Coal produced in tons per year, and number of persons employed in 1877.

REMARKS.	1877.
Coal produced in tons per year,	1,580,780
Number of persons employed,	5,847
Ratio of coal produced per person employed,	270
Number of lives lost per year,	29
Ratio of coal produced per life lost,	54,510
Ratio of persons employed per life lost,	202
Number of persons injured per year,	111
Ratio coal produced per person injured,	15,151

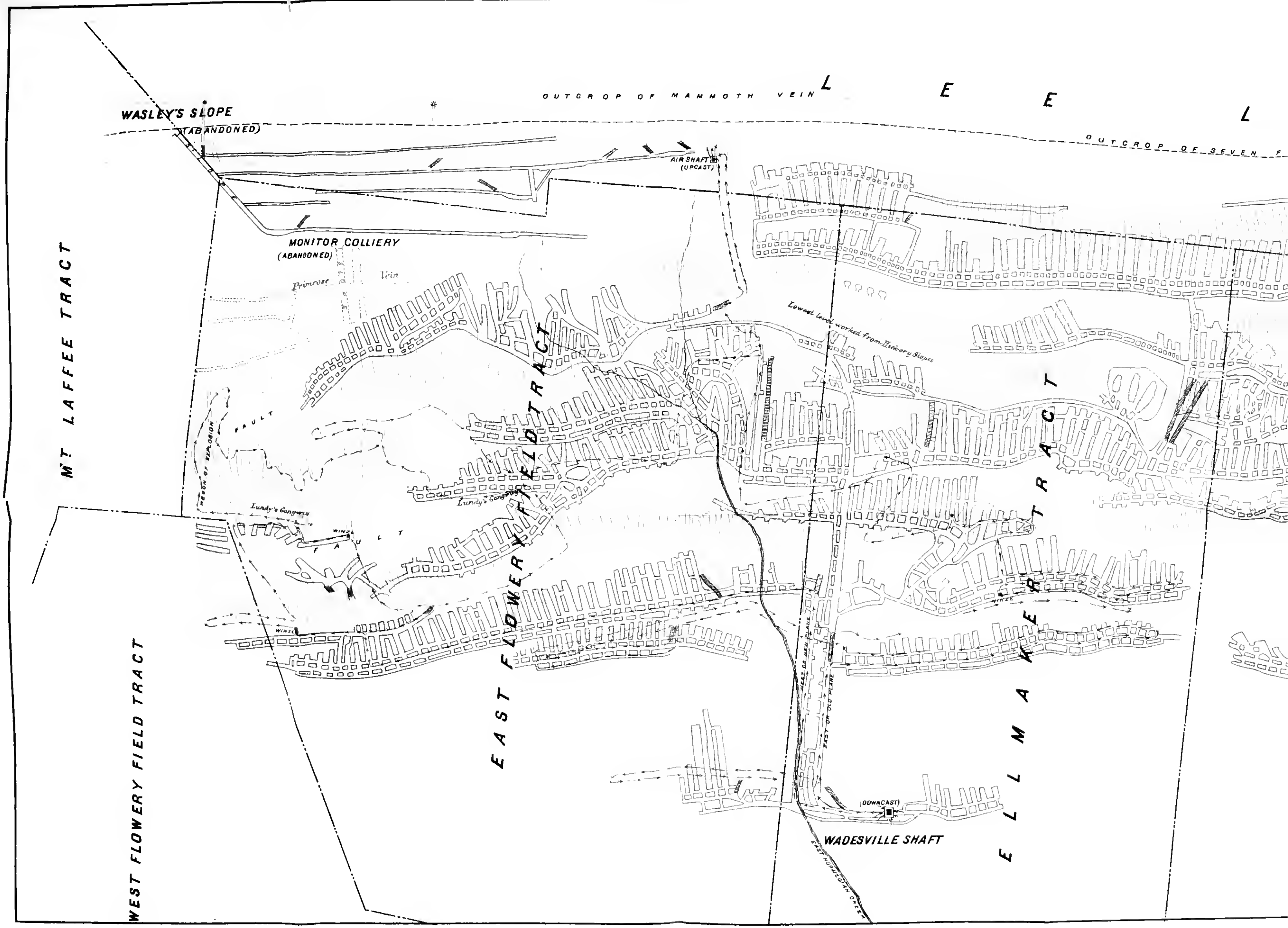
It now becomes my painful duty to refer to the most serious and fatal accident of the year, which occurred at Wadesville shaft, on the 9th of May last, and in doing so, I shall enter fully into all the details of that fearful catastrophe, not only for the purpose of giving all the particulars, so far as they came under my observations in the examinations made by me, but also in the earnest hope that those miners who may read this report may realize the importance of the fact that it is far better to obey the orders of their superiors than to trust to their own judgment, and in doing so I submit three maps, showing, in plate "1," a ground plan of the colliery on a small scale, showing the extent and character of the workings under ground. Plate "2," a ground plan on a large scale, showing the locality of the explosion and the ventilation thereof in detail. Plate "3," a sectional sketch, showing the method pursued to clear the old workings of standing gas in the region of the explosion, and the strata immediately above the Mammoth vein.

