DEVELOPMENT OF THE MINERAL RESOURCES OF THE MAHONING VALLEY, AND THE SURVEYING OF MINES.

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The discovery of Coal in the United States, and its uses, is an event of the present century. It is not definitely known when the Block Coal, for which the Mahoning Valley is famous, was first discovered. It was known to exist in various portions of the Mahoning and Shenango Valleys, where it cropped out in the ravines, at a very early day, probably as early as 1800, the township of Youngstown having been surveyed in 1797. As wood was plentiful and was an impediment to tilling the soil, coal was noticed but little, and then only as a curiosity. The Pioneers little thought the black stone which would burn, and which lay exposed in the ravines along the Mahoning, was destined to become a source of wealth to their children and develop the Valley into one of the most wealthy manufacturing regions in our country. Coal was little used, except for blacksmithing purposes, until the opening of the canal in 1840, when Governor David Tod sent a few boat loads to Cleveland to be used as an experiment for generating steam on the Lakes. But it was mined and shipped in a very small way until 1845, when Himrod and Vincent at the Clay Furnace, in the Shenango Valley, by accident, and Wilkinson Wilks & Co., at Lowell, in the Mahoning Valley, by actual experiment discovered that block coal could be used in its raw state for the purpose of melting iron. To these parties belong the honor of being the first in the United States to successfully smelt iron in a blast furnace with raw bituminous coal.

Since that time the production gradually increased until the completion of the Cleveland and Mahoning Railroad in 1857 when it received a fresh impetus and from about 1868 to 1772 reached a million tons annually, since which time it has gradually receded. Professor Newberry has fully described the geology of our region in the GeologicalReport of Ohio. And our worthy President very ably and clearly set it forth in his annual report of 1876.

There are still about thirty mines in active operation in this mining region, but the largest and easiest to work are mined out and abandoned. Many of them were free openings, but of those remaining all but one are either slopes or shafts. Of these and their dangers I will write more fully at some future time. In sur-

veying these mines the Mining Engineer is called upon and expected to perform a great variety of duties. First, he levels the drill holes, and locates the farm lines, and ascertains advantageous points for an opening, Then the kind of an opening is decided upon. Next he lays out the works, stakes out the railroad, and makes a drawing of the hoisting house, shutes, etc. Usually after the coal has been reached, the mining is pushed on until the remainder of the plant is completed; when he is again called upon to estimate the amount of coal taken out and credited to the proper parties. If it is not convenient for me to go at once I have the bank boss make a mark either in the roof or rib where he commenced weighing the coal, and then I estimate it at my leisure, as follows: After computing the area and finding the thickness from which I deduct the wastage, which is about double the amount that it is after the mine is fully opened, owing to the cutting of air courses, partings, sumps, etc., I then get the cubical content which is then easily converted into tons, a cubic yard weighing 2150 pounds. From this time on the engineer surveys the entry and rooms; transfers the land lines as they are reached into the mine; adjusts the royalty between the land owners; locates air shafts; levels through the mine for roads; drains; siphons; and he is frequently called upon to locate a slope, or man-way, for the hoisting of coal, or for men and mules to travel upon, where they drive from both bottom and top to meet at some point between. This is the most particular and difficult piece of work that can be given an engineer; as the space given him in which to perform his work is often very small, sometimes not over two or two and a half feet in height, and usually on a hill where the air is always the worst in the mine. This kind of work requires both accuracy and skill; but often the work is intrusted to workmen who know little and care less how they follow the directions or perform their work.

The mining engineer is called upon to examine mines as an expert, in regard to the manner in which they are being worked, their safety and condition, the quantity and quality of coal left in and to be taken out; he is also summoned as a witness where large amounts of money are at stake; is asked to act as referee between parties, and there are various other duties, to say nothing of the dangers to which he is exposed while on his perilous travels through the mines. In short, it requires a lifetime of experience and study to adequately fill the place expected of an

engineer, and for which services, few, if any, engineers are ever half paid.

I now come to the instruments employed in mining engineering. In the early days of mining in the Mahoning Valley, the surveys were made with a common compass, graduated to whole degrees, and mounted on a Jacob staff, the point of which was made very sharp, so that by a hard stroke it would stand in a tie and hold the compass. It was sometimes set in the debris that would accumulate in the corners between the ties and the rails. These surveys were made with the magnetic needle, and as there was no iron used on the road at that time, and the mines were small, it was sufficiently accurate.

