State inspector of coal mines reports

Section 3, Pages 61 - 90

These reports of the Kansas State Mine Inspector mostly concern coal mining, though by 1929 the scope of the reports broadens to include metal mines. The content of individual reports will vary. The reports address mining laws and mining districts; industry production and earnings; fatal and non-fatal accidents; accident investigations and transcripts of oral interviews; labor strikes; mine locations; mining companies and operators; and proceedings of mining conventions. The reports document the political, economic, social, and environmental impacts of more than seventy years of mining in southeastern Kansas.

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POISONOUS GASES.

CARBURETTED HYDROGEN GAS.

This gas is the fire-damps found in coal mines, and is the lightest of all hydro-carbons. Its molecular weight is 16 ($C=12$, $H\ 4=4$; $12+4=16$), or 25 per cent. hydrogen and 75 per cent. carbon. Its specific gravity is .555, taking air as 1,000.

In works on chemistry this gas is most frequently called marsh gas, which name is given it from the fact that low, marshy lands, containing organic matter in a state of decomposition, are constantly evolving it. It is tasteless and inodorous.

Being nearly half as light as air, it always rises to the highest points, and must be searched for next the roof and high places in a mine, where falls of roof have taken place.

Its presence can be detected on the small light of a safety-lamp. When one part of fire-damp is mixed with forty-five parts or air, a small brownish-colored cap is observed on the flame. When one part is mixed with twenty-five parts of air, the flame is surmounted by a cap of light blue. When one part to fifteen, it will burn in the lamp. One to nine is its most explosive mixture. One to seven, it is less explosive. One to four, it will not explode, but, on the contrary, will then extinguish lights.

The light of the safety-lamp is inclosed by a wire gauze of 784 apertures to each square inch. When the lamp is brought in contact with inflammable fire-damp, the gas passes through the fine wire gauze and immediately ignites and burns inside of the gauze. The chill of the fine wire gauze prevents the flame from passing out through it to ignite the gaseous mixture outside, except in cases where the velocity of the air-current is over eight feet per second, when it has been found that the light of a Davey lamp will pass through the gauze.

When introduced into air at this velocity, the Davey lamp is the best known indicator of the presence of gas, but there are other lamps that will stand exposure to a higher velocity without the flame passing through the gauze. These are not necessarily so good instruments for denoting the presence of gas, but are much safer in the hands of the careless or inexperienced miner.

This gas is found in but few of the mines in Kansas, and is not found in any of them in dangerous, explosive quantities. The Inspector at one time was able to kindle it in two mines in the State—in the Penitentiary mine, in Leavenworth county, and in the Lone Oak mine, in Crawford county. It has been seen and kindled by others in the Leavenworth coal mines; in a mine at Orchard, Linn county; in the Cherokee Coal Company's mine, near the city of Cherokee, and in Bovard & Dickson's No. 2 mine, at Weir City.

So far it is not known to the Inspector that anyone has been burned from it. A convict, while in the act of trying to frighten his partner by lighting a small accumulation of this gas, which he was informed by the fireman was there in the Penitentiary shaft, got himself singed for his fun. This is the only case on record I know of in our State at the present time. In all the above places mentioned it is being looked for and guarded against. Ten years, or perhaps less, will undoubtedly bring about a different state of affairs, more especially in our Crawford and Cherokee county mines.

An able mining authority states that this gas is most generally found in greater abundance near dikes and faults in the coal strata, and is more copiously evolved from coals of a highly coking nature than from those of an open, burning kind. The coal mentioned by this authority, I have found, compares very favorably with our Cherokee and Crawford county coal. We have a coal of a very highly coking nature, and which, no doubt, contains a very good percentage of hydrogen gas. As proof of the assertion, it is being used by nearly all the gas companies of our State. So far, this coal has been mined in places where the incumbent strata is light, and undoubtedly open to some invisible degree to the surface, thus allowing the gas from the coals of these shallow mines to have escaped long ago to an even pressure with our atmosphere and the resistance of the fissures and minute pores of the strata that it passes through to get to the surface. As I stated above, its presence has been detected, but only in the deepest mines of the two counties. Some years hence this shallow coal will all be mined and the deeper veins will be developed, when undoubtedly more gas will be found, on account of its being penned up under a greater pressure by the increased thickness of the incumbent strata above the coal.

I don't think the above remarks are out of place, even at the present time. I have regarded it as my duty, as Inspector, to make them, as the probabilities are that we shall have deeper mines, at least in those two counties, long before all the shallow coal is mined, which is nearly all owned now by coal companies. Other companies will come in and develop the deep coal, and most assuredly will encounter the expected gas.

Great discussion goes on in the mining papers in regard to this gas being detected by its smell. I, for one individual, do not believe that pure carburetted hydrogen gas has any smell; and I think in instances where it is detected by its smell in coal mines, the odor is due to some other ingredients accompanying the gas. In the penitentiary shaft, in Leavenworth county, the odor resembles that of benzine. This is the only instance in the experience of the Inspector where he ever smelled gas in a coal mine, and he has worked in the presence of larger quantities than he saw at this mine.

CARBONIC OXIDE GAS.

This gas, which is most commonly known as white-damp, by miners, is frequently met with in mines in this State, where the fine coal and refuse are subject to spontaneous combustion, and in mines poorly ventilated where large amounts of blasting-powder are used in mining the coal.

It is an exceedingly poisonous gas, acting almost instantly upon the system as a narcotic. Its effects on animal life are much more deleterious than those of carbonic acid, more commonly known by miners as black-damp. The carbonic oxide gas may be breathed for a short time without very serious effects, but the inhalation of air containing a much smaller amount of carbonic oxide than of black-damp, will very soon produce unconsciousness, which will result in death unless active restorative measures are immediately adopted.

White-damp (CO) is seldom found unmixed with other gases, and when produced by gob fires or explosions of powder, it is always accompanied with more or less carbonic oxide; its specific gravity is .976, that of air being 1.000. A little lighter than air, it is composed by weight of 57 per cent. of oxygen and 43 per cent. of carbon.

One of the worst features of this gas is, that there is no trustworthy method of detecting it. A miners' lamp will burn amidst a deadly atmosphere of it. The most of miners, brought up to blasting coal from boyhood, can detect its presence, when dense, by its odor, but the inexperienced miner may be stricken down by it without his knowledge. His life passes away as if he had gone to sleep.

We have had one accident from this gas in Crawford county. An explanation of this accident, by my predecessor, will be found elsewhere in this Report.

CARBONIC ACID GAS.

This gas, more commonly known by miners as black-damp, is found in greater or lesser quantities in all coal mines. Some of the coal mines in this State give off this poisonous gas more copiously than others. Its specific gravity is 1.524, that of air being 1.000, so that it is rather more than one and a half times heavier than air. It is composed of, by weight, 73 per cent. of oxygen and 27 per cent. of carbon. Lights burn badly when in air containing 5 per cent. of this gas, and it is unsafe for a person to be in an atmosphere containing 8 to 10 per cent. of it.

Its effect upon the miner is to produce a feeling of numbness, or dull pains in the joints of the legs and arms, followed sometimes by a violent headache, and a drumming sound in the ears, accompanied by deafness. It will surely impair the strongest constitution in a short time.

This gas is given off either mixed with fire-damp or separately, and is produced by the gradual oxidation of gob in in old workings, by the exhalation of men and mules, by combustion of lamps, and explosions of blasting-powder.

As mentioned above, this gas is given off more copiously in some of our mines than in others. In the mines of Osage county it will be found in the largest quantities, more especially in those mines that have direct communication with old unventilated and abandoned mines. Quite a large area of coal has been worked out by the miners of this county, and the old unventilated, abandoned mines are too numerous to mention. To excavate and mine all the coal, new mines tap through very frequently into these old mines, and get a large supply of this gas which has accumulated within. This gas often comes out of these old workings into the new ones in such quantities that the whole break-through must remain untouched until the old mine has emptied itself. A light will not burn in it. It is so much heavier than air that it will force itself through very small openings and many feet of gob waste. Like water, it will find its level, so that in many cases where new mines approach near to old works, this gas will find its way through into the new mines, although there may be no perceptible connections or avenues between the two. Men suffer considerably at times on this account. It will be sometimes days before the gas can be completely shut off, with every effort put forth by the mine boss to do so.

SULPHURETTED HYDROGEN GAS.

