

OFFICE OF STATE GEOLOGIST,
INDIANAPOLIS, INDIANA,
December 1st., 1873.

*To the Hon. President and Members of the
Indiana State Board of Agriculture :*

SIRS :—I herewith submit to your honorable body my
Fifth Report of progress in the Geological Survey of the
State, embracing observations made during the year 1873.

Very Respectfully,

E. T. COX,
State Geologist.

REPORT

ON THE

VIENNA EXPOSITION OF 1873

Under an Act of the General Assembly of the State of Indiana, I was appointed, by His Excellency, Thomas A. Hendricks, Governor of the State of Indiana, Commissioner to represent the State at the Universal Exposition to be held at Vienna, Austria. From the date of my commission, given immediately after the passage of the law, but ten days could be relied upon for collecting together such natural products of the State as were deemed important to properly represent our resources in agriculture and mines. It was found impossible in so short a time to make a showing of the agricultural products of the State that would do even half way credit, in this line, to her great resources, consequently the few specimens gratuitously sent in for the purpose were not thought of sufficient importance to be shipped, believing it was best to leave undone that which could not be made creditable to a State so justly celebrated for the products of its soil.

In order to be able to exhibit samples of native timber, I could do no better than employ Mr. O. B. Gilkey, an experienced carpenter of this city, to visit the nearest saw mills

and procure sections of such logs as they chanced to have on hand; and though we were unable, in this way, to get specimens that approached near to the maximum size of our giant forest trees, and that would even reach the medium size of some of the species represented; still, taken as a whole, they might be considered as exhibiting the average diameter of timber daily received at the mills of this city.

Of the more than ninety species of trees in the State we were only able to get the following:

Poplar, black and white walnut, red and white oak, elm, maple, sycamore, beach, cherry, hickory and ash.

Mr. B. F. Morris, Superintendent of the Sewing Machine Cabinet Company, furnished me with a collection of veneering cut from a variety of our most beautiful cabinet woods. This collection, imperfect as it was, elicited much attention at Vienna, and, with the exception of a few pieces of plank from Louisiana, comprised all the timber I saw on exhibition from the United States.

The display of woods from Brazil, Austria, and especially Hungary, was large, and in point of beauty and finish the Hungarian ash was not surpassed, if equalled, by any timber on exhibition.

In minerals, especially coal, I was enabled to make a better showing. Large, characteristic specimens of Caking coal, Block coal, and Cannel coal, were obtained from mines in various counties of the State. Along with the coals were specimens of pig-iron smelted with raw block coal, clay iron-stone from the coal measures, fire clay, fire brick made from the clay, building stone and specimens of various colored ochres [from Owen, Greene, Martin and Dubois counties.

The specimens shipped reached Vienna in good order, and through the kindness of my friend John A. Warder, M. D., Commissioner from Ohio, they were very advantageously arranged near the center of one of the transepts in the United States Department.

In addition to the natural products of the State I prepared a pamphlet, of which eight thousand copies were published

in English and German, for distribution along with the Geological, Agricultural and School Superintendent's Reports. Col. W. R. Holloway also sent over a box of "Holloway's History of Indianapolis," to be given to those who desired them. In the distribution of books treating of the mineral, agricultural and educational advantages of this country, our State was unsurpassed, and it cannot fail in producing good results.

The coal and iron, especially the fine large cubes of block-coal, were examined with the greatest interest by the European iron masters, and was of no less interest to the International jury who were appointed to examine into the character and merits of all the minerals on exhibition. This jury was made up of distinguished geologists and mining engineers from the different countries, and after a careful examination of its merits made the State an award of a medal.

The display of fossil fuel, at Vienna, from the various countries of the Old World, was large and very fine, some of the most important mines sending large blocks that represented a section of the entire thickness of the seam. All these thick seams represented, show a number of clay or shale partings which divided it into so many members, each varying from the others in its physical structure and apparently with regard to the amount of pyrites or sulphur stone which it contained.