The Wadesville Shaft Colliery is near the mining village of Wadesville, about three miles north of Pottsville, and has been in operation since the year 1868. The shaft, which is six hundred and sixty-four feet deep, reaches the Mammoth seam at that point, is used as the coal outlet, and also the down-cast or air intake. The second outlet, which is required by law as a means of egress from the mines in case of an accidental obstruction in the down-cast, is used also as the upcast airway, and is shown on Plate No. 1, marked air shaft "upcast."

The Mammoth, (colored in red,) and the seven-foot, (colored in blue,) Plates "1" and "2," are the only seams that have been worked from the shaft, the former being twenty-five feet thick and the latter eight feet six inches thick, with six feet of slate between. See Plate "3."

A lift of coal was developed by the shaft extending from its foot up a pitch, varying from ten to twenty degrees, to the red workings of the Hickory slope. See Plate "1."

The plan pursued to mine this coal was to drive two gravity planes, marked respectively east, or old plane, and west, or new plane, Plate "1," directly up the pitch to such points as would be favorable to turn gangways, from which the upper portions of the territory could be worked, the


OUTCROP OF MAMMOTH VEIN
WASLEY'S SLOPE
(ABANDONED)
AIR SHAFT
(UPCAST)
MONITOR COLLIERY
(ABANDONED)
Primrose
Vein
MT LAFFEE TRACT
Lowest level worked from Hickory Slopes
FAULT
Lundy's Gangway
Lundy's Gangway
FAULT
WINZE
WINZE
WINZE
EAST FLOWERY FIELD TRACT
WEST FLOWERY FIELD TRACT
ELLMAKER TRACT
EAST OF NEW PLANE
EAST OF OLD PLANE
(DOWNCAST)
WADESVILLE SHAFT
EAST NORWEGIAN CREEK

