (and over No. 5,) a bed of impure cannel is found six feet in thickness. This is perhaps the equivalent of Coal No. 6, to which I shall soon have occasion to refer. No. 3 here lies below drainage.

Along the line of the Railroad from Franklin Square to Long's Mill, coal may be mined at any point. The most accessible seam is No. 4, though the upper beds are contained in the hills, as yet unopened.

At Long's Mill we found Coal-seam No. 4 just in the grade of the Road, about 3 feet in thickness, and apparently of good quality.

The shales lying above and below it are charged with iron, and will probably have some economical value.

As this point the upper seams of coal are seen cropping out on the Road to New Lisbon, but are more fully exposed just below, on the

SHELTON AND ARTER FARMS.

These farms, somewhat famous in the vicinity for their mineral resources, exhibit an unusual concentration of iron ore, coal and limestone, and deserve the distinction they enjoy; yet it is true that the whole adjacent country for many miles in every direction, is scarcely less rich in valuable minerals.

On the Shelton farm we find Coal-seam No. 4 near the level of the creek, and the shales above it extremely rich in iron in the

form of nodules of from 10 to 100 lbs. weight, and of good quality. Above this, perhaps 50 feet, is Coal-seam No. 5, apparently some two feet in thickness, but scarcely opened sufficiently to determine its thickness or quality.

Limestone No. 3.—A few feet above this coal seam lies a stratum of limestone which is a conspicuous feature of the geology of Columbiana county. It is the third limestone in the ascending series, and is found as far north as Poland, in Mahoning county, thence southward to and beyond the Ohio, wherever the land is high enough to include it.

On the Railroad it is first found on the south line of Canfield, its lower portion capping the extreme summit of a high point south of the steam saw-mill on the Plank Road. It is doubtless contained in the hills about Franklin Square, but from the fact that, like other limestones, it is readily dissolved and removed by atmospheric influences, its out-crop is covered and concealed.

The upper portion of this bed, and sometimes its entire thickness, is of a light dove color, weathering yellowish-white. The lower portion is frequently darker and more argillaceous, and sometimes nodular and cherty. It is nearly destitute of fossils and, when burned, makes a lime of great purity and more nearly white than that from any other limestone of the coal measures.

From its quality, association and distribution, it is an important element in the mineral resources of the region where it occurs. For the purpose of identification I shall call it the *White Limestone*.

COAL SEAM NO. 6.—“THE BIG VEIN.”

A few feet above the white limestone is found on the Shelton farm, Coal-seam No. 6—or, as it is called for the sake of distinction, the “Big Vein.” This stratum is probably identical with the “Big Vein” on Yellow Creek, and is traceable over an immense area in Ohio and Virginia. As its name implies, it is a coal stratum of unusual thickness; in this respect excelling all others in the Ohio portion of the Alleghany coal field. On the farm of Mr. Shelton it is opened in several places, but nowhere penetrated to such a depth as to have passed the influence of the

external air, and to permit me to obtain a fair sample of its quality. For this reason I have made no analysis of it. Its thickness over the Shelton farm is 7 ft. 3 inches.

From what I know of this coal-seam elsewhere, as well as from what its out-crop here indicates, I infer that it will furnish a coal of but moderate hardness and highly caking in character. Where containing but little sulph. iron it makes an excellent coke, and in that form is now much used for the reduction of iron ores.

Sandstone No. 4.—Above the “Big Vein” is a stratum of shale of some 5 feet in thickness, upon which lies a bed of sandstone, here rather slaty, and not of great thickness, but toward the Ohio it becomes thicker and more massive, and is recognizable over a large area.

COAL SEAM NO. 7.

Over this bed of sandstone, at a distance not greater than 40 feet from the “Big Vein,” comes in Coal-Seam No. 7, the highest on the line of the Rail Road. It is here about two to two and a half feet in thickness,—quality not determinable. This seam, on Yellow Creek, as well as on the Little Beaver, nearer the Ohio, becomes thicker and more valuable.

Iron Ore. Lying upon this Coal-Seam is a deposit of iron, which may always be found wherever the coal crops out, though subject to great variation of thickness and value. The overlying shale is usually charged with iron, generally diffused through its substance, producing black-band ore; but it is sometimes also collected in nodules and lenticular masses.

On the Arter farm, and on the farm of Wm. Teagarden, this ore-bed is largely developed, and of great value.

On the Shelton farm, the “Big Vein” lies just on the grade of the Rail Road. On the Arter farm adjoining, it lies much higher, rising faster than the grade of the Road. Above it, on the hill, the uppermost vein is fully exposed, $2\frac{1}{2}$ feet in thickness, and having nearly five feet of black-band ore over it. Crossing the hill, in a ravine where the coal crops out, we find the upper vein covered by black-band, in which are lenticular masses of kidney ore.