A block from Kadno, Bohemia, was six and a half metres, or twenty-one and one-third feet thick, and contained five well defined partings or bands of clay and shale. The depth of the shaft to the coal is two hundred and eighty meters, or nine hundred and eighteen and a half feet. It is a caking coal, shining black color, somewhat friable, and the seams are filled with scales of calc. spar. It appeared to be comparatively free from pyrites, and the coke made from it looked strong and good. Another great pyramid of coal, on exhibition, was from Kubekschacht, Bohemia; depth of the shaft three hundred and sixty meters, or eleven hundred and eighty one feet. This seam is 11.4 meters, or thirty-

seven feet thick, and contains seven clay partings of considerable thickness. Both the coal and the coke made from it, looked to be of a good quality. West Bohemia sent some fine large blocks of cannel coal and a beautiful display of jet ornaments made of it; such as cups, vases, goblets, etc., etc., of which the color and finish was good.

The coals of Belgium were also extensively displayed, and they are among the best coals of Europe for coking.

From Italy there was a variety of specimens of brown coal showing woody structure; peat and charcoal, and specimens of the wood from which the charcoal was made, which indicated that mere bushes or saplings were appropriated for the production of the latter kind of fuel.

The pig iron, finished bar iron and steel made with these fuels was of good quality. Spiegeleisen was also one of the metals in this collection.

India had coal which in character is midway between brown coal and a bituminous coal, and a large and instructive collection of other economical minerals which abound in that interesting country. Indeed, owing to the indefatigable industry of Dr. T. Oldham, Director of the Geological Survey of India, and his accomplished assistant, Mr. R. Bruce Foote, this was made one of the most attractive geological and mineralogical displays in the building. The India coals are supposed to belong to the lower Permian epoch, a position just above the true coal measures. Some of the specimens on exhibition looked very good, and coke made of them appeared to be a very fair article for metallurgical purposes, but it will be seen from the following summary of analyses, kindly furnished me by Dr. Oldham, that they must take a very low rank as a fuel on account of the large per cent. of ash which they yield. Of seventeen specimens analysed the total carbon ranged from 39.2 per cent. to 63.8 per cent., the water, oxygen, nitrogen and hydrogen from 25.6 per cent. to 38.5 per cent., the ash from 11.2 per cent. to 35.2 per cent.

The ash from two of the most largely used of these coals contained :

| | No. 1 | No. 2. |
|---------------------|-------|--------|
| Silica - - - | 48.3 | 42.0 |
| Alumina - - - | 32.4 | 31.3 |
| Peroxide iron - - - | 7.5 | 10.1 |

To judge by the large per cent. of water manifest in these coals, one would be inclined to give them a much higher place in the geological series than the Permian. The seams are from six and a half to seventeen and a half feet thick, and the depth of the shafts from seventy-seven to two hundred feet. In 1858 the amount of coal raised in India was 221,000 tons. In 1868, 484,370 tons, being rather more than one hundred per cent. increase in ten years.

A very fair quality of fuel is made in India by mixing the coal debris with rice water, then press the mass in a mold and dry it in an oven at a temperature of about 250° Fahr. But, as I have said, coal formed only a very small part of the economical minerals displayed from this rich country, and Dr. Oldham deserves great credit for placing before the visitors the wonderful resources which his survey has brought to light.

A very interesting section of brown coal was exhibited from Moravia in the Austrian department; it contains seven seams of coal separated from one another by thin clay partings. All together they represented over twenty-six feet of coal. Brown coal, though rather a poor fuel, is extensively used in Austria, Germany and other parts of Europe for household and steam purposes, the railroads being very good customers. For the latter use it is mixed with bituminous coal.

Probably, next to bituminous coal, peat or turf ranks as the most important fuel in Europe. All the sections of the Exposition, except the American, contained a good display of it, both as sun dried cubes and balls and as partly charred masses and coke.

Several models of ovens for coking turf were also on

exhibition, and when properly coked it makes a fuel that is not to be despised, even for metallurgical purposes.

In Austria, Bavaria and Switzerland, sun dried turf, mixed with bituminous coal, is extensively used on the railroads. The shed depots in which it is stowed for use resemble great barns. In the Austrian, Russian, French and Belgian departments, there was also exhibited specimens of fuel manufactured from coal dust mixed with some kind of bituminous oil and formed under great pressure into cubes or hollow tubes. But I saw nothing new in the processes used in the manufacture of artificial fuel, in the washing of impure coal or coal debris, or in coal mining machinery. And so with coal mining in general and the metallurgy of iron, there was little or nothing to be seen that was new beyond a greater perfection in the machinery in some parts of the latter department of industry.