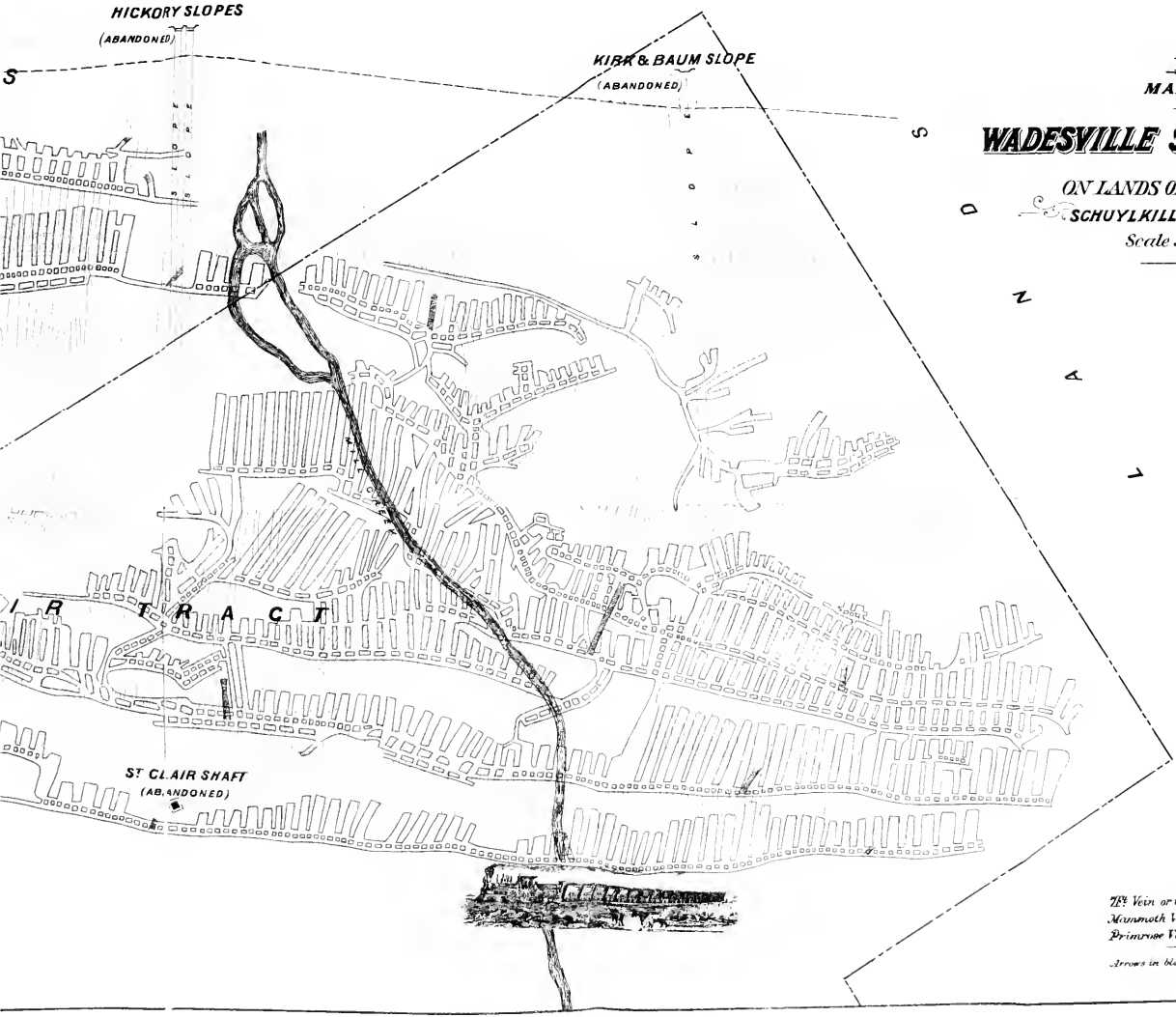


PLATE 1.

MAP OF THE

WADESVILLE SHAFT COLLIERY

ON LANDS OF THE P. & R. C. & I. CO.

SCHUYLKILL COUNTY PENNA.

Scale 300 ft. per inch.

NOTE

7ft. Vein or top bench of Mammoth in blue

Mammoth Vein in red

Primrose Vein in brown (dark)

Arrows in black indicate course of the Air

gangways extending east and west to the limits of the mining right. When the coal above these gangways was exhausted, others were started from the same planes at lower levels, and others again when they were exhausted.

In 1876, Lundy's gangway, (Plates "1" and "2,") had been driven to a fault, at which it was decided it should be stopped, and that the gangway should be robbed back, and all the coal taken from it that could safely be mined before abandoning work at this level. From the time the seams worked were opened by the shaft, they have always given off large quantities of fire damp, and it was necessary that in the robbing, provisions should be made to remove all the gas as fast as generated, not only where the men were at work, but also in those parts already exhausted, in order to prevent an accumulation there which might, by some accident, be forced in upon the men suddenly and cause an explosion. An air-way, marked "intake air-way," Plate "2," was driven nearly to the gangway face, and also a "return air-way," both of which were kept separate from the gangway by means of sufficient pillars of coal between, and batteries and doors put in wherever required to force a current of air through the intake around the face of the gangway and out at the outlet to the fan.

