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Ohio Mining Journal

Title: Explosive Character of Blanchester Mines

Creators: [Hibbs, William](#)

Issue Date: 1895

Citation: Ohio Mining Journal, no. 24 (1895), 101-106.

URI: <http://hdl.handle.net/1811/32694>

Appears in Collections: [Ohio Mining Journal: Whole no. 24 \(1895\)](#)

EXPLOSIVE CHARACTER OF BLANCHESTER MINES.

WILLIAM HIBBS, SCIO, OHIO.

Fellow Members of the O. I of M. E. :

The author's object in writing this short paper is to endeavor to place before the reading public a kind of information that may not seem important to the light newspaper reader, but is of considerable consequence to those who devote their energies to the art of mining.

Those persons who are intensely scientific need not listen or read. The attention is asked of men who have interest in the engineer end of mining and others who do the harder labor in carrying out their plans.

In the operation of mining too much responsibility is placed on the mine officials. The pit boss should have the education and brains of the mine, but miners also, should possess their share of learning and think for themselves as to the conditions and causes of danger that may surround them.

It is of little importance where the mines are located or by whom owned and operated, but will say, however, that they are east of the Ohio river and opened into No. 5 coal seam and within a little more than two years two explosions have occurred there resulting in the loss of the lives of thirteen men.

It is not the aim of this paper to tell how the unfortunate men came to their end, but to describe the surrounding conditions that have brought about the above mentioned results, nor does the author wish to be understood as saying that danger is found in only this mine.

To begin with will say that immediately over the coal seam lies a stratum of highly laminated and hard slate eight inches in thickness and in many places unbroken for many rods. Upon this lies a bed of very compact black shale which is from eight to fifteen feet in thickness. This in turn is covered by a ten foot bed of clay. A heavy stratum of sand rock lies further up in the series and forms a roof or shed deflecting the water from its otherwise downward course.

As a consequence of all these hard and to a great extent impervious rocks, very little water reaches the coal seam, very few drippers are to be found in the entire mine and as a consequence its tendency is to be dry and dusty.

The floor is like the roof, both being hard and very unyielding, even with the heavier blasting of the coal which is from three and one-half to six feet in thickness, and the only one of the kind in that region. It is in two parts or benches, the lower, which occupies a little more than half the seam, is hard, compact with lines of cleavage often twelve inches apart and breaks with a curved fracture.

The upper part of the seam is the reverse of the lower, cleavage lines are found through even the smaller pieces, besides being highly laminated and with occasional laminæ of charcoal and sulphurets. This forms a tough and woody structure which is too difficult to undercut by hand and in consequence most of it is blasted from the solid and in doing so great amounts of powder are used.

The roof and floor being hard and unyielding as well as rough, sometimes at the top and sometimes on the floor, the coal is torn from the solid grinding it into dust. This gathers little by little upon the projecting ledges of rock when dry and when damp upon every exposed surface that may appear. On this the damp dust forms a pasty covering.

During the periods when the outside air is warmer than the air in the mine the dust is kept in a pasty condition by the warm, heavy saturated air from the outside, being forced through the mine and coming in contact with the cold rocks is suddenly contracted when its moisture is deposited among the dust. This again by its capillary attraction forms a resting place for subsequent dust that always comes in clouds from every shot that is fired. So long as this dust is kept damp by the air or by watering the entire surface exposed, there is little danger of a dust explosion. The presence of a few inches of water on the floor is not a sufficient guarantee against danger.

When cold weather sets in, the heavy, dry air, as it passes through the ramification of the mine, becomes warm and expanded and in this condition picks up the little particles of water and leaves the accumulation of dust entirely dry. This change may happen within a few hours. If there is good ventilation "eternal vigilance" must be exercised to guard against dangerous effects of blowout or windy shots.

These phenomena in this particular mine are of three different kinds, or in other words, originate in as many different ways, but always produce similar results:

First—The space in close proximity to the working faces is, as a rule, dryer than elsewhere, owing to the shedding of heat from lamps, the workmen's bodies and from the heat of blasting. Dry dust will be found here when not at any other place. The fire from a well-regulated blast will often stir up this dust into the air and ignite it. Being small in quantity will not do much damage except to create, by expanding, a rush of air along the gang-ways toward the least resistance. The author has known windy shots to be fired, and on examining the location, found that the blast had been an entire success, the coal being dislodged in good condition. Thus proving that the hole was neither overcharged nor underlaid, but in reality the result was that the dust was burned, thus causing a miniature explosion and not a "blow-out shot."

Second—Holes are often tamped with slack or fine coal, which is sometimes dampened, but frequently is not. When this is done, the ramming with a heavy tamper is attended with enough force to pulverize the material used. When it happens that one of the coal-tamped blasts throws the tamping, the finely-powdered coal dust is thrown violently into the air and at the same time is pierced by the intensely hot tongue of flame which ignites it and the result is as in the first case—a slight explosion is felt, which, owing to the commotion in the air, is called by the miners a "windy shot." This occurs in the majority of cases when shots are overcharged.