The black-band ore of the Aster farm contains a large amount of carbonaceous matter (25 pr. ct.), and in its raw state 23.081 pr. ct. of metallic iron.

The kidney ore is fine-grained and dark-gray in color; has a specific gravity of 3.4135, and contains 42.976 of metallic iron.

On the farm of Mr. Teagarden, still farther south, the "Big Vein," where it is opened, has decreased in thickness to four feet. Above it, the upper vein crops out in several places, and over this the iron ore, principally in heavy nodules. These are somewhat more sandy than those of the Arter farm, have a specific gravity of 3.311, and contain 41.06 pr. ct. metallic iron.

Below the "Big Vein," on the Teagarden property, is a bed of shale several feet in thickness, apparently forming the roof of Coal-Seam No. 5, which contains iron, perhaps in sufficient quantity to pay for working.

From the farm of Mr. Arter to New Lisbon, the surface gradually declines, and it is probable that the upper seams of coal and iron will not be found in that interval. The "Big Vein" and the white limestone crop out, however, at several points on the Salem road, and may be worked over a large surface. The Railroad follows down the valley of the Middle Fork, which cuts deeply into the strata, exposing all the rocks between Coal-Seams No. 6 and No. 3.

In this section, three miles above New Lisbon, Coal-Seam No. 5 is seen two feet in thickness, about 80 feet above the stream, lying under sandstone. Coal No. 4, fifty feet below, is divided into several portions by dark shale, which contains considerable iron. Near the level of the creek No. 3 appears, about three feet thick, with the fossiliferous limestone immediately over it. On this bed of coal, as at Washingtonville, is a rich bed of kidney ore, which becomes more important as we approach New Lisbon.

Water Lime. One mile farther south, near the top of the left bank of the creek, is found the water lime from which was made the cement used in the construction of the locks on the Sandy and Beaver canal.

The excavations formerly made, have been in a great degree filled up by the falling in of the overlying sandstone, so that I was not able to get a view of the entire thickness of the deposit. It is said to be five feet thick, and is probably the equivalent of the white limestone described above, this being one of the changes to which the limestones of the coal measures are liable. It principally consists in the substitution of argillaceous matter for a portion of the lime of the rock, making it a clay-limestone, by which it obtains the property of consolidating under water.

This hydraulic lime is dark blue, with a remarkably fine grain. It contains, in addition to the clay and lime, a small portion of iron, which gives to the cement a reddish color. Its excellence has been thoroughly tested in the construction of the work above referred to. In tearing up some of the old locks which had been laid in it, it has been found that the stone would part more readily than the cement. Its quality is not inferior to that of any water lime now made in the country, and with the increased facilities for transportation furnished by your Road, might doubtless be profitably manufactured on a large scale.

THE FURNACE TRACT.

Coal. From the hydraulic-lime quarry to New Lisbon, what I regard as the equivalent of the "Bruce Coal," lies just above the bed of the creek, and is extensively opened on the "Old Furnace" property, now owned by J. McClymonds, Esq.

The mines of Mr. McClymonds very conveniently open on the grade of the Road, and are well located for the working of coal, both for manufacturing and for exportation. The coal is 3—3½ feet thick, and, exhibiting the general character of the same seam at Greene Village and Canfield, is better than in either of those places. It works handsomely in cubical blocks, is black and lustrous, and has the hackly fracture characteristic of the coal of this seam.

	ANALYSIS.				
Fixed Carbon,	-	-	-	-	47.502.
Bitumen, -	-	-	-	-	45.400.
Ashes, -	-	-	-	-	7.098.

Specific gravity 1.2854.

Coke 54.60 pr. ct., bright, hard, and well-cemented. Ash reddish, containing iron and considerable silica. Of gas it gives $4\frac{1}{2}$ cubic feet pr. lb., but such as requires much purification.

Kidney Ore.—Above the coal, and separated from it by black slate, lies the bed of kidney ore to which I have referred. It has been extensively denuded by the washing of the creek, and is found beneath the soil on the level lands adjacent to the stream, where it was formerly extensively worked for the supply of the neighboring furnaces. The thickness of the bed is from 5 to 10 feet, and the quality of the ore is good, as is proven not only by my experiments, but by the excellence of the iron formerly made from it.

This ore is more argillaceous than that from the same bed at Washingtonville, and contains 42 pr. ct. metallie iron.

Rock Ore.—Above the kidney ore bed is the limestone which has been noticed as lying over this coal-seam in several places. The relative proportions of its ingredients vary much in different localities. On the furnace property it is highly charged with iron, and becomes a rich calcareous ore, from 18 inches to two feet in thickness, containing about lime enough to flux it, and 36.186 metallie iron.

Bituminous Shale.—Above the rock ore occurs a thick bed of bituminous shale; a striking feature in the geology of the vicinity of New Lisbon, and the equivalent of Coal-seam No. 4, the cannel seam of Canfield.