As the seven-foot seam (not at the western extremity of Lundy's gangway in a workable condition) was close above the Mammoth, the slate between frequently broke down, and sometimes the seven-foot coal also in these air courses; and wherever this was the case, there was a large opening left above the air course, in which fire damp (evolved in especially large quantities from the seven-foot seam) could accumulate. This was prevented by the erection of slanting batteries, left open at the top, which caused the current of air to sweep upward into the opening and carry away any gas that might exist there. See plate "3." An examination of plate "2" will show that as long as the robbing was so conducted as to maintain the current of air in the direction shown by the arrows in black, and the doors and batteries there shown were kept intact, men could work with perfect safety in Lundy's gangway, and along the intake air course; but it will readily be seen that if two doors or batteries, or one of each, were removed or rendered inoperative, the current of air might be caused to cross from the intake to the outlet without sweeping around the face of the gangway, and the portion thus deprived of ventilation would necessarily accumulate explosive gas. The current of air that was passed around this portion of the work was forty thousand cubic feet per minute, and the greatest confidence in their freedom from danger was felt by the men there at work, and by the officers of the colliery. While it was not, under ordinary circumstances, considered necessary that the men should work with safety lamps exclusively, they were furnished with them, and instructed to use them on cloudy days, when the barometer was likely to be falling, and when any falls of rock or coal were heard which might in any way temporarily check the ventilation, and they were further instructed that

after such a fall they were to leave their working places and were not to reënter them again until after an examination had been made by the fire boss assigned to that section of the colliery. The robbing, under these circumstances had been successfully carried on for several months, and had progressed, on May 9, 1877, as far as the door marked "A" on plate "2." At this point, Joseph Millward and Benjamin Mosely were employed robbing the gangway; Herbert Moore was robbing the intake air course about opposite to them; Edward Weaklam was loading coal at the point "C;" William Kirk and Michael Farrel were robbing at "4;" Thomas Conners and James McAtee were robbing at "5," and John Durkin and William Hirten were repairing air course at about "6." The door at "A" was considered of especial importance to the ventilation, as well as the battery at "B," and instructions regarding them had been carefully impressed upon the men and drivers. The door was not to be left open longer than absolutely needed for the passage of men or wagons. No coal was to be taken from within a certain distance of the battery, nor on either side within a certain distance of the door. The door had been further secured by relief timbers near it a few days before, and the heading in which the battery was located had been filled with rock and dirt, to prevent a crush, should one occur, permitting the air to pass through it.

On the afternoon of the 8th of May, the door, at "A," was removed by some of the men then at work; and at some time during the afternoon, or early on the morning of the 9th, the pillar, at "B," was so far cut through, as to allow the air to pass through it. The current of air, therefore, instead of passing around the gangway-face, as shown by the arrows in black, took the course shown by the arrows in blue, viz: Through the heading, at "B;" through the opening where the door had been, at "A," and thence into the return air-course. Thus it will be seen, that a length of air-way, from "B" around the face of the gangway to the point marked "Fall of Coal," Plate 2, was deprived of ventilation, in which explosive gas could accummulate, and if not removed, would eventually fill it entirely. At about ten o'clock, on the morning of the 9th of May, the mining boss, while on his way to pay his daily visit to that portion of the work, and about three hundred yards distant, heard a fall, and after a few seconds, an explosion. At the time of the fall, Herbet Moore was unloading a buggy, at the point "C," where Edward Weaklam was working, and had the door at "C," Plate 2, open. Hearing the fall, they called up to Millward and Mosely, at "A," o know what it was, and received a reply to the effect that it was nothing serious. Herbert Moore then started to return to his working-place. While the door, at "C," stood open, the course of the air would be that indicated by the arrows in red; and the fall, causing a temporary check in the current of air, or, perhaps, even a pressure against the current, forced a portion of the gas accumulated above "B" down the in-take airway to the point 2, at which it is believed to have been ignited by Herbert Moore's naked light, while on his return to his working-place, pushing the empty

