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*PRACTICAL MINING SURVEYING.*

BY R. S. PAUL.

The first coal mines opened in our State were drift mines, and until of late years the extent of their workings required little assistance from the surveyor and none from the mining engineer, what little mine surveying was done was of the rudest character, reliance being placed on the magnetic needle alone for guidance in tracing the underground lines. The short distances to be determined made this class of work suffice. But even this aid from the surveyor was not generally employed, and the points in the bank were often located by striking with hammers on rocks on the surface and estimating by the sounds so produced the corresponding points below. Very few mine superintendents were skilled or educated men. Coal was cheap with but slow sale for it. Wood, chiefly used as fuel, was abundant, with a seeming necessity to get rid of it as fast as possible, while the means of transportation were very limited; hence there was little call to even locate lines of ownership. But all this is now changed and the practical miner, costly machinery, the skilled superintendent and the educated mining engineer are in demand. Already many localities once supposed to possess inexhaustible stores of coal are being rudely awakened to the fact that the wanton waste in the past if continued but a short time will render their coal fields worthless, and that the mining of coal is a business demanding the best of talent. The mining engineer has gradually become a necessity to the working successfully of our Ohio mines, nor can his work be successfully undertaken by the superintendent or anyone else. Mining engineering is a profession in itself, demanding especial skill and its own line

of instruments. Let us now define what are the duties of the mining engineer in our State, furnishing also an outline of his work.

The mining engineer must be possessed of the theory of land surveying, and of its practical application. He should have a general knowledge of civil engineering. He should be a good mechanical draftsman, and acquainted with the geology of his section or valley, and of the different methods of working a coal mine, the sinking of shafts, prospecting for coal, and with the construction and working of mining machinery. In engineering in all of its branches the engineer is the one who directs, who marks the way, who plans the work. Until lately in our State, owing largely to the facts already stated, the superintendent in most cases performed all the duties of the mining engineer—excepting, perhaps, the land surveying branch—in addition to his own proper duties; and to some extent this is the case still. If he performs all his own duties as superintendent, he does well; but if in addition he is the underground boss and the mining engineer of his mine, he is one of the hardest-worked men we know of, and must soon break down; nor can he give his full attention to his own proper business. The result has not been unfrequently the neglect and financial ruin of the mine. However, his employers do not as a general rule ask him to mine coal in addition, but do in some cases require him to keep the books, pay the men and sell the output. Where the superintendent, under such circumstances, has been neither skilled nor educated, and the employers grossly ignorant of all that pertained to coal mining, it is not surprising that mining should have proved so frequently ruinous. In a mine in the Tuscarawas Valley, a superintendent, confident in his capability of judging for himself of the direction to drive an entry to meet the workings, after expending over \$1,800 in the attempt, called on a mining engineer to locate the points for him, who found out that the entry had been driven to a point some distance further from the point desired to be reached than where he commenced. Instances could be cited where shafts have been located by the mine superintendents that did not reach the point desired within several hundred feet, requiring a mining engineer to be subsequently employed and a new shaft sunk. In short, it can truthfully be said that the amount lost each year by not employing competent mining engineers in the State would pay a handsome income to all the mining engineers that it contains.

**INSTRUMENTS.**—For short sights, and where no great degree of accuracy is required, the best instrument for rapid work is a compass with open sights without telescope, with a good magnetic needle, and a divided circle by which angles can be taken independently of the needle, being what is often called a railroad compass. This instrument, mounted on a short tripod, with shifting plate, and perhaps a quick leveling attachment, is one that is very easily and rapidly handled, with but small chance of error in its manipulations, not easily getting out of adjustment, or being readily injured by accidents. But for longer sights, and for connecting the inside and outlines through a shaft or slope, the mining transit is preferable, and in many cases is a necessity for accurate work.

**LAMPS.**—The best lamps are of copper, though brass ones are good enough for most purposes. They should have a close fitting lid, with the air tube extending high enough, so that in stooping no oil will waste. The shield form of lamp is good for a hat or cap lamp, but the form known as the Scotch lamp is the one generally used. The surveyor should be provided several good lamps, so that each of his assistants may have one. Plummet lamps, though very useful, are, I regret to say, but little used in this State.

**OIL.**—It is difficult to get a good lamp oil unless the mining engineer provides his own. He may rest assured that if he does not desire to ruin his eyesight or injure his lungs, he must not use the cotton seed or other vile oils in nearly universal use in our mines. Pure lard or sperm oil of the best quality bought of some reliable dealer should alone be used.

**MEASURES.**—In dry mines the steel tape, divided in ten-foot spaces are the best measures, but in wet mines steel chains with foot links are the easiest handled, and least liable to mistakes in our mines. Where chains are used the fifty-foot is the best length.

The operation of running a line is about as follows: The instrument is set up. A lamp is carried ahead as far as it can conveniently be seen, or to some desired point, placed on the floor of the mine, a sight is taken to it, and the distance ascertained. A lamp is left as a back sight; the instrument is carried ahead, either set up over the flame of the lamp, or at the point where the flame was, and a back sight taken to the flame of the rear lamp. The instrument, if a compass, is deflected; if a transit, reversed; the deflection to the right or left noted, the needle let down, and the

course read. The included angle is often taken, having less chance of error. In most cases no illumination of cross hairs is needed, they being plainly visible against the flame of the lamp which is sighted.