Sandstone.—The sand-rock (No. 3,) which lies above the black slate, is here very thick and massive, and furnishes a building stone scarcely surpassed in beauty, durability or in the facility with which it is quarried and worked, by any with which I am acquainted.

It is light drab in color, very homogeneous in texture, and may be quarried in blocks of any desired size. The locks of the Sandy and Beaver canal in this vicinity were constructed from this stone, and present some of the handsomest specimens of masonry which can be found in any country.

NEW LISBON.

COAL.

As we approach the town of New Lisbon, the coal-seam, which at McClymond's mine is at least 40 feet above the creek, dips rapidly, till at the mine of Mr. Potter it reaches the level of the stream. Sinking for a short interval below the stream, it again rises, and at the entrance to "Hephner's Hollow," and so down to "Arter's Hollow," and still below to Baker's and Green's mines, it dips nearly with the fall of the stream, and lies just above it. The quality of the coal is generally similar, but exhibits some local variations.

Iron Ore.—At the entrance of Hephner's Hollow on the lands of Mrs. Potter, the ore-bed overlying the coal is finely exposed, showing about 15 feet of shale thickly set with large nodules of ore. The specimens of ore which I took from this deposit contain 35.226 pr. ct. metallic iron. The average yield of the bed may be something greater. Over the ore lies the black slate, nearly 20 feet in thickness, and some parts of it rich in iron. High above on the hills, the white limestone has been quarried, here containing more iron and clay than usual.

In the bluff south of the town the ore-bed is not well exposed but it is apparently less rich than in Hephner's Hollow.

The limestone over it is highly argillaceous, and has been used for making cement.

The black bituminous shale is here very conspicuous, and has been mined as cannel coal. It is so highly charged with bitumen that it burns freely, and in the absence of a better combustible might be used for the generation of heat, but it contains too much earthy matter to form a desirable fuel. Nor is it probable that it would prove of greater purity when deeply penetrated. It is the equivalent of a coal seam, and on either side is found running into a bed of workable bituminous coal, but over an area ten miles in diameter it has the character which it here exhibits.

It contains 22 per cent of volatile matter, and from its abundance might be profitably used for distillation. A ton of it would yield 20 gallons of oil if properly distilled.

Above the black slate, and midway of the slope, a thin stratum of coal (No. 5) is seen cropping out. Still above this, at the crown of the hill, the white limestone appears. From this point the hills recede, and the upper coal seams are only found at some distance from the stream.

The country about New Lisbon contains a vast amount of mineral wealth which only needs to be developed to make it the theatre of extensive industrial operations. It is true that near the town the resources of the region are not so apparent; Coal-seam No. 4 is wanting and No. 3 is thin; but in the near, or more distant hills, exist great quantities of iron and coal, of potter's clay and cement, of building stone and mineral paint, which would give profitable employment to a large population and capital.

SOUTHERN DIVISION. NEW LISBON TO THE OHIO RIVER.

The route of the A. & N. L. R. R. from New Lisbon to the Ohio, had not been fully decided upon at the time of my visit, and of the two proposed routes I was requested to make an examination, that their respective merits might be more accurately compared. These two routes were, one along the line of the Sandy and Beaver Canal down the Little Beaver, and the other crossing the summit and following down Block-House Run to the Ohio at the mouth of Yellow Creek.

With the greater part of the latter route I was already familiar from former examination, and I did not therefore go over it. Of the former line I made a somewhat hurried examination and am able to give the following general report.

The distance from New Lisbon to the mouth of the Little Beaver, following the windings of the stream, is 26 miles. The difference of level between Lock 15 in the town of New Lisbon and low-water mark on the Ohio, is 302 feet. The necessary difference of Rail Road levels would be about 260 feet, or 10 feet per mile. The grade is therefore peculiarly favorable.— following the line of the canal, there are also some advantages

which the Rail Road would derive from that abandoned work. In many places, and for long distances, the grading already done would be immediately available; and the forty locks scattered along the line, all built in a most elaborate and massive style of masonry, will probably supply an amount of material already finished and furnished where wanted, sufficient for all the purposes of construction required.

The mineral resources of this route are fully equal to those of any part of the line already located, and would perhaps contribute as much or more than any equal area to the business of the Road.

The geological formation is nearly the same for the entire distance, and the strata exposed at New Lisbon, or their equivalents, form the banks of the stream to its junction with the Ohio.

There are, however, some changes noticeable in the composition and thickness of some of the strata, which have a high scientific interest, and which materially effect their economical value. To the first I can only allude; the second I will briefly indicate.

Coal.—The lowest Coal-Seam exposed at New Lisbon (McClymonds), follows with its dip the fall of the stream nearly to its mouth, the local waves of the strata sometimes carrying it below the water level, but it usually lies a few feet above it. A mile and a half below the town, at the mines of Messrs. Baker and Green, where this coal is quite extensively worked, it appears well, having nearly the thickness and quality which it exhibits at McClymonds's mine above the town. From this point the thickness of the stratum gradually diminishes, and below Elkton it becomes scarcely workable.