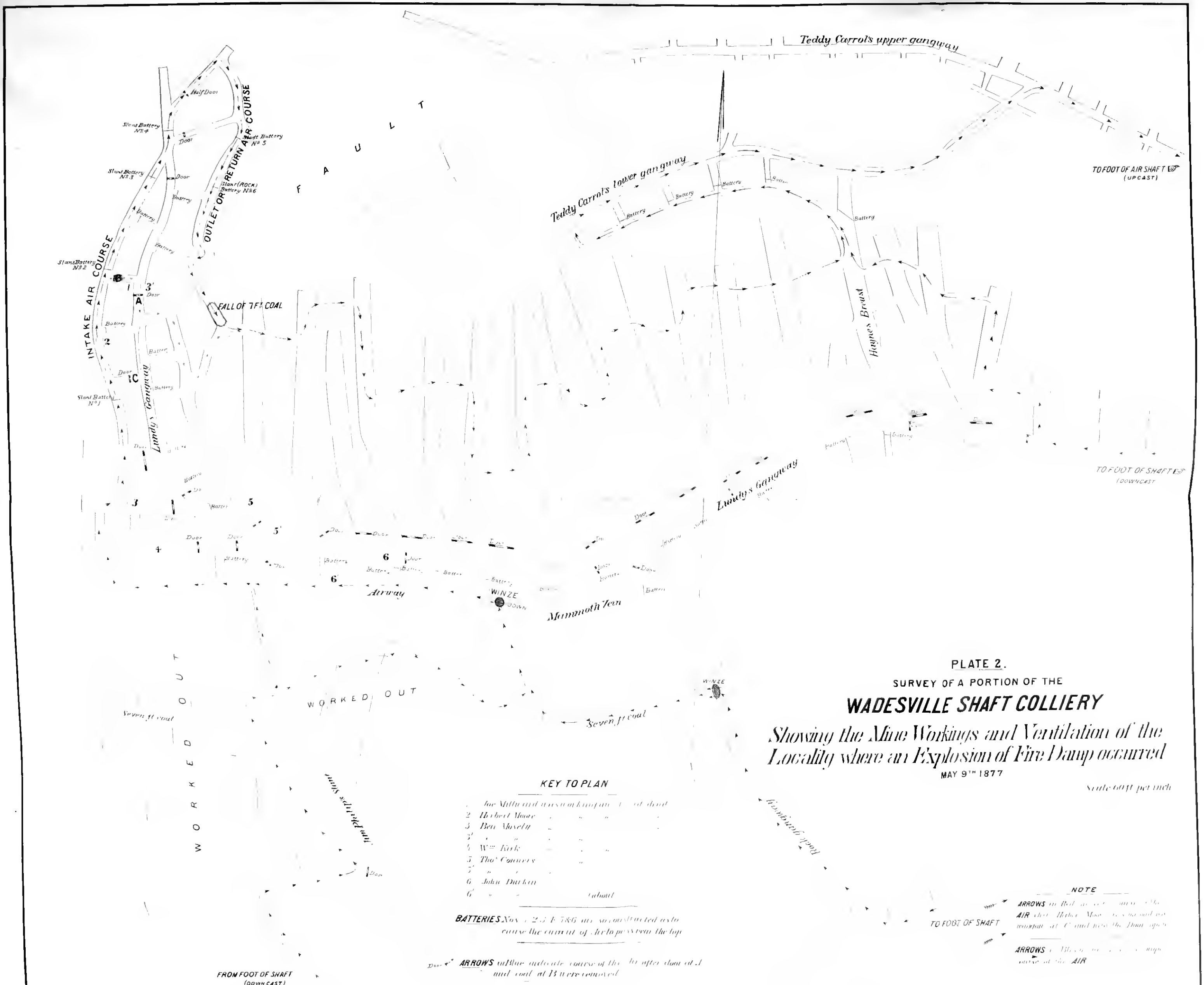

Teddy Carrol's upper gangway
Teddy Carrol's lower gangway
TO FOOT OF AIR SHAFT
(UPCAST)
F A U L T
Half Door
Slant Battery N° 4
Slant Battery N° 5
Slant Battery N° 3
Slant (ROCK) Battery N° 6
Slant Battery N° 2
Slant Battery N° 1
INTAKE AIR COURSE
OUTLET OR RETURN AIR COURSE
FALL OF 7 FT COAL
Lundy's Gangway
Haynes Breast
TO FOOT OF SHAFT
(DOWNCAST)
Airway
WINZE
Mammoth Vein
WORKED OUT
Seven ft coal
Lundy's Slant
FROM FOOT OF SHAFT
(DOWN CAST)
KEY TO PLAN
2 Herbert Moore
3 Ben Mosely
4 Wm Kirk
5 Thos Conners
6 John Durkin
BATTERIES
ARROWS
NOTE
TO FOOT OF SHAFT

PLATE 2.