The composition of this gas is 94 per cent. sulphur and 6 per cent. of hydrogen. Its specific gravity is 1.177, that of air being 1.000. It is a condensable gas, becoming liquid under great pressure, and is capable of being frozen into an ice-like mass by the application of cold. It is a colorless gas, and, like carbonic oxide (white-damp), a light will burn well in an atmosphere contaminated by it so as to be capable of causing fatal results. It can be detected by its very disagreeable odor, which can be plainly recognized when the gas is present, even in very small quantities. It is itself combustible, but does not support the combustion of other bodies. It is irrespirable, and, when existing in large proportions in air, exercises a poisonous action on animal life. Its effect produces sickness, giddiness, weakness, and loss of sensation. Like carbonic oxide (white-damp), it appears to act on the blood and brain, but it is not considered so fatal as that gas.

It is found in old unventilated workings, partly filled with water, or by action of water upon pyrites in old workings, and it may be generated by the action of oxygen dissolved in water with timber. Upon one occasion, known to the Inspector, this gas was found in one of the mines of Crawford county. This mine is known as the Rogers Coal Co. No. 3. While the Inspector had the underground superintendency of this mine, a part of the dip workings had been abandoned, being worked to the boundary of the land then owned by the company. A year or so after this part of the mine had been abandonded, the adjoining land was purchased by the company, and this unventilated portion of the mine was reopened and pipes were being put in to take the water out. The workings being somewhat to the dip, the pipe-fitters would wade into the water and screw on a length of pipe before the pump would have the water pump dry from the last length screwed on, and kept following the water up in this way. The occasion before mentioned, when this gas was detected, was while the pipe-fitters were screwing on a length of pipe. When near the face of the old workings they advanced into a very low room, which was going hard to the dip, and were nearly overcome by this gas. They were experienced men, and had presence of mind enough to come out before it was too late. The lamps burned well in this mixture. It had all the indications, above described, that it was this gas.

VENTILATION IN MINES.

NATURAL VENTILATION.

Having briefly considered the nature of the gases to contend with in coal mining, let us now notice the means we possess for removing them.

There are two general methods of ventilation, viz., natural and artificial. The statute in Kansas seems to recognize both, which is an evil in the law that should be corrected. Upon this account many of the operators in the State still adhere to the natural forces, both summer and winter, so that it is only a trust-to-luck means for ventilating these mines.

The theory of ventilation by natural forces is, that the air in the mines, becoming rarified and heated to a higher temperature than the air outside, will rise through the air-shaft or outlet and its place be supplied by the fresh and denser air from the inlet. This theory is undoubtedly correct in cool weather. On hot, close, sultry days, however, the course of the air is reversed, and the outlet draws down. During days of variable external temperature, the air in such mines goes backward and forward, or as the miners say, "boffels," so that but little ventilation ensues. Under ordinary circumstances, and where no gases exist, this natural system generally affords sufficient ventilation in winter; in no case does it do so in summer. Where carbonic acid (black-damp) is found in any quantity, it is safe to say that it cannot be removed by natural ventilation. In view of such facts, the law should distinctly say that artificial means should be erected and be ready for use at all times.

ARTIFICIAL VENTILATION.

This may be divided into furnace and mechanical ventilation. Of these, the furnace is most generally used in Kansas, and the results obtained are in most cases satisfactory if properly attended to. In many cases, however, the furnace is entirely inadequate in size for the duty demanded of it. A furnace requires constant attention, and the neglect of the mine boss or the fireman in keeping up the fires is soon apparent in the decreased volume of air circulated in the mine, and the air-current will fluctuate more or less from this cause. Better results are obtained from furnaces in deep shafts than in shallow ones, owing to the increased upright column of heated air ascending from the shaft.

In erecting furnaces, care is not always taken to make them large enough to accommodate the increased wants of the mine consequent upon its future development. Very frequently the usefulness of a furnace is impaired by the up-cast shaft being smaller in sectional area than the inlet to the furnace. Frequently, also, in shafts having a third compartment partitioned off as an up-cast from that of the two hoisting compartments, in addition to its small sectional area and inability to pass an increased volume of heated air, the partition separating it from that of the down-cast, or hoisting compartments, will be found to leak more or less at every joint or seam. It cannot be expected that air after being increased to double its volume by passing over the furnace fire, can be conducted with the same facility through an opening smaller than it occupied when cold and condensed.

Air-shafts, in all cases, should be a little larger in area than the return air-courses of the mine. Instances have been met with in this State, in drift slope and shaft openings, where the furnace was provided with a chimney on the outside, where the area of the return was from 8 to 10 feet, and the area of the stack through which the heated air passed did not exceed one and one-and-a-half feet. Air-ways are also found that vary in size at different points, thus increasing the friction and retarding the current. To be safe, the practical working capacity of an air-course should be calculated at the point of its smallest area.

The friction of air in mines is not looked upon by mine bosses as much as it should be. In some instances this results from ignorance of what friction really is. It is also very frequently lost sight of by mine bosses that know better. It seems not sufficiently to enter into their calculations of the resistances to be overcome to insure proper ventilation. In fact, eight or nine-tenths of the power employed in ventilating mines is consumed in overcoming frictional resistance, while the remaining one or two-tenths do the actual work of ventilation. Therefore it is proper to take advantage of every circumstance to reduce to its mimimum this resistance. Each airway, as near as practicable, should have the same area throughout. The sides of the air-ways should be as smooth as the nature of the work and vein will permit, and no obstructions, such as props, braces, falls of roof, and many others, should be permitted in them.

MECHANICAL VENTILATION.

There are various contrivances for ventilating by mechanical means, such as air pumps, the steam jet, the centrifugal fan, and others not necessary to mention.

In one shaft in this State the necessary air-current is produced by using the pump side of the shaft as an up-cast, and depending on the heat derived from the steam pump and pipes conveying the steam to the pump at the bottom, to raise the temperature of the air and bring about the upward movement required. While this is found to be all that is desired in this mine at the present time, as it is of no great magnitude, yet it would prove wholly insufficient in many of the large mines of the State.

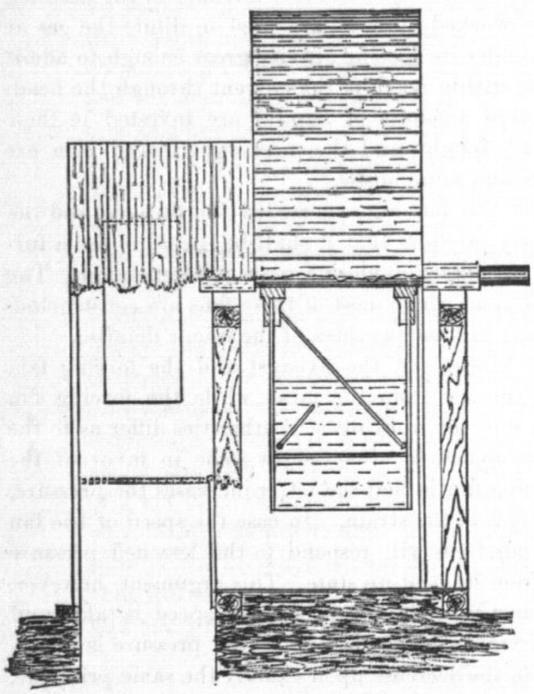
The centrifugal fan has proved to be the best mechanical ventilator yet introduced. There are many varieties of fans, but first among all stands the Guibal. Its superiority has been demonstrated in England and on the continent, and in the anthracite region of Pennsylvania. The pitching veins of the anthracite coal fields are probably the most difficult to ventilate in the world. Most of them are full of fire-damp, and are worked with safety lamps exclusively. As they pitch at angles varying from 30 to 65 degrees, or even more, the fire-damp, owing to its specific gravity, floats up at the face of the rooms or breasts, and the miner works for the most part surrounded by the deadly element. Headings or break-throughs are driven between the rooms from fifteen to twenty yards apart, in order to bring the air-current close to the miner. When the room is in advance of the heading, or break-through, hand-fans, worked by boys, are used to dilute the gas at the face of the rooms, and render its specific gravity great enough to admit of its being brought down to within reach of the current through the heading or break-through. Large amounts of capital are invested in these collieries and the best talent is sought, and the most experienced men are employed as superintendents and mine bosses.

Throughout all this region, the fan has superseded the furnace, and the new mining law now expressly provides that it shall be illegal to use a furnace for ventilation in mines where explosive gases are generated. The Guibal principle is the basis upon which most of these fans are constructed, but each individual fan maker has his own idea of the minor details.