The black slate of New Lisbon, which, I have said, is the equivalent of the cannel coal of Canfield, and of the Washingtonville coal, at Elkton contains a foot of bituminous coal in its lower part. Four miles below, on the farm of Levi Williams, this stratum has increased to $3\frac{1}{2}$ feet in thickness, with another foot of coal 5 feet above it; below it, McClymonds' coal, less than two feet thick, and the black slate over it converted into an impure cannel, which has been worked to some extent. Thence,

to the mouth of the river, this coal is almost constantly visible, and is opened in many places. It becomes gradually thinner, however, and on the farm of Charles Fulke, three miles above the mouth of the creek, it is only two feet in thickness but of good quality.

Near the middle of the section exposed to the bluff opposite the town of New Lisbon, is a thin seam of coal which I have referred to, as occurring first in the hills near Green Village. In the immediate vicinity of New Lisbon it is about two feet in thickness, and may be found in Arter's Hollow, and in many other localities. Within two miles of New Lisbon this seam becomes much thicker, and one of the most valuable in the series. On the *Whan farm*, it lies about fifty feet above Green & Baker's coal, is four feet thick and of excellent quality. The black slate lies about twenty feet below it; its characteristic fossils, *Solenemya*, scales of *Elonichthys*, teeth of *Diplodus*, &c., as at Canfield, Washingtonville, and New Lisbon.

The Whan Coal is jet black and resinous in appearance, having the hackly fracture and the general aspect of the Brier Hill coal, which it also somewhat resembles in composition, though more bituminous, softer, and containing rather more sulphur iron, and a larger amount of ash.

My analysis gave the following as its composition,—

Fixed Carbon,	-	-	-	-	-	-	55.22.
Bitumen,	-	-	-	-	-	-	39.93.
Ashes,	-	-	-	-	-	-	4.85.

Coke 60.07 pr. ct. Hard and bright, retaining in some degree the form of the coal. Of gas it yields 4 cubic feet pr. lb. of good quality.

The ash is buff in color, containing a small quantity of iron and silex, and will not produce any considerable amount of clinker.

This is a hard, open-burning coal, containing but little injurious impurity, and will serve an important purpose in the reduction of iron ores which abound in the same region.

On the opposite side of the creek, on the lands of Mr. John

Kemble, this seam is again seen, exhibiting the same characters; and from this point to the Ohio it is found in all the hills lying back from the immediate bank of the stream.

Still higher in the hills is found the white limestone. Below it is intercalated a thin seam of coal, and above it lies the Big Vein of the Arter and Shelton farms. This coal is found in all the country lying between New Lisbon and the river, but nowhere observed by me has a greater thickness than $4\frac{1}{2}$ feet. Like the Whan vein, it varies from 3 to $4\frac{1}{2}$ feet.

Above the "Big Vein," coal seam No. 7 is found wherever the hills are high enough to receive it over all this region, but it is generally thin.

It is claimed that Coal Seam No. 8, or the Pittsburgh seam, is found in the tops of the hills bordering the Ohio, but I was not able to discover any traces of it.

I was much interested in finding a perfect accordance in the geology of the hills from the Arter farm to the Ohio. They are composed of the same strata, and show conclusively that they are but portions of what was once a continuous plateau, the vallies, which now separate them, frequently from 300 to 400 feet deep, being due entirely to the erosive action of water. The same remarkable uniformity of altitude and geological structure prevail in the hills of a much larger area than that I have cited, as I have traced the strata which compose them throughout Columbiana, Carroll, Tuscarawas, and a large part of Jefferson counties. Of the strata which compose the summits of the hills in all this region, one of the most distinctly marked, is, what I have termed the *upper conglomerate*, a sandstone, often dark-red in color, lying above the "Big vein," and filled with very small quartz-pebbles, generally not larger than a grain of wheat, though sometimes of the size of a pea or a bean.

This sandstone (No. 5,) is largely developed near the mouth of the Little Beaver, and huge blocks of it undermined by the action of the stream, have fallen and now strew the slopes of the banks.

On the summits of the hills I found scattered blocks of lime

stone, which is doubtless that underlying the Pittsburgh coal seam.

Iron Ore.—The Iron Ores of the region bordering the Little Beaver are remarkably rich and continuous; in their aggregate quantity, excelling those of any other portion of the Alleghany coal field which I have examined.

The bed of kidney ore which I have mentioned as lying over McClymonds coal seam, and fully exposed at Hephner's Hollow, extends with varying richness quite to the Ohio. At Green's mine, below New Lisbon, it is seen lying over the coal. The ore is here of good quality, and contains about 40 per cent metallic iron; farther down, it is visible below Elkton, at Williamsport, and at many intermediate points. In some localities it forms a good black band ore, and at others, the two varieties are combined. At Fare's, below Fredericktown, on the north side of the stream, it is a meagre black band; on the other side the shale is more arenaceous, and the iron has formed with it a remarkably compact, blue, micaceous sandstone, containing a large proportion of protoxide iron, which, when peroxidized converts the whole into an ochery mass.