SURVEY OF A PORTION OF THE

WADESVILLE SHAFT COLLIERY

Showing the Mine Workings and Ventilation of the Locality where an Explosion of Fire Damp occurred

MAY 9TH 1877

buggy before him. It may have been, that the door, at "C," being partially filled by the buggy, did not permit all the air to pass through it, but that a portion of the current took the course indicated by arrows in blue; in which case, the gas must have been ignited by the men working with naked lights, at "A."

Joseph Millward, Herbert Moore, William Kirk, Thomas Conners, and John Durkin, who had come on the gangway from his working-place, at "6," for some material required, were instantly killed. Edward Weaklam saw the flash in the direction taken, a moment before, by Herbert Moore, and, throwing himself down, seized the rail, until the force of the explosion passed over him, when he made his way out in the dark, to a place of safety, as did also Michael Farrell, James McAtee, and William Hirten. Benjamin Mosely must have endeavored to do the same, but, becoming confused in the excitement and darkness, or becoming so overcome by the after-damp, as to lose partial consciousness, he turned to the right, into one of the breasts, instead of keeping in the direction of the gangway, where he was smothered by the after-damp.

After the explosion, a large piece of coal, (marked fall of seven-feet coal, Plate 2,) was found to have fallen, and there is little doubt that this was the immediate cause of the accident.

What amount of gas had accumulated in the portion of the intake and return air-courses, deprived of ventilation, is, of course, unknown; but, if it had been entirely filled with fire-damp, in an explosive condition, unquestionably all the men then at work in that section of the colliery would have been lost.

I have thus, I think, given a clear and concise statement of the causes which led to this terrible accident, by which six lives were lost that were valuable to the community, lost through a want of foresight and intelligence in utilizing the means that were amply furnished for their security. Mining is necessarily a dangerous calling, but its necessary dangers are very much increased by a lack of intelligent coöperation on the part of the workmen, with the endeavors of the employers to provide for their safety. A few wagons of coal, taken where convenient to mine, and contrary to the orders of the boss, does not appear to be a serious matter; a system of ventilation, depending upon a door, which it is found to be too much trouble to open and shut, or the coal around which can be cheaply mined, has hitherto ventilated the locality well, and the removal of the door is not supposed seriously to affect its operation. Notwithstanding that it is directly disobeying the bosses' orders, the coal is removed, and also the door, a fall occurs at an inopportune moment, and the legitimate consequence takes place.

Much is now done to furnish a supervision, by means of bosses and under-bosses and fire-bosses, so close as to counteract, in a great measure, such a tendency, but the event has proven, on many occasions, that this alone will not answer all the requirements of the case, and that it is neces-

sary for the men to take some heed to their own safety. It is surely not beyond the reasoning power of any working man to decide that if he works at a colliery his first duty is to obey the orders of the boss, and when he considers that not only his own safety, but also that of many others, friends, companions, and, it may be, relatives, working near him together, both the welfare of his and their families may depend upon his doing so, it would seem impossible that any one possessed of powers of reflection should act otherwise. In ninety-nine out of one hundred of the collieries now in operation in Schuylkill county, the means provided for the safety of the men are fully ample to provide for any known contingencies, and if the men themselves would let me say to them, do nothing contrary to orders, nine out of ten of the fatal accidents would be avoided.

Ventilation.

Although this is a word that is used as often as any other, in the coal regions, and also one that is most important to our miners and operators, it is probably less understood among the parties most interested, than people outside of this locality would believe.

It would naturally be supposed by outside parties, that people whose health and life depend upon their knowledge of the principle of the difference of the pressure of the atmosphere, would endeavor to become acquainted with the laws of nature, which contribute to the creation of what is called a current of air in coal mines. In such knowledge our mining population are deplorably deficient, and, therefore, for the information of such a portion of the parties engaged in mining, who desire to become acquainted with these laws, I append the following remarks.