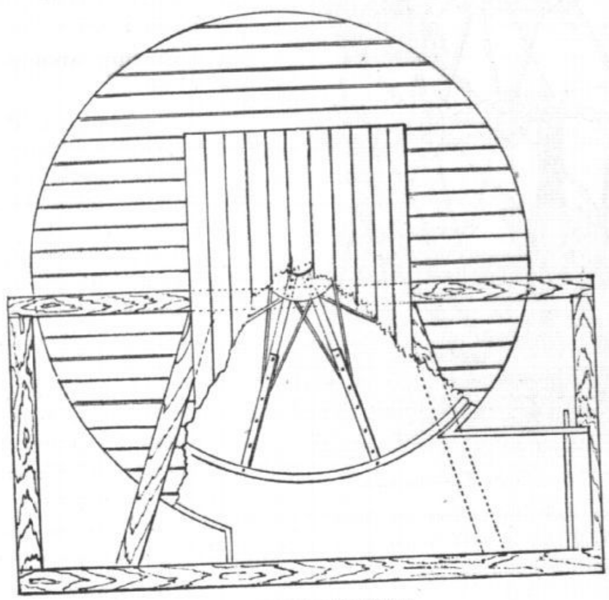
Fans are of two general kinds, viz., the exhaust and the forcing fan. The exhaust fan exhausts the air from the mine, while the forcing fan forces it down the shaft and into the workings. Authorities differ as to the relative merits of each. An objection advanced by some in favor of the exhaust and against the forcing fan, is that the latter increases the pressure, thereby damming the gas back in the strata. In case the speed of the fan is slackened off, the accumulated gas will respond to the lessened pressure and spring out in volumes from its pent-up state. This argument, however, works both ways. An exhaust-fan running at a given speed is taking off pressure, and if anything occurs to block the intake the pressure is diminished, and the gas responds to the decrease upon exactly the same principle.

Others claim in favor of the exhaust fan, that it has the benefit of the tendency of the heated air of the mine to ascend to assist it in its work, which the forcing fan does not obtain. I do not see why this can be so any more with the one than the other. If the forcing fan has not the tendency of the heated air to assist it to begin with, does it not have it just exactly on the same principles to finish with as it comes out of the up-cast, other than the one the fan is forcing down? In my opinion, there is no difference with a fan forcing the air into the mine or exhausting the air out of it, other than the chances given it in either way at the point of receiving the air or delivering it when it is constructed. A party will build a fan to act as an exhaust and to act as a forcer by changing doors, etc., in erecting it. Although he may think he has taken all the necessary precautions in giving it equal chances to work the one way as well as the other, yet he will find that it produces more air one way than it will the other. Of course, he will conclude that a fan will do better as a forcer or an exhauster, as the case may be. However, some one else will construct another fan, but contrary to the former, it works best to the opposite.

And this, I think, is just where all this difference of opinion hinges. It would seem that the same law governs the one that governs the other, viz., the atmospheric pressure. As the force exhausts the air out of the mine, does not the atmospheric pressure fill in and take the place of that exhausted? When the fan, for argument's sake we will say, exhausts the air into the mine, don't the atmospheric pressure fill into the fan just exactly on the same principles from open day as it did from the mine, and from the same cause? A fan is not a compressing machine, nor an exhausting machine, fitted with a tight piston, and with suction and forcing valves. If it was, it seems the above objections, in favor or against, would undoubtedly cut some figure; but so far as they are concerned with the open centrifugal fan, I think the difference is more in the opinion of the builders, and the chances given the fans. A fan will not force or exhaust any more air than the atmospheric pressure will give it, and then only in quantities in proportion to its speed and capacity of the volume it is capable of containing. It would seem that, no matter how much the air had been rarified or expanded before it reached the fan, it could not pass the fan without coming in its way, so that it could only displace the same volume of heated air that it could of air with a greater density. However, a little additional power might be needed from the engine to displace the volume having the greatest density.


FAN, SECTIONAL ELEVATION.

Cuts of two cheap and durable ventilating fans can be seen in these pages, one with a casing having straight blades from the center; the other, without casing, having direct connections and inclined blades. Both fans give fairly good results. Authorities agree that the inclined blades in practice give the best results, and some claim it makes no difference, provided the point of delivering the air from the blade is made to suit the blade. It would seem that the air could be displaced and cut off better with a blade bowing backward, with curved surface, on the line of a radius drawn from the center, and the blade bowing backward with a flat surface next, and the straight blade with no bow last of all. The fans now working in some of our

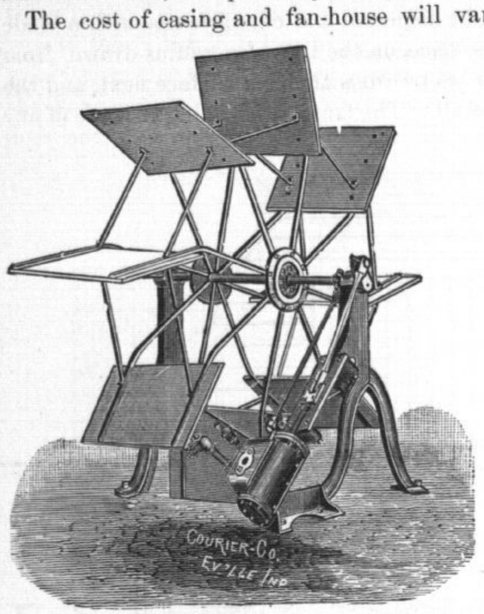


FAN, SIDE ELEVATION.

mines have the flat blade bowed back, as seen in the cut, and they all, without any exception, give good results and entire satisfaction to those owning them.

Either kind here shown can be bought without the casing, any size required, from seven to thirty feet in diameter. The fans now in use are from nine to ten feet, and the casing is built so that all can act either as exhausters or forcers. Thus, in the winter months, by making the fan a forcer, ice can be kept out of the hoisting shaft by the heated air coming out of that opening. This, however, is objectionable where large quantities of powder are used to mine the coal, and where miners have to come out of the same upcast opening after firing their shots, as they are compelled to find their way to the bottom of the shaft through clouds of powder-smoke. A stairway in the inlet shaft in shallow mines, under those circumstances, would overcome this objection to some extent, but if the inlet was wet the probabilities are that the steps would be frozen up by the cold, dense air being forced into the mine. That difficulty might be encountered and accidents happen, should anyone attempt to climb up the stairs frozen with ice. Fix things as you please, there is always more or less trouble, attended with danger to the miner's life, and probably always will be.

The cost of casing and fan-house will vary according to circumstances. The following kinds and quantities will build the casing, and the fan and engine house, where engines are geared direct for fans of the following dimensions, either kind:



(Built by Wm. E. Cole, Washington, Indiana.)

FIFTEEN-FOOT FAN.—1800 ft. matched flooring; 36 pieces, 2x4x16; 5 pieces, 6x8x14; 6 pieces 2x6x16; 1 piece, 21x22x14. Roof, 4 squares.

TWELVE-FOOT FAN.—1500 ft. flooring; 36 pieces, 2x4x12; 4 pieces, 6x8x16; 4 pieces, 2x6x14; 1 piece, 8x18x14. Roof, 3 squares.

TEN-FOOT FAN.—1100 ft. flooring: 36 pieces, 2x4x12; 4 pieces, 6x8x12; 4 pieces, 2x6x12; 1 piece, 8x14x10. Roof, 2 squares.

EIGHT-FOOT FAN.—900 ft. flooring; 36 pieces, 2x4x10; 4 pieces, 4x6x10; 1 piece, 8x12x10. Roof, 1½ squares.

SEVEN-FOOT FAN.—800 ft. flooring; 36 pieces, 2x4x10; 4 pieces, 4x6x10; 1 piece, 8x12x10. Roof, 1½ squares.

EFFECTS OF BAD VENTILATION.

The following notes are taken from Roy on Coal Mines:

T. E. Foster, a British inspector of coal mines, in an examination before a royal commission appointed to inquire into the condition of mines, in 1874, gives the following answer in regard to carbonic acid gas (black-damp.) "It is my opinion," said he, "that there are quite as many men killed where there is nothing but carbonic acid gas (black-damp), as where there is inflammable gas. The men's health is naturally destroyed. They do not go immediately, but they go on for a few years, and die."

Andrew Roy, an eminent inspector of mines, says: Asthmatic diseases, at an early period of life, are the unfailing results of bad ventilation, and when miners are attacked in their lungs, the shoulders rise, making the head look like sinking, as in ordinary consumption. The breathing apparatus becomes clogged up, and there is expectorated a black spittle which finally results in the black-lungs, or coal miners' consumption.

Professor Graham examined the lungs of a miner, the greater part of which were permeated with a black, solid matter, like lamp-black, and above one ounce of charcoal was obtained out of the mass.

Dr. Wm. Thompson has recorded a number of cases of miners' lungs which were infiltrated with black matter. The following are some of the cases: D. C., aged 58 years; miner 12 years; lungs uniformly black, and a carbonaceous color. D. D., aged 62 years; miner from boyhood; lungs uniformly black, not a vestige of natural color left; refers his disease to breathing an irrespirable atmosphere. G. H., aged 54 years; miner all his life; whole lungs dyed with black matter.