On the farm of Chas. Fulke, 3 miles below, it is again a rich kidney and black band ore.

Above this stratum comes the limestone ore noticed as occurring on the "Old Furnace" property, near New Lisbon. This deposit is traceable nearly the entire distance from New Lisbon to the Ohio. On the farm of Wm Kemble, Esq., at Elkton, it is a very pure limestone 4 feet in thickness, of which the lower foot is highly charged with iron. It usually occurs as a calcareous ore varying in richness from 35 to 42 per cent. metallic iron, and over the greater part of this line may be estimated as furnishing a continuous sheet of one foot in thickness, of ore of this quality.

Upon this calcareous layer rests the black slate, which at the entrance to Hephner's Hollow, contains some diffused iron. As we descend along this line of the canal, the quantity of iron increases, and it ultimately becomes an important ore bed. On

the Whan farm, the lower portion of this slate or shale contains a layer of rich black band ore, the best specimens yielding 32.606 per cent. iron, and the poorest 22.464; but it also contains so much sulphur as seriously to impair its value.

Between Middle Beaver and Williamsport, this stratum is exposed in several places, lying upon the coal, from 8 to 10 feet in thickness, mingled black band and kidney ores. On the farm of Mr. Fare, near Fredericktown, it is 10 feet thick of similar character, and quite rich. Still further down, on the farm of Chas. Fulke, it is 5 feet thick. I also observed it at many intermediate points, which do not require separate notice.

I have estimated the amount of iron ore along the course of the Little Beaver, below New Lisbon, as equivalent to a continuous bed of ordinary richness, ten feet in thickness on both sides of the stream to the Ohio.

To show that in some localities at least, this amount is much exceeded, I give a section of the rocks on the banks of the Little Beaver, 3 miles above its mouth, on the farm of Chas. Fulke.

	THICKNESS.		REMARKS.	
No. 1	Shale and sandstone to top of hills, perhaps containing a thin seam of coal,	50 feet.	The upper seams of coal are not opened on this farm, but are in many places in the vicinity.	
" 2	Coal,	3 "		
" 3	Fire clay,	3 "		
" 4	Sand-rock,	40 "		
" 5	Shale,	10 "		
" 6	Coal,	3½ "		
" 7	White limestone,	6 "		
" 8	Shale and shelly sandstone,	20 "		
" 9	Coal ("Whan Vein,")	1½ "		
" 10	Fire clay,	2 "		
" 11	Sand-rock, shelly above,	25 "		
" 12	Kidney and black-band ore,	5 "		K. ore 44.834 pr. ct. iron.
" 13	Bit. Shale,	3 "		

	THICKNESS.	REMARKS.
" 14 Coal (worked,)	2	"
" 15 Fire clay,	3	"
" 16 Kidney ore,	8	"
" 17 Black band,	5	"
" 18 Blue Shale,	1	"
" 19 Coal,	$\frac{1}{4}$	"
" 20 Fire clay,	1	"
" 21 Shelly sandstone,	20	"
" 22 Kidney ore,	5	"
" 23 Block ore,	1	"
" 24 Shale,	33	"
" 25 Sandstone to river,	20	"

{ Var. A. 39.476 pr. ct. iron.
 } Var. B. 45.192 pr. ct. iron.
 Best 12 inches 31.030
 pr. ct. iron.

Salt Springs.—At Several points near New Lisbon and below, salt springs occur, which have led to the supposition that salt might be obtained from boring at these places; and, in fact, boring was many years since commenced $1\frac{1}{2}$ miles below New Lisbon, but the works was stopped by an accident before the salt rock was reached.

The "Salt Rock" (conglomerate) has been struck in many places on Yellow Creek—of which the valley lies but 12 to 15 miles from that of the Little Beaver—at the distance of 300 to 600 feet, and salt is now made in considerable quantities at Salineville, from brine derived from one of these borings.

There is little doubt that the salt rock may be reached anywhere in the valley of the Little Beaver, at a depth not greater than 500 feet; and from wells sunk in that region, as on the Kanawha, Muskingum and Yellow Creek, salt may probably be profitably manufactured.

Water Power.—In estimating the claims of this route, the water power which will permit mills to be established on every mile of the Road, should not be omitted.

This water power, fed by springs coming from the coal-seams, is copious and never-failing. During all the unprecedented drought of the past year, the fine mill of Mr. Culbertson, at Fredricktown, continued to run without the loss of a day; and this was the case with many others.

NEW LISBON TO LINTON.—BY BLOCK HOUSE RUN.