Most men who have worked in coal mines, or who have in any way been connected with the workings of them, are aware of the fact that as soon as a seam of coal is struck, it evolves gases of some kind or other—these gases having been generated thousands of years ago, by the decomposition of vegetable matter. The chemical composition of these gases are to them unknown, and so far as they are practically concerned, it is only necessary that they should be acquainted with their dangerous properties. Unfortunately, they become too familiar with the consequences of coming in contact with them.

Fire-damp, or light carbureted hydrogen gas, in a pure state, is non-explosive; but when mixed with a certain proportion of atmospheric air sufficient to supply enough oxygen to maintain combustion, if brought in contact with a flame, ignites, and has a tendency to expand, upon ignition, to many times its original volume. The gas, while in a state of combustion, emits a quantity of heat which is of three-fold more intensity than that evolved by the combustion of anthracite coal in any stove with which we are acquainted; consequently, when an explosion of this gas occurs, persons exposed to its influence become burned in a terrible manner. The best method which has at present been discovered for the prevention of such accidents in coal mines, is an adequate supply of atmospheric air,

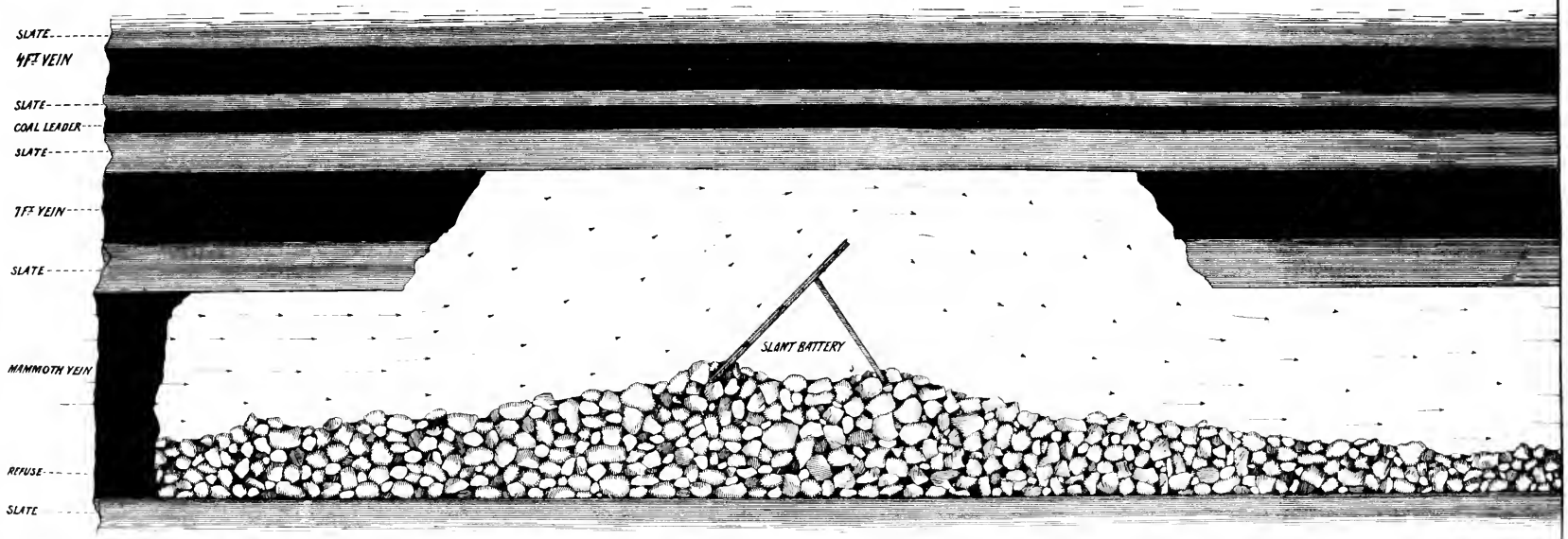


PLATE 3.