Although pathologists do not agree, says Dr. Hutchinson, about the exact cause of this carbonaceous matter, whether caused by the mechanical inhalation of black matter or by a chemical action of breathing carbonic acid gas (black-damp), it matters little to the miner. All agree that the lungs are blackened up with carbonaceous matter by foul air and something peculiar to the art of mining; and all agree that the more pure the air the more healthy the lungs. These facts call for more air to circulate and better ventilation in mines.

AMOUNT OF AIR REQUIRED FOR VENTILATION.

The following statements, by some of the ablest practical mining engineers of Great Britain, showing the amount of air required for the thorough ventilation of mines, are submitted:

Prof. Phillips states that in most of the English mines which yield fire-damp abundantly, six hundred cubic feet of air per minute for each miner, is circulated, and two hundred feet in addition for each acre of waste.

Mr. Blackwell, in his report on ventilation, says that from two hundred and fifty to five hundred cubic feet per man per minute, ought to be circulated, according to the requirements of the mine.

Mr. Hedley, Inspector of Mines, says that in practice he moved from one hundred to five hundred cubic feet per minute for each miner employed.

Mr. Taylor, Mining Viewer, says that in a mine which yields no fire-damp, with one hundred and twenty to one hundred and thirty men employed, a current of twenty thousand to thirty thousand cubic feet per minute might be a fair quantity, if properly conveyed up to the faces of the workings and made to sweep those districts where the people are employed; but in fiery mines very much more than this quantity would be required.

Mr. Dunn, Inspector of Mines, says: "I should say that the minimum quantity of air for the most harmless of pits, ought to be from ten thousand to fifteen thousand cubic feet per minute."

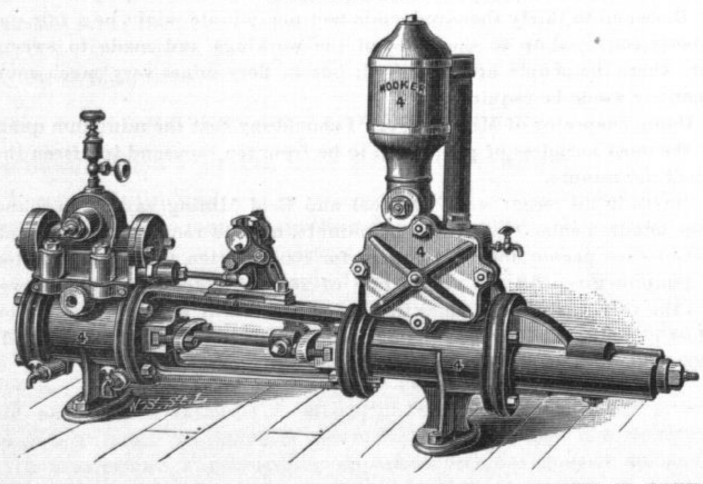
Mr. Smyth in his recent work on Coal and Coal Mining, says: "In round numbers, one hundred cubic feet of air per minute, may be required for the health and comfort of each person under-ground, or for 100 men ten thousand cubic feet; but if fire-damp be given off, say at the rate of 200 cubic feet per minute, we would need, at the very least, thirty times that amount of fresh air to dilute it, or 6,000 cubic feet in addition. Increase the number of men and liability to gas, and 40,000 or 60,000 cubic feet of air may be indispensable for safety."

ENGINES AND PUMPS.

HOISTING ENGINES.

The cut on page 31 represents a good, durable and light hoisting engine, just the right kind of engine for the shallow mines of this State. It can be built of any size to suit the purchaser. It is compact, takes up but very little room, and still contains all the necessary working-parts required for a light and shallow hoist, and can be easily set up in place, without the assistance of a machinist, by any person of ordinary intelligence. They come from the shop all fitted and adjusted, so that, if put on a level foundation and bolted down and in line with their work, they are ready to hoist coal. This type of engine is in general use in Crawford and Cherokee counties, and gives good satisfaction. However, none that are in use now have a brake on the winding-drum, such as is on this engine, and which is to be highly recommended on that account, as the mining law of this State requires the brake to be on the winding-drum, instead of on the fly-wheel or crank of the engine. The above can be furnished with an iron spiral drum or a drum with wood lagging, to suit the taste of the purchaser.

MINE PUMPS.

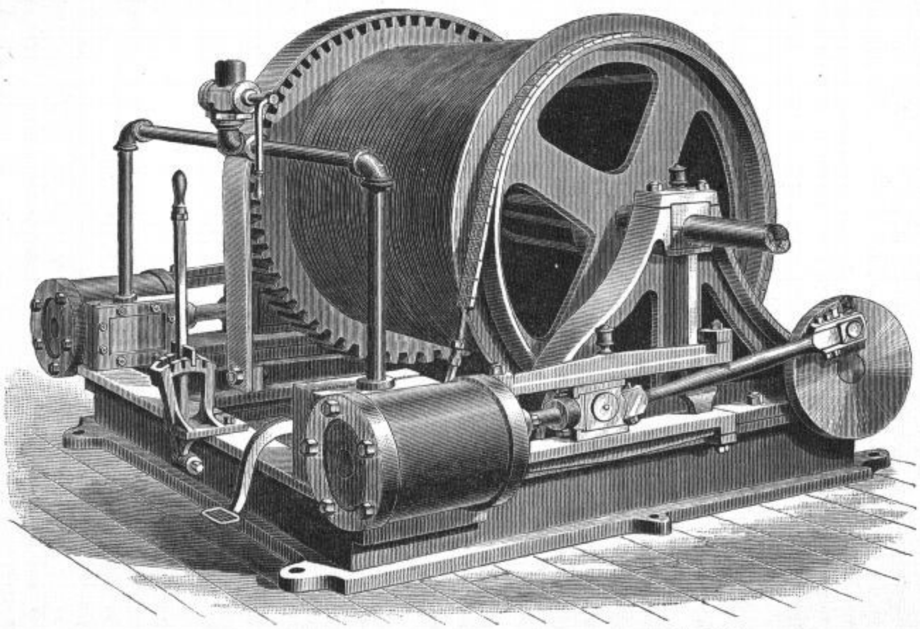


HOOKER-COOLVILLE STEAM PUMP CO., SECOND AND CARR STREETS, ST. LOUIS, MO.

The above cut represents the No. 4 Hooker Mining Plunger Pump. There are a few good pumps in use in mines in this State: the Knowles, the Blake, the Cameron, and the Hooker. The latter is becoming the most used, giving the best satisfaction.

The ingredients in the mine waters of Crawford and Cherokee counties

State inspector of coal mines reports



HOISTING ENGINE—BUILT BY OTTUMWA IRON WORKS, OTTUMWA, IOWA.

are such that a pump having the least joints about it is best. They will eat a cast-iron plunger so as to ruin it for more use, in 24 hours; and will eat away a cast-iron cylinder in that many days. These waters seem to take all the cohesion out of the iron and leave it like block lead.

A bronze metal well adapted to stand the attacks of these waters is manufactured by the Hooker Pump Company. The water cylinders are made from this metal, and are cast all in one piece, thus preventing any liability to leaky joints. This cylinder has but two joints about it — the plunger bonnet and the valve-chamber cap. This cap can be taken off and the valves examined, and be readjusted, in less than one minute. I know a pump made from the above metal which has been in use for over one year, and is, outside of ordinary wear and tear, as good to-day as it was when put in. It is, in my judgment, the best mine pump in the market, and I take pleasure in recommending it to mine operators, as such, for light and heavy duty, in or out of the mines.

AMENDMENTS OF THE MINING LAW RECOMMENDED.

I presume it is one of the duties of the Inspector to make recommendations in regard to the mining law, in order that defects may be remedied and the law made to more fully meet the purposes sought for; also to make suggestions for the addition of new features, when he sees the same are needed.

With this view, I wish to suggest the need of a

UNIFORM SYSTEM OF SIGNALS

to and from the bottom of shafts to the surface at the pit-top, or engine room, where steam is used for hoisting or lowering the cages and their contents. In order to demonstrate the need of such a system of signaling, I shall endeavor to show as clearly as possible where lives not lost can be saved, and where lives lost could have been saved, had the signals been such as I wish to suggest for a uniform system.

In the first place, I wish to call your Excellency's attention to the only provision the law makes concerning signals. In chapter 117, amended law of 1885, section 1, it reads as follows: "And there shall also be maintained the ordinary means of signaling to and from the top of such shaft or slope."