The grade on this route must necessarily be very heavy in crossing the summit; subsequently no formidable obstacles would probably be encountered.

The geological structure of this route would be essentially that of the Yellow Creek Valley, which, though less rich in iron than that of the Little Beaver, exhibits a greater concentration of coal than exists perhaps anywhere else west of the Alleghanies.

To show the mineral resources of this region I subjoin a section of the rocky strata on Yellow Creek—such as prevails, with local variations, from the Summit to the Ohio river.

Of the *quality* of the coal and ores, I have not now time to speak. I have, however, made analyses of all of them, and can say that they will compare favorably with any similar group of minerals in the country. One of these coals, the “Strip Vein” (No. 18) is of peculiar excellence, and is now very extensively used in the lake-cities as a gas coal.

Furnaces are now building on Yellow Creek to be supplied with all their raw material from that region.

SECTION OF THE STRATA ON YELLOW CREEK.

		Thickness—Feet.
No. 1	Red sandstone,	-
“ 2	COAL,	1½ “
“ 3	Fire clay,	2 “
“ 4	Shale,	90 “
“ 5	Limestone,	10 “
“ 6	Shales, sandstones, and iron ore,	78 “
“ 7	COAL, “Groff Vein,”	4 “
“ 8	Fire clay,	3 “
“ 9	Sandstone and shale,	102 “
“ 10	COAL, “Big Vein,”	7 “
“ 11	Fire clay,	5 “
“ 12	Sandstone,	30 “
“ 13	Limestone,	8 “
“ 14	Shale and sandstone,	70 “
“ 15	COAL, “Roger Vein,”	3 “
“ 16	Fire clay,	3 “
“ 17	Shale with iron ore,	50 “

" 18	COAL, "Strip Vein,"	- - - - -	2½	"
" 19	Fire clay,	- - - - -	12	"
" 20	Shale,	- - - - -	8	"
" 21	COAL, "Creek Vein,"	- - - - -	4	"
" 22	Fire clay,	- - - - -	3	"
" 23	Shale and sandstone with iron ore,	- - - - -	20	"
" 24	COAL,	- - - - -	1	"
" 25	Yellow Creek at mouth			

APPENDIX.

To give to my report the greatest possible practical value, I have thought best to add to it, in the form of a brief appendix, some facts in reference to the mode and cost of mining and manufacturing the minerals found in the country traversed by the A. & N. L. R. R., to the cost of their transportation, and to the markets which are opened to them.

COAL.

Cost of Mining.—So many conditions, such as thickness, hardness, facility of drainage, nature of the roof, amount mined, &c., &c., affect the price of mining to such a degree, that only a general rule applicable to cases which present no extremes, can be given for it. The cost of mining usually consists of several distinct items, viz: the price per ton paid the miner, the dead work and superintendence, outside expenses, and interest on capital.

The price paid the miner in Ohio and Western Pennsylvania varies considerably with the seam and somewhat with the season. It may, however, be estimated at 45cts per ton, in a 6 feet seam, 55 in a 4 ft., 70 in a 3 ft., and \$1 in a 2 ft. seam; the miner furnishing his tools, lights, and powder.

In an ordinary coal-seam 4 ft. in thickness, miners will average 3 tons per day; many of them considerable more.

The "dead work," *i. e.* driving entries, turning rooms, taking up bottom, &c., &c., varies so much, that not even a general rule can be given for it. In a coal seam of 4 ft. in thickness, the

entry, which to admit a mule or pony should be at least 5ft. high on the rail, and 7 ft. wide across the rail, well timbered and laid with a good tram road, ties, 3 ft. apart, will cost \$5 per yard linear.

When the coal is fairly reached the cost of driving entry is much less, sometimes being all paid by the coal taken from it. The cost of superintendence, weighing, screening, and putting on railroad will necessarily vary greatly in different cases. These expenses rarely fall below 50 per cent, and rarely rise much above 100 per cent on the price paid for mining proper. A safe general estimate applicable to many cases is to compute the cost of the coal on the R. R. cars, as double the price paid the mine. Including interest on capital and all incidentals, this is scarcely too large an estimate even for mines favorably located.

In connecting mines with the railroad the cost of the tram road will depend upon the difficulties of grade encountered, the proximity of timber, and most of all on the style of road adopted. Where no heavy grading is required, an excellent road, with ties six inches square, 3 feet apart, rails $3\frac{1}{2}$ by 5 inches, capped with strap rail $2\frac{1}{2}$ by $\frac{1}{2}$ in., may generally be constructed for \$3,000 per mile.

When the grading is light and timber cheap, a good road may be made with iron $1\frac{1}{2}$ by $\frac{3}{8}$, for \$1,500 to \$2,000 per mile.

COST OF TRANSPORTATION.

The rate of transportation of coal on the C. & P. R. R. was formerly, for considerable distances, $1\frac{1}{4}$ cts per ton (of 2,000 lbs.) per mile; two years since the price was raised to $1\frac{3}{4}$ cts, which is the present rate.