SKETCH SHOWING THE CONSTRUCTION OF BATTERIES NOS. 1.2.3.4 & 5. ON A MAP ENTITLED

SURVEY OF A PORTION OF THE WADESVILLE SHAFT COLLIERY

Showing the Mine Workings and Ventilation of the Locality where an Explosion of Fire Damp occurred

(MAY 3RD 1877)

SCALE 10½ FT. PER INCH

and when we consider that by a bountiful providence we are supplied with an unlimited quantity of this element, it appears strange that it is not so utilized as to prevent the possibility of an accident arising from the ignition of the gas, after being compelled by circumstances to adopt some method of supplying, by artificial means, a quantity of air sufficient to enable the owners of collieries to take out the mineral which is so essential to the comfort and well-being of the human race.

Various methods have been applied. The two most important of such appliances are as follows:

First.—An air furnace, as it is technically termed, which, by the application of heat, so rarifies the air in the upcast opening, or outlet, of the mine, as to disturb the natural equilibrium which is caused by the equal pressure of the atmosphere. This pressure amounts to fourteen pounds and a fraction per square inch of the surface exposed to its influence. Now it is evident that if the dimensions of the two outlets are equal, and the height of the columns equal, there will be no current, as the pressure is equal on both sides; but if, by any means, any part of the weight can be removed from one side, the air will be forced through the caverns of the mine at a velocity proportional to the quantity of weight so removed.

It has been proven, by very careful experiments, that four hundred and fifty-nine cubic feet of air at zero of Fahrenheit thermometer, the pressure of the atmosphere being constant, will expand $\frac{1}{459}$ths of its volume for every degree of increase of temperature, as indicated by said instrument, and as the specific gravity of the air varies in an inverse ratio with its expansion, it will readily be seen that by the application of heat, the column of air on one side would not be so heavy as it would be on the other side; and the difference of weight produces a movement or current of air which, if intelligently directed and carried to every working place in the mine in sufficient quantities, would render innocuous all the dangerous gases which have been generated by the fermentation of compressed vegetable matter, and emitted after the coal vein has been opened, at a ratio proportionate with the weight of the superincumbent strata, and the resistance, opposed by the pressure of the atmosphere.

In accordance with this law of nature, this principle has been applied and used in coal mines on the continent of Europe for many years, but some fifteen years ago another system of ventilation was adopted, which, in its practical application, has proven to be far superior to furnace ventilation, as it removes the pressure from one column without being liable to the danger of setting fire to the coal in the mine, or igniting inflammable gases which have been accumulated in the workings, and by passing over the furnace in large quantities have been the cause of many accidents.

This method is known among our mining population by the name of the suction fan. This word *suction*, as it is generally understood, would imply that by mechanical means the air would be drawn from the mine, together with all gases that have accumulated therein; but this idea is

erroneous, as all that the fan can possibly do is to create a vacuum over the aperture which is called the upcast opening of the mine. The air is then forced through the mine by the natural pressure which exists on the other side. When we understand this fact, it is evident that after a perfect vacuum has been created any additional power applied to the fan is useless, and will not add one iota to the quantity of air passing through the mine; therefore, when it becomes necessary to increase the quantity of air passing through a mine, it is absolutely necessary that all the passages within should be enlarged in proportion to the extra power which is supposed to be necessary to procure an increased quantity of pure air to pass through the mine. But the most important factor, and at the same time the least understood in the ventilation of mines, is the resistance opposed by friction. In the open air a difference of pressure of one pound per square foot would, by the force of gravity, cause a movement in an opposite direction to the heaviest side, at a velocity of nearly twenty-nine feet per second, but when the current is forced through the contracted openings and rugged obstacles with which it comes in contact during its passage through the mine, its velocity is very materially decreased.

At the best ventilated colliery, where scientific experiments have been made in England, it has been proven that seven eighths of the power used to procure ventilation is expended to overcome the resistance offered by friction. On an average, in our anthracite mines, no less than nineteen twentieths parts of the power used is expended for a similar purpose.

A knowledge of these facts should teach our superintendents and foremen of mines that it is of vastly more importance that all the air-passages in the mine should be enlarged and rendered as smooth on the surface as is consistent with the physical circumstances surrounding the mine, than it is to increase the power or add to the size of the fan.