Third—When drill holes are undercharged, or the cartridge, which is made with paper and filled with powder, has too great length, the windy shots again occur in the following way: In ramming home the charge, the miner fails to thrust his blasting needle entirely through the powder, or, in tamping, does not confine the powder sufficiently so that when the needle is withdrawn its hole in the explosive does not extend far enough or it falls short to its outer end. Therefore, when the fuse or igniting squib carries fire to the powder, the outer end ignites and explodes probably a second before the inner end, with sufficient force only to rend in the coal out of which the force of the inner end escapes with a vengeance, causing a roll of fire to fly at times forty to fifty feet, and should there be dry dust along the passage, it will, as with the other case, be thrown into the air and ignited and the fire will roll along the gang-ways toward the least resistance—slowly at first, but in a few seconds, as the air expands, it develops a tremendous speed and force which can hardly be understood, ex-

cept by those who have felt its hot breath, and leaving in its train, by perfect combustion, a dense volume of carbonic acid gas and by imperfect combustion of the fine coal on the roof and walls which the force does not dislodge an equally obnoxious production in the form of smoke, a combination which is impenetrable to any great distance or time by any living man.

Advice is plenty and talk is cheap, and no doubt many would successfully handle these difficulties, but these remedies seem to suggest themselves: Tamp the holes with clay; water, whenever it is dry, and let those in charge have brains and learning and be always on the watch for changes in the surrounding conditions.

MR. BEATTIE: Mr. Chairman, I would suggest, as the author of the paper is not present, that criticism be deferred until some future meeting.

A MEMBER: There is one feature in the paper I consider important, and upon which I would like to have information. That is, in regard to pushing the needle to the extreme end of the powder. It has occurred to me that it did not matter whether you pushed it to the far end or not, as soon as you withdraw it, the hole closes up.

A MEMBER: I think the member's idea as to the hole in the powder closing up when the needle is withdrawn is wrong. I think the hole will remain when the needle comes out.

THE CHAIR: The paper said if it did not close, then this does not occur.

MEMBER: He refers to the front of the cartridge exploding before the back if the needle is not pushed well to the back of the cartridge.

A MEMBER: I would say from my experience that to get the full effect of the powder, the sooner it is exploded, the sooner combustion is over, the stronger is the blast. The idea is to have the needle extend the full length of the cartridge at once, so as to have it all explode at once.

SECRETARY HASELTINE: In his paper, Mr. Hibbs says: "When drill holes are undercharged, or the cartridge, which is

made with paper and filled with powder, has too great length, the windy shots again occur in the following way: In ramming home the charge, the miner fails to thrust his blasting needle entirely through the powder, or, in tamping, does not confine the powder sufficiently, so that when the needle is withdrawn its hole in the explosion does not extend far enough or it falls short to its outer end. Therefore, when the fuse or igniting squib carries fire to the powder, the outer end ignites and explodes probably a second before the inner end, with sufficient force only to rend in the coal, out of which the force of the inner end escapes with a vengeance, causing a roll of fire to fly at times forty to fifty feet."

After some further discussion of the question presented, Professor Lord was asked for an opinion.

PROFESSOR LORD: I feel that my practical knowledge of mining is limited. As to the theoretical aspect of the question is concerned, in regard to the speed of the explosion of the powder, it is generally determined by the size of the grains of powder; and unless the charge is so rammed that it should become solidified, so there would be no space between the grains, I think it would make no appreciable difference as to the speed with which the explosion would go through the mass of powder. In other words, the explosion would pass through the space between the grains of powder about as fast as it would pass through a hole the size of the needle. Of course, if you would reduce it to a powder and ram it tight, the speed of the explosion would be very slow. Then you would have to drill through the center to get any force at all. The fire would spread from grain to grain, between the grains, unless the cartridge were of extraordinary length. If the cartridge were very long, there would possibly be some advantage in having the impulse of the first explosion extend through to the other end.

In referring to dust explosions, of course I cannot speak practically; but it is a well known fact that inflammable dust mixed with air constitutes an explosive mixture—more or less explosive. It depends upon the proportion of dust to air, in the first place, and in the next place, on the actual inflammable character of the

dust. The dust of lydopodium, for instance, which is extremely inflammable, ignites at a low temperature.

MR. ROY: Does it ever explode, or does it simply inflame?

PROFESSOR LORD: It seems to me that explosion is simply inflammation carried on at so rapid a rate as to produce disastrous effects.

On motion the Institute adjourned to meet at the State Capitol at one o'clock, standard, for the visit to the Ohio State University.