On the Reading R. R., the great coal road of Pennsylvania the price of transport has usually been about 2 cts per ton (of 2,240 lbs.) per mile. This Railroad cost more than three times as much as any Western Road of equal length, and of course pays a proportionate interest, and yet its business is highly remunerative. It should, however, be remembered that it is also immense.

The grades of the A. & N. L. R. R. will be somewhat lighter than those of the C. & P. R. R., and coal can be sent to the Lakes at least as cheaply by the former Road as by the latter.

The cost of transport need not, therefore, exceed $1\frac{3}{4}$ cts per ton per mile; and I should hope it might be done for $1\frac{1}{2}$ cts. I would, however, suggest that the tariff of prices be as high as is *necessary* at first, so that if a change be made it may be a reduction, and not an elevation of the price; as a contrary change might have a ruinous effect on enterprises before remunerative; and the true interests of a Railroad are inseparable from those of its patrons.

If we reckon the price of a ton of coal put on the cars at each of the places where it may be extensively mined, at \$1, and the handling and dockage at Ashtabula at 25 cts—a liberal estimate—we shall have for the cost of the coal on ship board, or at least delivered in market, to be as follows:

Niles 50 miles,	\$1.00 × 87½ × 25—	\$2.12½ per ton.
Austintown, 55 miles,	1.00 × 96 × 25—	2.21 “ “
Canfield, 60 miles,	1.00 × 1.05 × 25—	2.30 “ “
New Lisbon 80 miles,	1.00 × 1.40 × 25—	2.65 “ “
Washingtonville, (seam thinner) 70 miles,	1.50 × 1.23 × 25—	2.98 “ “

Iron Ore.—The cost of mining ore is even more liable to variation than that of coal.

In Ohio, up to the present time, but little iron has been mined by drifting; the ore bed has generally been “stripped” at its out-crop, the cost of stripping depending on the nature and the amount of overlying material. For a rich ore, it is said that a foot of earth can be profitably removed for every inch of ore, but this estimate is based upon a certain relation between the value of labor and of the manufactured article which would not always obtain. In some instances which have come under my observation, the price paid for digging ore has been from 75 cts to \$1 per ton.

Where the ore forms the roof or floor of a coal-seam, they can of course be very profitably mined together; the coal being first mined and the ore brought down or raised by powder or wedges.

The consumption of ore will be, in a great degree, local, and much less will be transported over the Road than of coal, but the furnaces now established in Mahoning county carry a large portion of the ore which they use, in wagons, and will doubtless make use of the Railroad when it is completed.

The price paid for ore at Youngstown has varied from \$3 to \$3.50 per ton.

In working the ores of this region, manufacturers will find it desirable to avail themselves of the great variety in the ores which are distributed along the line Road. The skill of the iron master is nowhere shown to greater advantage than in the mingling of ores; a process from which he derives results as decided and satisfactory as the painter from the blending of his colors. With a judicious combination of the materials here attainable, there is nothing in the manufacture of iron which is elsewhere accomplished, which may not be as well and as cheaply done here.

The black-band ore, as a general rule furnishes an iron which is highly carbonized, contains some sulphur and phosphorus, fuses at a low temperature, flows freely, and gives a smooth and handsome surface to the castings made from it. It is therefore better adapted to foundry purposes than to the manufacture of bar iron. In some cases, however, it yields a soft and tough iron.

On the other hand, the kidney ores, especially such as are fine grained, liver-colored, and show nowhere crystals of the sulphurets of iron or zinc, yield a coarse grained, soft, tenacious iron, which is readily made malleable. If the kidney ore is blue, brittle, and contains crystals of sulph. iron, it will make a hard iron.

The calcareous ores vary in quality, but often furnish an excellent iron.

Of these different varieties an abundance of each is to be found on your road, and whatever can anywhere be done with coal measure-ores, can be done with them. The excellence of the iron produced by the Hanging Rock and Massillon furnaces from similar ores is an indication of what may be done with the carbonates of Ohio.

A still wider range of combination than that of the Ohio, ores

may also, be profitably adopted by manufacturers upon the A. & N. L. R. R. I allude to the union of the specular and magnetic ores of Lake Superior and Lake Champlain with the carbonates of the coal series.

This combination has already been made with the best possible results by Genl. Curtiss, at Sharon, Pa., and for its accomplishment every facility is afforded by the Ashtabula & New Lisbon R. R.

Lake Superior ore can be delivered at Ashtabula or Cleveland, at \$8 per. ton, containing 60 to 70 per. cent. pure metallic iron. This may be brought down the road by returning coal cars, and deposited at points where the fuel and the carbonates are associated, at a price which will be much more than repaid by the benefit derived from it.