Now the question arises, what constitutes an ordinary signal? In my judgment, it would be anything that every Tom, Dick and Harry might wish to put on, at the least expense. All men do not look at things alike, and if any of them should be called in question about their signals by the Inspector they would offer a thousand-and-one arguments in favor of their own system. Some people might say that it is the Inspector's duty to regulate those things, and no doubt a great many think so; but I do not. If I understand my duties correctly, I am to see the laws enforced, not to make laws, unless in special cases provided for by the statutes.

Now, to enable me to show further the need of a more safe and uniform system of signaling, I call your Excellency's attention to fatal accident No. 3, reported in previous pages. By referring to the same, it will be seen that Creosta Armand lost his life, partly by his own carelessness, but more by a defective system of signaling than by any fault of his own. But while I say that it was through defective signaling at this place, I wish to state that the same system prevails generally throughout the State where steam is used. It was the first system established in this (Crawford and Cherokee) district, and has been in use so long that it has become a habit, as it were, which is hard to break off.

By referring to the description of the accident, it will be seen that when Creosta Armand came to the bottom of the shaft he gave the bell, or signal, the usual three raps, calling the attention of the engineer to the fact that men were on the cage and wanted to come up. The engineer not being at his lever to respond by lifting away the cage at once, Armand undoubtedly concluded he was not there, so he commenced to climb the shaft above the cage. But it unfortnately happened that the engineer was within hearing distance of the signal, which he proceeded to obey as soon as he could get to the lever of his engine, and on hoisting away the cage it caught poor Armand before he had climbed much above it, and killed him. If Armand had signaled again to the engineer before he started to climb — but this time only bell 2, this being a signal to the engineer to let the cage remain at rest — the engineer hearing the three bells, would no doubt have heard the two, and would not have moved the cage until he had received further signals to do so. Then Armand could have reached the top of the shaft in safety by climbing. But it so happened, either through his thoughtlessness in not giving the signal to remain still, or through his ignorance of the existence of such a remain-still signal, that he put his life at the mercy of the machinery, and by so doing lost it.

Now, on the other hand, had it been the custom (as it should be) for a back-signal to be given to the men below by the engineer, after they had notified him by signal that they wanted to come up, responding to them that he was at his engine ready to hoist them, they then to give him another signal that they were on the cage ready to come up — if this had been the system used in Armand's case, the engineer, in the absence of a response to his back-signal from the engine room, would not have moved the cage, so that Armand could have reached the top in safety.

This is the first fatal accident that has happened to my knowledge in the State from this cause, defective signaling, but I have personally witnessed many hair-breadth escapes from the same hazard. But as there is any quantity of room for accidents to occur again, if the system of signaling now practiced remains, I think it proper, in view of that fact, to recommend that the law require operators to arrange a safe system as soon as possible. Such a provision of law should have a penalty for non-compliance in every case where steam is used. The signals required should be loud and distinct. If such a law were in force, a miner moving from one shaft to another could give the proper signals at a strange place the same as if he were acquainted.

I will here give the present and defective system which is used almost generally throughout the steam districts. Before giving them, I wish to state that, when the shaft is in operation, the signals from the bottom are under the control and hearing of the coal dumper, (and not in the hearing of the engineer, as they should be.) The engineer has nothing to do with the signals from the bottom, but, on the other hand, pays attention to a signal given him from the *dumper*, who is liable from the surrounding excitement and noise to give the signal to the engineer to hoist before the men at the bottom are ready. This is another source of danger, and was the cause of another life being lost, as I will show further on. When the shaft is not dumping coal, or not in operation, in the absence of the dumper the engineer attends to the signal from below. Should anyone happen to be in the mine, as there most always is, and as the signal is placed to suit the dumper's hearing, it is in a number of cases heard from the engineer's quarters very indistinctly, so that there is a probability of accidents happening through this cause also.

Here are the present signals: One bell, to hoist coal or other matter. This signal is all right, but it is given to the dumper, not to the engineer, as it should be, and the dumper then gives it to the engineer. One bell, to stop the ascending cage while in motion. This is correct, but it has the same bad feature. Before the engineer will stop his engine, the dumper has to give him the signal, which takes a little more time, and if he has not got his hand on the bell-wire, considerable damage may be done before the engineer gets the signal to stop. This could, to a great extent, be avoided, were the signal given direct to the engineer from the bottom. One bell, to hoist away the last ascending cage that was stopped after leaving the bottom of shaft. Two bells, to back down the last ascending cage that was stopped after leaving the bottom of shaft. Three bells, that men are on the cage, wishing to come up.

This last signal has also a very objectionable feature. Supposing a car of coal to have just been sent up, and that before the dumper gets the car off the cage on top, the men wanting to come up step on the opposite cage. The car of coal on the cage above may have jumped the track while the dumper was pulling it off. He gets a lever under one end of it, and raises it on the track. While this is being done, some lumps of coal roll off the car and fall down on top of the men and kill some of them. Accidents of this kind have happened. Most miners do not take risks of this kind until they are sure the car on the cage above has been taken off; but, once in a while, some thoughtless fellow will take the chances, and get on the cage, and in some instances lose his life.

To avoid all these risks, I would suggest that the following be the uniform system required: First, that all signals given from the bottom go direct to the engineer, and not to the top-man. Let the top-man have a separate and altogether different sounding signal to give from his top to the engineer when he is ready, and that signal govern his own work only, the engineer attending to both signals, and starting his engine only when he has heard both.

1 bell, for coal or debris to be hoisted.
1 bell, to stop ascending cage while in the shaft in motion.
1 bell, to start and hoist the ascending cage that was stopped in the shaft.
2 bells, to back down the ascending cage that was stopped in the shaft.
2 bells, to let cage remain still in the bottom, after it had been rung away.
3 bells, that men are at the bottom of the shaft wishing to come up; and before they step on the cage, let the engineer respond to these three bells with his back-signal, giving one bell, as much as to say, "I am ready to hoist you; get on the cage." The men then get on the cage and give the engineer one more bell, as much as to say, "We are all on the cage; hoist us up."

This system of signaling, it seems to me, must prevent a recurrence of the accident before mentioned, and also the accident which I shall hereafter mention. As I stated above, another life was lost by having the signal from the bottom to the top-man instead of to the engineer. A description of said accident will be found in fatal accident No. 6, on a previous page. Julius Herzog came to his death by being caught by the ascending cage, which was hoisted away through an unintended and irrecallable mistake of Theodore Schill, a strange dumper, who gave the starting-signal to the engineer before they were ready at the bottom.

Now it is an indisputable fact to me, as I know it is to many others connected with the coal business, that the engineer about a coal shaft is a man filling a position which is less frequently changed as to its occupant than any other position about the works. Especially is this so as contrasted with the dumper's position, which, I can safely say, is changed ten times for once of the engineer's position. Why is it so? It is because precautions are used in hiring the engineer. None but the most careful men are employed to take charge of the machinery. His careful habits, his sobriety, coupled with his ability to take good care of the engine and boiler, are looked into before he is considered a permanent employé. On the other hand, a strong man with activity to handle the pit-cars quickly, and dump lots of coal in a short time, are the most necessary qualifications of a dumper. And it seems, from a practical view of dumpers in general, that such are the prevailing qualifications, regardless of their carefulness, although all the particulars mentioned are needed, and some have them; but operators seem to pick on the former qualifications first. No doubt it is a profitable selection, and would be a sensible and humane one, if the signals were controlled by the engineer instead of the dumper.

I do not mean to say that any operator will intentionally select a man, knowing that he is not capable of taking charge of the signals, but I will venture to say that the selection is made in view of the fact that so many tons of coal dumped by one man more than another, means so much more profit from the business. Dumpers can be selected out of any class of workmen around a shaft, but engineers cannot. This is one reason why I discourage the system of having dumpers control the signals, other than their own, from the pit-top to the engineer.

I may state here that a dumper is the worst annoyed man on the whole work, especially if he is kept busy dumping coal. He has a dozen different things to attend to, and, if he is of an excitable temperament, he tries to do them all at once. He is in a manner the telephone exchange of the whole work. He attends to the signals, pulls the stops to let the cage go, hands in the checks of each car as it is dumped, to the weighmaster, answers all calls from the bottom for prop timber, rails, etc., and in some cases greases or oils the cars, and pays attention to car trimmers, etc. And if he don't hurry up, he gets his blessings from the foreman. Under these circumstances, why keep other men's lives in his hands by giving him control of the signals? He can hardly be held responsible for a mistake in signaling. From continual annoyance and the rumbling of coal down the chute as it is delivered from the pit-cars, and his over-anxiety to get along with his work, he may imagine that he heard the signal from the bottom, when it was not given. While a man may have all his senses, coupled with ability and carefulness, he still can't help making mistakes in this position at times. Therefore too much care should not be placed on him. He may be in the act of dumping the ninety-ninth car out of one hundred without a stoppage or a break, and in all the ninety-nine cases the signal from the bottom may have been given before he got back to the cage with the empty car, so that he belled away to the engineer as soon as he was ready himself. Such were the circumstances at the death of Julius Herzog. In the putting on of the one-hundredth car, as it were, it jumped the track. He got on the cage to lift it on, and before this was accomplished the dumper had returned with his empty car, put it on the cage, and belled it away, as he had none in the ninety nine cases before.