MARKING THE SURVEY POINTS.—This is done in several ways. 1st. By holes drilled or picked in the rock of the roof. 2d. By marks pointed or chalked in the roof. 3d. By nails or spikes driven in the over-head timbers, from which a plum bob can be suspended. 4th. By pegs driven in the holes in the roof. 5th. By spikes or marked stones set in the floor. 6th. By the same kind of marks in the rib as in the roof, where, by reason of bad roof or bad floor, the foregoing methods can not be employed, and which are witnesses to the point desired to be kept; and in very many cases all permanent marks in the roof or floor should be witnessed by marks in the rib, and near these points should be plainly marked, if possible, the number or letter of the station.

In conclusion, I would remark that there is a bright future before the mining engineer, and that from the miner, the superintendent, the mining engineer, with their allies the chemist, the geologist, and the metallurgist, must come the solution of the problem how can we best carry out economical, and healthful, and safe working of coal mines, as far as appliances are concerned, and at the same time raise the status of the great army of workers who delve for the subterranean treasure, and on whom we are practically dependent for the supply of moter power and heat.

The address of Mr. Paul was listened to with profound attention, and a vote of thanks was unanimously passed by the Institute.

A general discussion of these papers followed after which the Secretary submitted a brief paper containing a number of questions bearing upon Mining Engineering subjects. Several letters were read from members regretting their inability to be present. The recommendations contained in the Governor's Message touching the iron ore mines and the acquirements of Mining Superintendents, were then taken up and after being discussed at length, the following resolutions offered by Mr. R. S. Paul were adopted:—

*Resolved*, That all the mines in the State, whether of coal, iron ore, fire-clay, or other minerals, should be included under the Mines Inspection Act, in accordance with the recommendations contained in the late Message of the Governor to the General Assembly. Also,

*Resolved*, That the recommendations of the Governor, as contained in his late annual message to the General Assembly, that all mining bosses should be required to pass a satisfactory examination before an examining board and receive certificates of competency, should be enacted into a law.

The resolution was adopted.

Section 296 of the Revised Statutes of Ohio, relating to the maps or plans of mines was taken up and discussed, pending which the Institute temporarily adjourned.

On again assembling the discussion was renewed. The necessity of preserving maps of mines that were worked out was discussed by Messrs. Howell, Paul and Jones, and also the defectiveness of the present mining law, as to keeping up the maps of mines.

The following resolution introduced by Mr. Howell was passed:

*Resolved*, That Section 296 of the Revised Statutes should have a suitable penalty attached, to secure the better enforcement of the mining law regarding the surveying and mapping of mines, and in all cases of mines being abandoned or closed that maps or plans of such mines should be preserved and recorded in some suitable place for reference in future times, and that neglect or refusal on the part of mine owners to furnish maps for preservation and record should render the offender liable to some penalty.

The subjoined queries were then discussed: "What is the best, easiest manipulated, and most economical instrument for general purposes that can be used in coal mining surveying?"

The next question propounded was "What is minable coal?" Mr. Paul said that in a recent mining suit this question came up in the courts; mining experts were put upon the stand to defend the question and the testimony of the witnesses was quite various. Mr. Roy remarked that the term "minable coal," which was generally used in coal leases, meant all coal of such quality and thickness as could be mined with profit to the operator of the mine. Coal may, by reason of its distance from market, cease to be minable after receding below three feet, while a mine more fortunately situated could mine down to two and a half or even two feet of height. No mine operator will work coal which does not pay him. Hence, coal, no matter what its thickness or quality may be is not minable that there is no money in. "What is a horseback?" was the next question discussed. Mr. Paul observed that it fully merited discussion with a view to settlement. The term is too general and meaningless. Every mining fault is called a horse

back. There should be well defined names to all faults in mines. Mr. Roy said the word "horseback" is an Americanism and originated in the early days of mining in the Pittsburgh district. In the coal floor of the mines around Pittsburgh there are frequent rolls which rise to a height of about two feet; after the coal is cut away they resemble the shape of a horse's back, and miners, especially the younger ones, get a straddle of them, and in this way the term "horseback" was invented, and soon became applied to all troubles in the strata. The English use the word "fault" as we use horseback, though the real meaning of "fault" is a depression in the pavement or roof of the mine. Mr. Howell suggested that the Institute adopt names for every kind of fault or horseback. In the present chaotic state of mining terms a well defined and easily understood mining vocabulary is necessary. Mr. Paul said there were a number of mining troubles which cut out the coal in part or in whole. Sometimes the fault is in the floor, more frequently it is in the roof, while occasionally both roof and floor will show faults at once, cutting out the coal entirely.

Mr. Paul observed that he did not find drill holes generally perpendicular, and as they seem to be considered as evidence affecting lines,—what would be considered their largest variation per hundred feet?

Mr. Roy stated that perhaps no drill hole is perfectly perpendicular, but they seldom varied more than two feet per hundred feet. He had had considerable experience in drilling. He thought the general practice of regarding drill holes as evidence affecting lines should be continued, as it was not possible to go far astray, and it would be very difficult, if not impossible, to prove the true perpendicular line of a drill hole.

The election of officers being in order, on motion Andrew Roy was re-elected President; Fred Howell, Vice President; R. S. Paul, Secretary; John Ackley, Treasurer.

The President then announced that he would call the next meeting at Nelsonville, Athens county, on Thursday, May 11. The meeting then adjourned.