In determining the amount of iron contained in the ores which I examined, I have made use of Penny's process, by bichromate of potash, which gives only the per cent. metallic iron. This is simpler than any other process, and gives apparently accurate results. The quantitative analysis of each variety of ore would have consumed much more time and money than were allotted to the work.

Since the report was written, I have received from Messrs. Jas. Ward & Co., the following interesting letter which I am happy to say, confirms all I have said of the value of the Black band and other ores of Mahoning and Columbiana Counties.

This letter is of the greater importance, as it embodies the results of many years experience in the use of the materials on which I am called to report.

NILES, Dec. 17th, 1856.

DEAR SIR: * * * We have been using the Black-band ore at our blast furnaces for more than three years past. We have used it in various ways, and with a mixture, sometimes of "Hard Blue Rock Ore," sometimes with Kidney ore, sometimes with Lake Superior or Lake Champlain ore, and sometimes by itself.

Having been the first discoverers of this ore in this country, we gave it a fair trial in every possible manner, and are happy to inform you, that it works well in any mixture, and when used alone, it produces the very best of foundry iron, open grained

and strong; in fact, it is superior to the "Scotch Pig" for foundry purposes.

Three and a half tons of raw ore will make a gross ton of pig metal, and two and a half of roasted ore will do the same. It is very easily smelted, requiring but two tons of coal to make a ton of metal, while our other ores require three tons of coal for a ton of iron.

One of our furnaces was running on rock and kidney ores, and making 50 tons of metal per week, when we changed her on to the Black-band ore exclusively, and she ran up to 68 and 74 tons per week; showing how easily it is smelted.

When the Black-band ore is mixed with our native ores, or Lake ores, say $\frac{1}{3}$ to $\frac{1}{2}$ Black-band, it will make a good quality of iron for forge purposes.

We have made, and we are now making a first rate article of pig iron, from a mixture of $\frac{1}{3}$ Black-band ore, $\frac{1}{3}$ Rock ore, and $\frac{1}{3}$ "Tap Cinder" from our boiling furnace at the Rolling Mill. We manufacture all our pig metal into bar iron and nails, and the bar iron is "as good as is made in the western country." So say our customers.

We have been manufacturing here for some fourteen years, and when stone-coal iron first came into use, it was an up hill business to get it introduced; but we have persevered till we have accomplished the manufacture of bar iron from stone coal metal exclusively, *and that of a quality suitable for locomotives and cars, for which it is extensively used.*

We worked here the first pig metal that was made with raw stone-coal in the United States. We have used it (raw coal) ever since, and now we use nothing else.

When we say that $3\frac{1}{2}$ tons of black band ore are required to make a ton of iron, we mean ore taken just as it comes from the bank; if it were selected $2\frac{1}{2}$ tons could do it. The ore lies under our coal, and in raising it considerable coal sticks to it sufficient to roast the ore without any additional fuel.

We consider this the best location for manufacturing iron in the States, as we have vast fields of coal and iron ores of almost all varieties, convenient to the lakes. All the Lake Superior and Canada ores must be brought here to be smelted, as this is the first point where they meet the fuel and mixture of other ores.

The coal has been tested and found to be the best adapted for iron, of any in the country. It is now used by six blast furnaces.

Yours respectfully, JAS. WARD & CO.

Prof. J. S. Newberry, Washington, D. C.

MARKETS.

The markets open to the coal of the A. & N. L. R. R. are those of the Ohio and the Lakes.

Of these, that of the Ohio with its connections is almost infinite, but the borders of the Ohio are so liberally furnished with this indispensable article, that it can be furnished in the river towns at a price which requires that it should be put on the river, at an extremely small cost. It is, therefore, doubtful if at present, this market would offer any attractions to miners at all removed from the immediate bank of the stream.

The shores of the Great Lakes, destined to be occupied by a population more dense than that of any other portion of our country, are entirely destitute of deposits of this, better than the philosopher stone.

Thence, we may expect a great and constantly increasing demand for coal, which can be furnished of good quality much cheaper from Ohio than elsewhere, and from no part of Ohio so cheaply and so well, as from that traversed by this Road.

The coal trade of the Lakes is immense, and yet the first ton of bituminous coal used on Lake Erie or its shores was sent to Cleveland from the Tallmadge mines in 1828, by my father, Henry Newberry, Esq., of Cuyahoga Falls.

The coal trade of Cleveland has since increased with great rapidity.

In 1840 it amounted to		5,065 tons.
“ 1850	“	83,850 “
“ 1851	“	103,233 “
“ 1852	“	140,000 “
“ 1853	“	“
“ 1854	“	250,000
“ 1875	“	318,611 “

Notwithstanding this enormous increase, the price of coal has constantly advanced.

In 1850 the highest price paid for coal in the Cleveland market was \$3,50 per ton; in 1856 the same coal was uniformly sold for \$4,50 per ton.

The coal trade of Erie exhibits a proportionate increase, and there has seemed to be no possibility of glutting the market.