After a careful study of the fuels so bountifully displayed at this great exhibition, from the four quarters of the globe, our countrymen could not help feeling how blest was the United States in this essential element to progressive arts and the welfare of man, and yet how meagre was the display which she had made. I trust, too, that I may be pardoned for the pride I felt in the exhibition of coal from Indiana, which looked none the less bright and good by comparison with the coals of the nations to which it was subjected. In the iron and steel departments, each country of Europe made a magnificent display. Here it was that the genius and power of man to subdue and render submissive to his will the dead minerals of the earth could be studied in the greatest perfection.

By the side of the crude iron ore and coke was seen the rough pig metal and bars of finished iron and steel, from sheets not thicker than ordinary writing paper to immense armor plates and shafts of wondrous size. Indeed, to go over all the ground in this department would fill volumes, and I cannot do better than introduce, instead of my own imperfect study of the resources of Europe in this branch of industry, a paper from my learned friend Hugh Hartmann,

C. E., on the iron and steel industries of Rhenish Prussia, one of the most important iron manufacturing districts of Europe. Mr. Hartman was for many years connected with the iron business of this country, and his paper cannot fail to be read with the greatest interest by those who desire to learn of the resources of districts which are becoming alarming rivals of the English iron masters, for even their home market.

The wonderful growth of the iron industry all over Europe, and no less in our own country, has brought the iron masters to seriously consider the extent of the ore and fuel beds at their disposal. Nowhere has this question met with a more serious and intelligent study than in Great Britain, where with a rapid increase in the cost of coal, ore and labor, her long and well earned fame as manufacturer for the world, is about to be questioned by her continental neighbors, and by this country, which has heretofore been her best customer.

At the time of my visit to Middlesborough, the capital of the Cleveland iron district, in the north of England, coal was selling at twenty-two shillings (\$5.50) per ton, and Durham coke at forty-two shillings (\$8.50) per ton. Cleveland iron stone, containing, on an average for raw ore, thirty-one per cent. of iron, was selling at thirteen shillings (\$3.25) per ton at the mines. Even with this price for ore I was told that there were fully eight thousand ore miners on a strike for an increase of wages, whose demands, if complied with, must add to its cost. Pig iron made from the Cleveland iron stone was selling at one hundred and ten shillings (\$27.50) per ton, which was anything but remunerative at the existing cost of coal and ores and the high price of labor involved in its production. At Middlesborough I received the kindest attention from the iron masters, and feel myself greatly indebted to Mr. John A. Jones, of the Ayrton Rolling Mill, and one of the Commissioners sent to this country, by the Iron and Steel Institute of Great Britain, to investigate the practical working of the Danks Machine Puddler. Mr. Jones took me to the Cleve-

land Hills, where we were hospitably received by Mr. George Lee, Superintendent of the Easton mines, and his son. The ore seam is here fifteen to twenty feet thick, and has an elevation in the hills of eight hundred feet above the plain of Middlesborough. About three thousand tons are mined daily. The miners are paid from seven and a half pence (15 cents) to fifteen pence (30 cents) per ton. About 2,500,000 tons of this ore are smelted annually in the Cleveland District; which produces from one-third to one half of all the iron made in the Kingdom. From the Easton mines we could look down upon the fires of one hundred and one blast furnaces that are smelting this lean ironstone which lay neglected and uncared for until within a few years past. All that now prevents this highly favored district from continuing in its brilliant career of iron production is the corresponding increase in the cost of coal, coke and ore. With these facts staring iron masters in the face they do not fail to see that if the increase of consumption of iron and coal continues in the present ratio for ten years to come, that demand must be met by the growth of the iron industries of America.

The immense coal and iron fields of the United States, many parts of which have been looked upon as worthless on account of their remoteness from lines of transportation, are being rapidly developed and made accessible to market by railway lines, so that good coal and iron ores, instead of increasing in value as in Europe, will become cheaper; and though labor may still command a higher price here than there, we are, nevertheless, fast approaching a point of development where defiance may be bid to the competition of the world in the manufacture of iron and steel.