After the mining of coal became a business, and strap iron, which has been recently supplanted with T iron, was introduced on the road, more accurate instruments had to be called into use. First, was the Vernier compass, graduated on one quadrant; this was rather a crude instrument, but answered in its day. Next came the transit, which is the most accurate of any instrument yet in use, but the objections against it are that it is a laborious job to level it, and on a long survey, making from thirty to fifty stations, a day will break any ordinary back. The guides also cast a shadow on the needle, which makes the reading unreliable. This is a great objection, as the needle should always be read to insure accuracy.

It is also a complicated instrument, and a small injury that may fail to be observed, will throw it out of adjustment and render the work inaccurate. Its weight, too, is a great objection, a transit suitable for mine work weighing not less than twenty-five pounds. This makes it top-heavy, and the uneven floor on which it sets, sometimes in mud, and sometimes in broken stone, and if allowed to stand any length of time between sights, it is liable to move.

The difficulty of seeing is a very great objection, as they are graduated very finely, there being apparently a rivalry among the manufacturers to see who can make the finest graduated instrument. The verniers being set quite deep below the plates, renders it with the dim light of the miners' lamp, almost impossible to be seen. Especially is this true, if the air of the mine is impregnated with black damp, when upon the least jar the lamp will go out altogether. The engineer's head will swim unknowingly

to himself, and the error of parallax will be very great, though he seem steady at the time. I have discovered this in checking over surveys made under such circumstances. The observation taken must be watched with great care that there be no obstruction on either side of the entry to interfere with the taking of the back sight and compel the taking the sight over again. The focus of the transit in the mine is the best recommendation it has. When it is in what engineer's term out of focus on the outside, it is in the best possible focus on the inside. The flame of the lamp then appears as large, and has the appearance of the setting sun, and the cross hairs are always discernable, and is easier on the eye than in any other way. The best instrument I have ever used is a railroad compass with a double vernier and a six-inch needle, mounted on a tripod with a shifting head, and with at least three inches throw. The long needle gives a fine opportunity to get the lamp in a position to see to read. The space on each side gives a place to set the lamp while putting down the notes. The vernier on such an instrument can be graduated coarse and can be easily seen. Being on a ball and socket joint, it can be easily and quicky leveled, and being mounted on a tripod, it will stand firmly; being furnished with a shifting head, it can be readily put in place, is easy to come apart, light to carry, not weighing more than ten or twelve pounds; it is strong, and no common injury will throw it out of adjustment. Observations taken with it are plain, and irregularities on the sides are more easily overcome than with any other instrument I have ever seen.

Next, as to marking. This is a subject of especial study, and so far as my observations go, has no rule among engineers, even in the same mining district.

In the early days of mining in our region, the stations were marked with holes in the roof, and the numbers placed on the top or rib with chalk. This practice is still in general use. Since the introduction of instruments mounted on tripods' nails are sometimes driven into the sleepers. In dry mines, or on black or grey slate, or sand-stone roofs, the chalk is as good as anything I have ever seen used; but in wet mines, such as are subject to being flooded, it washes and sweats off, and will not answer. In the mines at Washingtonville and Leetonia, in Columbiana county, where the roof is a species of slate that seems oily and constantly peals off, holes in the roof rarely standing from one survey to the next. Here chalk

will not mark with any satisfaction. In surveying these mines I resorted to the use of fire clay, by cutting crosses in the ribs and filling with clay, and had the numbers put on with the same, in the consistency of putty. The objection to this is the great amount of time required, and the constant strain on the Engineer's mind in taking reference to the marks. Some four years ago I tried white lead and oil, made very thick, as an experiment. This gave the best of satisfaction, being speedily put on, would not sweat off, could be put on the rough edges as well as the smooth, and was easy to be seen. I tried this in the Tuscarawas Valley, in the Nimsilla Mine, some two years ago, with the best results; here the roof is a flinty rock, impossible to penetrate with a pick, and constantly covered with globules of water, which the miners call "drippers"—here chalk would not mark at all. I visited some portions of this mine last spring, and found on entries pouring with water, and in constant use, the marks as clear and distinct as the day they were put on. My plan of marking here was by driving nails in the sills, and putting a cross with paint exactly over it, and the number on the rib. In the Mahoning, Shenango and Beaver Valleys, the roofs being either slate or rock, I mark my surveys with nails in the sills and holes in the roof, and mark the numbers on the side with chalk.