I regard the dumper's position, while he has charge of the signals, as the most responsible of any around the works, although it is not rated as such at all places. And in view of those facts, I think it would be a just act of your Excellency to recommend to the Legislature the removal of a responsibility from the dumper where lives are in danger, and the imposing of such responsibility on the engineer, where it really belongs.

To make matters more clear, we will view the engineer's position. He is shut up in his engine room, controlling the death machine as it were, without the least responsibility of lives in his engine's grasp. He has nothing to trouble his mind but the attention required by his boiler and the throttle of his engine, which he starts when commanded to do so by the signal from the top-man. He has no one to ask him to do a dozen jobs at one time, as it is with the dumper. He is set apart from all other parts of the business, in a house by himself. He has the least to trouble him of any employé around the works. Why not make *him* the telephone exchange, so far as signals are concerned, from the men below? Let him have a back-signal from his engine room to the surface landing of the shaft in shallow mines; and in mines where it cannot be distinctly heard in the bottom from the surface landing, let it be put far enough down the shaft so that it can be distinctly heard. If such had been the case at the time Julius Herzog lost his life, the probabilities are that he would have been living to-day. Should the engineer think that the signal from the bottom is given, but not be certain, he can quickly find out by asking the men below, as it were, with his back-signal. If they are ready, they will respond; if not, then the bell will remain silent, or they will give the engineer the remain-still signal.

Now the system of signaling that I have recommended is the system used in the large coal districts of Illinois, and from its long use it has been demonstrated to be the best. It would be well, if such a law is made, to require each operator where steam is used, to post up printed instructions and keep them up, both at the bottom and top of the shaft, stating what the signals are, so that strangers coming from other States can educate themselves and avoid giving the wrong signal.

TO PREVENT PREMATURE EXPLOSIONS OF POWDER.

Since my appointment to this office, five victims have been caused much pain and suffering, as well as loss of valuable time, through injuries sustained by the premature explosion of charges of powder. A description of such accidents please find under the head of non-fatal accidents 1 and 11. In my short time in this office, no accidents of a fatal character from this cause have occurred; but it is only a question of time, it may be short or long, until fatal accidents will occur through this cause, if the iron drilling-tools now in use are continued.

Taking this view of the matter, I think "a stitch in time will save nine." I would suggest that a provision of law be passed prohibiting the use of iron or steel drilling and blasting-tools in the mines in this State, and substituting for them copper tools, which will cost but a trifle more. Such a law has been in existence in the State of Illinois for several years, and not a single accident has occurred by premature explosions since the law came in force.

I have made some inquiries of the leading manufacturers of these tools in the State of Illinois as to their cost, and they say that they can furnish a copper needle and a copper tamp-end for $2.50 per set. A copper needle, with ordinary care, will last a lifetime, while those made of iron or steel will only last a few years, and are generally rusty, and often roughen or case the needle-hole when they are withdrawn, and in consequence the miner has a squibbed shot. A copper needle will not rust, is easily withdrawn, and always leaves a clean, smooth needle-hole, and the miner has less squibbed shots. Of course when coal is wet, a blasting-barrel will have to be substituted for the needle, but at the same time the charge is stemmed with the copper tamp-end drill; so that there is, in a manner, no risk of an explosion with a blasting-barrel. The copper tamp-ends for tamping-bars, are fastened onto a piece of iron at the manufactory, so that it can be welded onto any drill or tamping-bar at the mines.

Accidents cost money, both to operators and employés, and I can safely say not one operator out of ten will ask his workmen more for these tools than they can purchase them for, until all their men have been supplied. I think the operators will be only too glad to get the safety tools introduced to prevent accidents, without asking an exorbitant price for them. The makers of these tools say that miners can club together and get the tools from them in one-dozen lots, at as low a figure as any dealer can. Nearly fifty per cent. of our coal is now being mined by the blasting process, and it is only a question of time until a larger percentage will be mined by this method; so that accidents are bound to increase from premature explosions, instead of diminishing, as long as the use of iron blasting-tools in our mines continues.

If a law prohibiting the use of iron tools would prevent accidents now, it would surely prevent more in the future. I think it is a wise plan to pass laws to prevent accidents when the cause is foreseen, and is more humane than to wait until more accidents have occurred, and then pass a law. Lives in full bloom can be saved, sometimes, by a little forethought, but lives lost cannot be recalled. If all the money and loss of time spent on injuries received by premature explosions was summed up in dollars and cents, I venture to say it would go quite a long ways toward defraying the expenses of furnishing safety blasting-tools. If such a law were made, six months' time could be given every miner to furnish himself with a set, and it would also give the manufacturer time to make them.

The following is a copy of the section of the Illinois mining law, which refers to copper tools:

"SEC. 19. That all miners and employés engaged in mining coal shall use copper needles in preparing blasts in coal, and not less than five (5) inches of copper on the end of all iron or steel bars used for tamping blasts of powder in coal, and the use of iron needles and iron tamping-bars not tipped with five (5) inches of copper, is hereby declared to be unlawful. Any failure on the part of a coal miner or an employé in any coal mine to conform to the terms and requirements of this act, shall subject any miner or employé to a fine of not less than five dollars nor more than twenty-five dollars, with costs of prosecution for each offense, to be recovered by civil suit before any justice of the peace; said fines, when collected, to be paid into the treasury of the county where the offense was committed, to the credit of the fund provided for the payment of the county inspector of mines."—[An act approved June 21st, 1883; in force July 1st, 1883.

BREAK-THROUGHS IN MINES WORKED BY THE ROOM-AND-PILLAR SYSTEM.

It will be seen by referring to sections 5 and 6, of chapter 117, Laws of 1883, providing for the ventilation of mines, and the measurement of the same, that they refer more particularly to the long-wall system of working out coal, than to the room-and-pillar system. Now while those two sections may be considered practicable in the former system, they are, to a certain extent, impracticable in the latter. It is an easy matter to circulate air in and around the working-faces in long-wall work, but it is not so economical and practical in room-and-pillar work. In long-wall work the working faces, practically speaking, are the air-courses of the mine; but in room-and-pillar work the break-throughs nearest the faces are the air-courses so far as the working-places are concerned. It is not practicable nor is it necessary, unless in mines where large and dangerous quantities of firedamp are generated, for air to circulate close to the working-face of each and every room. The mutual diffusion of the air alone is sufficient to keep the room in a safe and sanitary condition, provided the air-current passes such room at a reasonable distance from the working face. Both miners and operators will agree upon this fact. It would be a great and unnecessary expense to an operator of a mine, worked by the room-and-pillar system, to have to carry air close to the face of every room. It can only be done by carrying with the room a close board brattice, or partition, which would have to be extended as the working-place advanced, and would require a large amount of lumber and expense for its erection.

As a practical and economical substitute for the brattice in our mines, which are mainly free from dangerous quantities of fire-damp, I would suggest that a limit be set on the distance that rooms can be driven in advance of the last break-through, before another one is made. I would suggest that no working-place be driven more than fifty feet in advance of a break-through, or air-way, in a mine, when no dangerous quantities of fire-damp are generated; and that all break-throughs, or air-ways, except those last made near the working-faces of the mine, be closed up and made air-tight by brattice, trap-doors, or otherwise; and that it be obligatory, with some penalty attached, on the part of the miner in mines where it is customary for them to make the break-throughs, or air-ways, through the coal pillar, to do so at the distance above mentioned, when asked to do so by the owner, agent or operator of the mine. And, as soon as a new break-through, or air-way, is made, that it be made obligatory on the part of the owner, agent, or operator, with some penalty attached, to close up and make air-tight the break-throughs, or air-ways, outside of the one last made by brattice, trap-door, or otherwise; and that it be obligatory, as provided for in the Laws of 1883, for the owner, agent or operator of mines, where fire-damp is generated, to circulate air in and around the mine and working-places in sufficient quantities to render it harmless.