I now come to the subject of Lights During the early days of Mining and Mining Engineering, when the magnetic needle was relied on wholly to determine the course and extent of the mining, the tallow candle was generally used as a means of light for the miners, and fell naturally to the Mining Engineer, and at what date its use was superceded by a lamp I am not informed. I used a candle with a lump of fire clay for a stick, during my first surveys, not being able to get a copper lamp made in our vicinity. Now, every engineer has such a lamp, or a more tasteful and better one of brass. But few tinsmiths have the requisite skill to make a brass lamp, and they have *no* practical knowledge of the requirements of an engineer's lamp, which are lightness and a spout long enough to extend one-half inch above the lid, and large enough to hold from fourteen to sixteen strands of fine wicking. The quantity of oil consumed is of no consequence to the Engineer, and plenty of light facilitates the work, which is a greater consideration to the employer than the quantity of oil consumed, besides its relief to the eyes of the engineer. The lid is better to be screwed on, as

a hinge lid is liable to fly open and spill oil over ones notes, and perhaps destroy the work of a day or two. There should also be a tube on top for an air hole, to prevent the oil from flowing over and dropping. The lid should have a rim on the inside, so that it will hold a cork under the air hole. Such a lamp can be held in any position without spilling a drop of oil.

On the subject of oil I expect to write more fully at some future time. Prior to the panic of 1873 pure lard oil was burned for light in the mines. It burned with a clear light, giving off but little smoke, and in a close place did not seem to be of any especial injury to the air, and the light was uniform and required but little attention at the hands of the miner.

During the hard times following the failure of Jay Cook & Co. anything that was cheap was sought after. It was then that the various brands of miners' oil were introduced into the mines, all being branded as "pure lard oil," but bearing no resemblance to it at all, as it burns with a large flame and gives off a large amount of smoke, and if allowed to stand three or four days in a lamp will corrode, and the lid can hardly be raised, leaving the wick of the consistency and appearance of warm beeswax, and when lighted the smell is almost unbearable. In an entry ahead of the air, as all entries are, the lamp when filled with this oil pollutes the air more than the men and all other things combined. The wick is constantly crusting over and requires the constant attention of the miner to keep it flushed up to a uniform degree of light. This keeps the cloud of disagreeable smoke constantly arising, which inflames the eyes and throat; any one familiar with mining can tell by their eyes the men who work in the entries or ahead of the air; and I think many a poor miner who is gradually dying of asthma can attribute it more to the effects of the oil he has burned than anything else. The mining engineer who stands over his lamp and is constantly inhaling the smoke should shun this cheap miners' oil as he would a viper, and use his utmost to have its use abolished. I also call the attention of the Inspector of Mines to this subject.

The future for the mining engineer is very bright, as his field is rapidly expanding and his services are more and more sought after; but the dangers that attend it and the dirty and disagreeable labor that is connected with it render it a profession but little sought after by young men.

After the discussion of the papers closed, the President stated that since the meeting of the Institute, in January last, Thomas O. Davis, of Jackson County, a member of the Institute, had died having been killed by being caught in the machinery of the hoisting engine of a mine of which he was foreman. Mr. Roy paid a high compliment to the character of the deceased whom he had long known personally. On motion of Prof. Orton the President appointed a committee of two to draft appropriate resolutions in memory of the deceased. Mr. Thomas Middleton, of Pomeroy, and Mr. H. C. Mitchell, of Nelsonville, were appointed the committee, who reported the following resolutions which were unanimously adopted:

WHEREAS, it has pleased an all wise providence to remove from among us a worthy member of our Institute, Mr. Thomas O. Davis, of Jackson County, therefore be it

Resolved, That in the death of Mr. Davis the Institute has lost a worthy member, and society a good, useful and respected citizen.

Resolved, That a copy of the above Resolutions be forwarded to the wife and family of the deceased by the President.

A resolution was offered by Mr. Hazeltine directing the President to furnish the editor of the *Trade Review* with a list of members of the Institute, so that the paper might be sent to their address, which was adopted. In the absence of the regular Secretary of the Institute, the President was also directed to furnish the *Trade Review* with the official report of the proceedings of this meeting of the Institute and also with a copy of each paper read before the meeting.