The law, as it now is, is all right, so far as the air going along the face in long-wall work is concerned, but, as I have explained, the objection is to keeping it there in room-and-pillar work. It is hoped that the necessity of drawing a line somewhere will be seen. As it is now, it is a hard matter for the Inspector to settle a distance the same with all operators. Some contend, because there is no statutory provision to that effect, that sixty feet from the face is close enough, and others seventy-five feet, and others one hundred feet. The only way to settle this diversity of opinion is to provide by law a limit. Then there can be no question as to the proper distance. If our veins of coal were thicker, perhaps a distance greater than fifty feet would do as well, and keep our mines in as good sanitary condition as fifty feet will in the thickness of coal we have.

THE VALUE OF SEPARATE AIR-CURRENTS IN MINES.

There ought to be different ventilated districts in our mines, especially in those of any magnitude, and there ought to be some limit as to the number of men that should be allowed to work in each district, separately ventilated. With separate equal currents, more air could be circulated with the same ventilating pressure than can be in one current, and a more bountiful supply of air would seek the last as well as the first man's working-place, in a much purer and more healthful state.

To illustrate this fact, we will take a mine worked by the long-wall system, where the vein of coal is but fourteen inches thick, and the mining clay below the vein four inches thick, which gives a working height of eighteen inches. For argument's sake, we will say that there are 125 miners at work, and that the mine is separated into two ventilation districts. One district has twenty-five men and the other has one hundred men. Now, on account of the thinness of the seam of coal, the sectional areas of the air-ways practically are limited to a very few square feet; and as the miners are obliged to keep a light so that they can see to work, and to avoid blowing their lights out, and to avoid carrying away the heat from the miner's body too fast, leaving him uncomfortably cold, the velocity of the air-current has to be regulated to suit these circumstances. This being the case in the district where the twenty-five men are at work, with clean air-ways and circumstances as they ought to be, nothing of an unhealthful nature can exist, as a sufficient amount of pure air, at a moderate velocity, passes them in a given time; but, on the other hand, in the district where the one hundred men are at work, altogether different conditions prevail, as will be seen further on. In view of the fact that the sectional area of the air-way is limited, there cannot be a sufficient quantity of air circulated past the first man's room so as to reach the last man out of the one hundred in a pure and healthful state without making it very uncomfortable and cold for the first man to work in, and he be able to keep a light to see to work by. In cases of this kind, it is looked upon as a settled fact by some mining bosses that too much air is in circulation, when the complaint is only made by the first few men that the air-current passes. In consequence of a complaint from the first men on the current, the furnace is kept down until the velocity is reduced. This condition of affairs is often met with by the Inspector. On being reprimanded for keeping poor air, the pit boss will often say that So-and-so complained of too much, and to prove it, just ask him to suit them.

Admitting, now, that the first few men are entirely suited, let us follow the air-current from the beginning of its journey to the end of it. It passes on from place to place, from one man and boy to another, from one lamp to another, gathering noxious gases from the exhalations of the miners; from the combustion of the lamps and combustion of powder, and from gases generated from the coal and accompanying strata, and before it reaches its destination it is so charged with impurities that it is injurious for any living being to breathe it. It is often impregnated with carbonic acid (black-damp) to such an extent that the miner's lamp is kept lighted with difficulty, his time being employed in encouraging it to burn.

Now we will say, for argument's sake, that this same mine working 125 men, is divided into four separate and distinct currents, each current ventilating in round numbers 31 men. In the first place we split the air in long-wall work at the head of the main entries on both sides of the mine, which is generally of large dimensions, and by so doing we increase the sectional area of the air-way to double its former size, while at the same time we do not increase the rubbing surface or friction arising from the air rubbing on the top, bottom and sides of the air-ways, as the air, practically speaking, has only the same distance to travel in the four currents that it had in the two currents. Consequently we get a much larger volume of air with the same ventilating pressure; and, as a last consequence, we have a much purer and more healthful mine.

Now as the above refers to mines other than those of Cherokee and Crawford counties, it would be well to say something in regard to them, and also of the benefits that would be received with separate air-currents in them. While there is a much thicker vein of coal in the mines of those counties, and while it is a much easier task to circulate a large volume of air in them with the same ventilating pressure, I do not think it will be saying a word against them, to say that they much need a larger volume of air. We have to counteract the disadvantages arising from small air-ways on the one hand, and a large amount of noxious gases to contend with on the other, especially the gases arising from the combustion of large quantities of blasting powder, and which renders the air very impure to breathe. The coal in these two counties is mined by the process called "blasting from the solid," so that large quantities of powder are continually in use.

To make the changes necessary within the immediate reach of all operators, I would suggest that the limit of men allowed to work in one air-current be placed at forty; and that it be made discretionary with the Inspector to curtail this number to at least thirty, in cases where in his judgment it shall be found necessary to do so to keep the mine in a sanitary condition.

In favor of the suggestion, it is encouraging to say, that Mr. Robt. Craig, superintendent of the Osage Carbon Co.'s mines, in Osage county, is making separate air-currents in most of his mines at the present time, and whether there is a law made to that effect or not, the changes will be all made in time in his mines. He will ventilate a still smaller number of men in each current than I have suggested. I may state, also, that Mr. J. E. Carr, superintendent of the Leavenworth City Shaft, has his mine at present separated into four distinct and separate air-currents, and says he shall have it divided up into ten before he is satisfied. This mine needs a larger volume of air than any other in the State; not because it gives off fire-damp, nor because they use large quantities of powder, but because it is so deep and extensive that the heat given off from the strata and from the slow combustion of the gob-waste, or excavated ground, makes it somewhat uncomfortable for men to work in. Near the face of those works a man will perspire without doing any work, and with nothing but his pantaloons on. I presume this does not injure a man's health as much as one might think, but no doubt it keeps him from performing a certain amount of labor that he could do if in a cooler atmosphere, which can be secured by having more separate and distinct air-currents in the mine.

I would suggest again, that if the law be made made to cover the above, some specified time be given each operator to accomplish the changes sought for.

A LIMITED AMOUNT OF POWDER ALLOWED TO BE TAKEN INTO THE MINES.

The Legislature of 1885 amended section 7 of chapter 117 of the Laws of 1883 with a provision as follows: "No miner, workman or other person shall take into any mine more than five pounds of powder at one time, and this shall be used before taking any more into the mine; and all powder, or other explosive substances, shall be kept in a close, tight vessel."

Now while I do not dispute that the provision was well intended, I cannot say that I agree with it. It was no doubt thought by the Legislature that such a law would prevent the occurrence of accidents similar to the Lone Oak powder explosion; and while it no doubt points in that direction, there are other dangers which ought to have had some consideration as well. No father, who deserves to be called a father, would subject his children to dangers that he did not want to encounter himself. For that reason, I have thought best not to enforce the law. When a miner purchases his powder, he can only buy it by the 25-pound keg. He cannot buy it loose in small quantities like sugar. He must either purchase it by the keg, or do without it. When a miner purchases a keg of powder, and, under the existing law, is prohibited from taking it into the mine, where can he take it? Above all things, he has not the heart to take it home, to be a plaything for his children and a terror to his wife. He cannot hide it outside somewhere, and run the risk of losing it, as his daily bread depends upon its safe keeping. But admit that he can keep it at home. Upon leaving home for his daily toil in the morning, he fills his five-pound flask or vessel provided for by law. He uses in the course of the day say four out of the five pounds. He has only one pound left, and, under the existing law, he cannot, without subjecting himself to a fine, bring more to the mine next morning to do his next day's work. He has to use the one pound left from the previous day, before he can bring in any more. If the one pound is insufficient to perform the work, and he cannot borrow from his neighbor, what in the name of common sense is he to do? It is a conundrum to me; and in view of this, I have thought the law impracticable, and too inhuman to be enforced.

I would suggest that the provision be stricken from the law, and if any limit be put on the amount, do not make it less than a keg. I would also suggest that every miner be required to keep a close, tight wooden chest in the mine, under lock and key, of sufficient size to hold his keg of powder. This is being done now in a great many instances; but a provision of law to that effect would make it become general. Operators could have such chests made and sell or give them to their employés. This, I think, is about the only practical, safe plan for keeping powder in the mine, and to avoid having it lying loose in every corner, subject to ignition from different causes.

INSPECTOR TO GATHER COAL STATISTICS FROM ALL MINES IN THE STATE.

My predecessor, as a labor of love more than a duty devolved upon him by law, gave the annual coal tonnage of the State in his reports. While credit is due him for his efforts in this direction, it is believed that, owing to the legislation of 1885 on the subject, the estimate, as it will appear in my regular report, February 1st, 1886, will be nearer correct than any that has preceded it. Every mine and strip-bank known to me in the State, large and small, has made returns to this office up to the month of December, 1885.

I think the coal statistics, gathered since my appointment to this office, bearing upon the relative amount of coal that can be mined in a given time, per man, in each district or county, can be easily calculated. Although I have been very fortunate in the short time that I have been in this office in getting returns, I must say with due respect to myself, that I have left no stone unturned to get them. I have had a great deal of writing to do to accomplish this. I have written as many as four times to a great many places, in order to get them started to send the reports of their establishments; and in every instance where I have had to do so, I have prepaid the postage to insure its return. I am sorry to say that in fifty per cent. of the cases, I have to do so yet. This is an expense bill that I have to foot.

At the last session of the Legislature an attempt was made to pass a bill, a section of which was partially framed by my predecessor, governing the reports of coal statistics made by each operator. It required them to make these reports monthly to this office, but, through some mistake or misunderstanding, the bill passed requiring the reports to be made quarterly. Since my appointment, and through my predecessor's advice—which I have found to be good—I have endeavored to collect them monthly. And I have found that operators who run anything of an extensive business, make up their books and pay off monthly, so that they would rather make monthly than quarterly reports. I have not heard a word of complaint from any of the above operators, nor, in fact, from anyone, except in such cases as I have above mentioned, where I have had to write three or four times more than I ought to, and prepay the postage every time, which is extra work and expense to the Inspector, and no way to get out of it.

While the action of the Legislature of 1885, in making it the duty of every operator to make quarterly reports of the coal statistics, etc., to the

Inspector, was well intended, it has failed, to a certain degree, in accomplishing prompt returns from all sources. And the only theory on which I can account for such slow returns is, that there is no penalty attached to the provision to make it operative. And in view of that fact, I would suggest that a light and easily-applied fine be attached to the provision, which no doubt would facilitate the duties of the Inspector in that direction. I would suggest, also, that the same provision and fine should apply to strip-coal operators, as there are about as many of them as mine operators. In order to make the coal tonnage statistics of the State complete, it is necessary that these reports should come in as regularly as the others.

THE INSPECTOR AUTHORIZED TO SHOW DRAWINGS OF IMPROVEMENTS, ETC.

It is customary in all other States that have district and State coal-mine inspectors, for such officers to show diagrams of improved ventilating machinery; maps of mines, showing the different systems of working out coal in the district or State; parts of mine-workings where accidents have happened by explosions of fire-damp, explosions of powder, or by suffocation, or otherwise; also diagrams showing improved methods of conducting the ventilation in and around the working-faces of a mine; systems of working out coal that would be economical in small shafts, slopes, or drift-openings; in fact, anything that would be an object-lesson, as it were, of the subject in discourse, to the general mining public, or others; and which aids the inspector very materially in explaining anything of interest or importance that he wishes to suggest as an improvement on some old method. I would suggest that the Inspector of the State of Kansas be authorized to do likewise.

It is a noticeable fact that in eight cases out of ten, persons starting out in the coal business in a small way, with a limited capital, and with a view to increase and extend their business as they make money, are men of no experience in the coal business, and who, from the lack of means, cannot at once pay a competent man to manage it for them, but have to depend on information given them from every Tom, Dick and Harry, and which often leads them to ruin. An inspector, understanding his business and the natural conditions of his field of operations, could offer suggestions in his report, accompanied with a diagram of the subject in question, which would be as plain as day, materially aid the uninstructed, and no doubt tend to produce a more flourishing state of affairs. Such facts would be to the interest of all concerned, by preventing the squandering of many a dollar through mismanagement under the advice of some incompetent or unworthy man.

TO REGULATE DISTANCE OF BOILERS AND MACHINERY FROM THE MOUTH OF SHAFT OR SLOPE.

One source of danger to men employed in mines worked by shaft or slope has been noticed, that is well worthy the attention of the Legislature. It is the placing of boilers and hoisting machinery too close to the shaft or slope. Too much stress cannot be placed upon the danger to those working below, from the risk of fire among the buildings at the mouth of the shaft or slope. This is particularly the case with shafts. The necessary timber structure over the shaft, becoming in time dry, and soaked with oil in many places, is exceedingly inflammable, and in hot, dry weather a spark may cause a conflagration fatal to all in the mine below.

There are some shafts in the State employing a number of miners, that have not been in operation long enough to come under the statutory provision for a second opening. In such cases, with the only means of escape cut off by fire, with the shaft choked with falling timbers, and the smoke and gases from the fire above going with the air-current down the shaft and through all the workings, the chances for life among the imprisoned miners would be but few indeed. The accidental burning of a shaft which had no second opening, at Carbondale, Osage county, in 1881, in which five lives were lost, and the appalling loss of life from this cause by the Avondale disaster on September 6th, 1869, in the State of Pennsylvania, lead me to suggest that the distance of all boilers and machinery from the mouth of the pit be in future regulated by statute.

IT IS NOT ECONOMY FOR THE INSPECTOR TO EXTEND MAPS OR PLANS.

Section 1 of chapter 117 of the mining laws of 1883 provides that after the Inspector receives the first map or plan of mines, he shall extend such maps and plans once in each year, in accordance with the original maps or plans of such mines kept at the office of such mines.

So far, I am sorry to say, this has not been done, either by my predecessor or myself. Practically speaking, it is impossible for the Inspector to do so and attend to his other duties without an assistant. We will take, for instance, my predecessor's report for 1884, in which he states that there are 273 shafts, slopes, and drifts, and we will say that the Inspector had to extend a map or plan for each mine once in each year. We will assume that he had the extended survey notes or other information to enable him to extend the maps or plans at hand at one time. How much time do you suppose would be left him to attend to other duties, which are too numerous to mention? I will venture to answer that question by this statement—that any expert at the business will say that if the extensions are made legibly and intelligibly, as a matter of future record should be, the Inspector would be employed one hundred days out of the year doing nothing else. This is too much time for one man to lose in this manner, who has all the other duties of an inspector to perform. While the Inspector is and ought to be competent and qualified to do this work, I think it is entirely impracticable for him to do it, while it *can* be done by the operators just as well as not. I may state to the credit of the larger operators, that they have heretofore done so, and they who understand the business laugh at the idea of the existing law requiring the Inspector to do it.

In view of the facts above mentioned, I will suggest that all owners, agents or operators be required to extend the Inspector's map or plan of their mine or mines, as well as the original plan kept in their office.

Herewith I append section 1 of chapter 117 of the laws of 1883, so amended as to conform to the ideas above suggested. The proposed new provisions will be found in italics, and the omissions from the present law are inclosed in brackets:

That the owner, agent or operator of every coal mine shall make, or cause to be made, within six months after the passage of this act, an accurate map or plan of the workings of such coal mine and each and every vein thereof, on a scale not exceeding one hundred feet to the inch, and showing the bearings and distances, which shall be kept in the office at such coal mine; and it shall be the duty of the owner, agent or operator of such coal mine to furnish the State Inspector with a true copy of said map or plan, the same to be deposited at his office. And such owner, agent or operator shall cause, on or before the 10th day of July of each year, a plan of the progress of the workings of such coal mine during the year past, to be marked on the original map or plan of the said coal mine, *kept at their office; and they shall also correct and verify the map or plan of said mine workings in the Inspector's office, which shall be sent to them for extension by the Inspector, and be by them returned to the Inspector when so extended.* [And the Inspector shall correct his map or plan of said workings in accordance with the above map or plan thus furnished.] And when any coal mine is worked out or abandoned, *the owner, agent or operator shall notify the Inspector, and they shall extend the original map or plan kept in the office of such coal mine to the date of abandonment, and they shall also extend the Inspector's plan of such mine to the date of abandonment, which shall be sent to them by the Inspector, and be by them returned when so extended.* [The fact shall be reported to the Inspector, and the map or plan of such coal mine in his office shall be carefully corrected and verified.] *Provided,* If the owner, agent or operator of any coal mine shall neglect, or refuse, or for any cause fail, for the period of two months after the time prescribed, to furnish the said map or plan, as hereby required, or if the Inspector shall find, or have reason to believe, that any map or plan of any coal mine furnished in pursuance of this act is materially inaccurate or imperfect, he is hereby authorized to cause a correct map or plan of the actual workings of said coal mine to be made, at the expense of the owner, the cost of which shall be recovered from said owner, agent, or operator, as other debts are recovered by law: *Provided,* That if the map or plan which the Inspector claimed to be incorrect shall prove to have been correct, then the aforesaid expense shall be paid by the Inspector.

The penalty mentioned in section 16, applying to this section, to remain attached as it now exists.

AN APPROPRIATION TO PAY THE EXPENSES OF THE INSPECTORS.

It is customary in all other States having mining interests which have district and State Inspectors, for the Legislature to appropriate funds to defray the expense of the office and expenses incurred by the Inspector while discharging the duties intrusted to him in his district or State. But