An informal discussion was then had by the members from the northern part of the coal fields as to the proper time and place for holding the next meeting. All seemed to favor Youngstown as the place, and October as the date, but left the matter to the judgment of the President. It was then agreed that the visiting engineers from distant parts of the State should pass all day of Friday in examining the mines and the mining machinery in the leading mines of the valley. The meeting then adjourned to meet the next evening in the Dew House on the return of the visiting engineers from the mines.

FRIDAY'S PROCEEDINGS.

The first mine visited on Friday morning was the Half Moon Mines of the Akron Iron Co., situate at Buchtel, on Monday Creek. This mine, as are nearly all others in the Hocking Valley,

is opened on Coal No. 6, generally known as the Great Vein Coal. The engineers were taken in charge by Mr. Wm. N. Black, foreman of the mine; one attraction of this mine was the splendid ventilating furnace in use, which moves twenty-six thousand cubic feet of air per minute along the main airways of the mine; the furnace is 8 feet wide, 4 feet high above the bars, 24 feet long, has a double arch, and rectangular chambers or air passages on each side, its whole construction being alike mechanical and substantial in character. The manner of laying out the workings of the mine is by working rooms 30 feet wide leaving 10 feet ribs or pillars between rooms; two tracks are laid in each room; the pillars are taken out as soon as rooms are driven up their distance, which is one hundred yards usually. The entries are all double in the mine. The chutes were carefully examined and were found of recent and approved patterns, being modled after the dump or tipple in use at Brooks Mine but was less complex and apparently did equally effective work. The manner of assorting the coal was well arranged.

On returning from the mines the engineers were taken in charge by Mr. Buchtel, the general manager of the Akron Iron Company, who showed them around the furnace and the new store of the Company. This latter building elicited the admiration of the visitors, not less by the magnificence of the structure than by the elaborate and practical division of the compartments. The engineers were put under obligations to Mr. Buchtel for his courtesy and hospitality. No visitors will be required to "put both hands on and lock themselves up" who may call on Mr. Buchtel.

After dinner the engineers, in company with Mr. Buchtel, visited the mines of the Hocking Iron Co., at Orbiston, and examined the mines, accompanied by Mr. Palmer, the mining boss. They found the mine in excellent condition as to ventilation, the roads good and dry, and they examined with interest a self-opening trap-door which Mr. Palmer was trying to perfect.

The furnace of this mine has two side chambers through which air escapes without passing over the fire. Mr. Palmer has found by experiment that these side chambers increase the current of air fully two thousand cubic feet per minute, the maximum power of the furnace being 33,000 feet. This fact of the increase of current lead to quite a discussion among the visiting engineers; Mr. Hazleton taking the ground that there must be a mistake somewhere

in the calculation, as the cool air by mixing with the hot air which passes over the furnace would decrease the temperature in the upcast shaft and so lessen rather than add to the amount of current traversing the air galleries. Mr. Head believed the facts were as stated by Mr. Palmer; that side chambers invariably increased the current, while it at the same time lessened the consumption of coal in the furnace. It was finally agreed to discuss the question before a meeting of the Mining Engineers.

The next mines visited were the Longstreth Mines, in which five Lechner Mining Machines were at work. The party was accompanied by Mr. Thomas Black, Supt. of the Akron Iron Company's Mines, to whom the engineers are under obligations for this and other courtesies extended to them. The Lechner Machine is quite differently constructed from the Harrison, the cutter consisting of a horizontal bar 3 feet long into which a number of knives are inserted. A groove four inches in height, 3 feet wide and 5 feet in depth is cut in the bottom of the coal The weight of this machine is 1,500 pounds, and it seemed to impress the visitors more favorably than the Harrison, as it makes less waste and cuts faster. Both machines are ingeniously constructed. Mr. Thomas Berry, Supt. of the mines, and Mr. Henry Engles, mining boss, placed the party under obligations for kindness extended. The visitors were rather late in reaching the Longstreth Mines, and regretted not having a better opportunity to examine the Lechner Mining Machines.

In the evening another meeting of the Institute was held in the Dew House to finish up the business of the session. A programme for a meeting to be held in Youngstown was again discussed and this place was agreed upon for the next meeting which, will be made upon the call of the President, and be duly announced in the columns of the *Trade Review*. The session then adjourned, all the members highly delighted with the results of the meeting.