none the less cut off in all the vigour of life, but under conditions which escaped administrative statistics.

Good ventilation in all cases is indispensable, and it is therefore necessary that the mines should be largely and sufficiently ventilated, not only to remove the fire-damp, but also, and especially, so that the miner shall be placed in hygienic surroundings. If ventilation is indispensable to fiery mines it is no less so for others for which it would be known to possess only slight inconveniences, against which it would be easy to guard, if its intensity became a trouble or even created a peril in case of fire. But the necessity of sufficient ventilation being admitted, we must not close our eyes to the part that this ventilation may play from the point of view of propagation of explosions of fire-damp, and if it has beeen proved or only suspected that the activity of the air current has not been unconnected with the great explosions which have desolated the St. Etienne basin, the workers of fiery mines are under obligations to make fresh efforts in view of avoiding in a manner as absolute as is, humanly speaking, possible, all accumulation of gas, either by augmenting their vigilance, or by organising new means for effecting a more complete diffusion of the fire-damp in proportion to its production.

Already some have praised in this respect the secondary ventilation employed in the Blanzy mines, where its efficacy appears to be well established. Would it not be opportune to extend it to the mines of the Loire, only considerably modifying the conditions of application to the exigencies of working, which differ essentially from those of Blanzy, as much by the methods employed as by the nature of the coal and the encasing strata? Does not there arise also, in every case up to the present, the necessity of establishing in all the fiery mines a canalisation of compressed air which permits, either directly or by the intervention of mechanical arrangements, of dislodging the fire-damp from the numerous cavities which may secrete it, and which makes it possible for it to escape a diffusion, to which it always manifests an aversion?

Beside the canalisation of air, would it not be equally indispensable, or at least eminently opportune, to establish another parallel canalisation furnishing water under pressure to sprinkle the coaldust, if not continuously, at any rate at very frequent intervals, and to dislodge it, concurrently with the fire-damp, from the cavities where it tends to accumulate?

To sum up, has the improvement of the ventilation of the mines of the Loire, by the creation of rapid currents of air, exercised in recent catastrophes an influence on the propagation of explosions of fire-damp? If this question can be answered in the affirmative, or if this influence may be only suspected, then there is room for occupying oneself with devising suitable methods for augmenting the diffusion of the fire-damp by the establishment of a secondary ventilation adapted for the interior parts in which this gas liberates itself, and completing the action of what may be called the primary ventilation, which is insufficient, however excellent may be its distribution, for entirely effecting this diffusion. If finally we admit, and it appears to us to be difficult not to admit it, that coaldust plays an important part in great explosions, there is equally a need for other installations than those hitherto employed, and remaining almost entirely inefficacious, such as a canalisation of water.

Safe Blasting.

In the *Colliery Guardian* for 11th March last there was a short notice of some safety wadding for shots in dusty and fiery mines, that was reported to have been used with efficient results on the Continent, especially in the Centre district of Belgium. The wad was said to have consisted of solidified, or rather gelatinised water, the elasticity due to the gelatinous consistency permitting the wads being used in all shot holes, no matter what the diameter or inclination. It was further stated that the use of these wads permitted the men to return at once to the face, and also that they lessened the violent effect of dynamite, thus rendering its action more efficient in collieries.

This safety wadding appears to bear considerable resemblance to the so-called gelatinous cartridge, or thickened water tamping, of Messrs. Heath and Frost, which is used with equal safety and efficiency at their colliery. This latter cartridge consists of 94 per cent. of water, with 6 per cent. of foreign matter—viz., 4 parts of soap, 1 part of starch, and 1 of glue, all three melted together. As not one of these substances is capable of extinguishing flame, the water alone is relied on for this purpose. The same result is obtained in the Continental wadding, which is stated to be water solidified, or rather gelatinized, by the addition of ½ per cent. by weight of foreign matter; and a judicious proportion of boiled glue or size would, no doubt, impart the elasticity with which the wad is credited. It is evident that in both cases water is the real extinguisher of the flame, which circumstance vividly recalls the Macnab water cartridge, introduced in 1876.

Notwithstanding the many attempts to produce a flameless explosive, this has been found practically impossible; and water, with the addition of some substance or another to give it a certain amount of consistency, is still found to be the safest and most trustworthy friend in fiery and dusty mines. In the description of the Continental wadding there has evidently been some misapprehension with regard to the water cartridge, when reference is made to the necessity for putting in the shots vertically, as if the water were to be poured in, instead of being enclosed in a case so that it may be placed in any position. Again, it is stated that the water is liable to be projected forward in a single mass; but, so far from this being the case, the latest form of Macnab cartridge, when tested in the light, and under great pressure, was seen to "sweat" just like a steam boiler subjected to great hydraulic pressure, the water in both cases exuding in the form of a thick mist. The latest form of the Macnab water-cartridge has a casing of remarkably strong and yet flexible Japanese paper which prevents the water from becoming dissipated in fissures of the rock; and this cartridge may be inserted in a hole in the roof, filling up any irregularities in the hole so as to leave no air space whatever.

Some practical experiments, or rather demonstrations, were once made with this cartridge at the Rhiwbach slate quarries, Festiniog. Ordinary shots with dynamite charges having only made a cavity—a hole filled with dust—but without cleaving the rock, a 2 inch hole was put into the slate, 8 feet deep. The last six inches was filled with dynamite, and then 18 inches of blasting powder was charged in on top of it. A 24 inch water cartridge was then inserted, and the remainder of the hole was filled up by tamping, first with clay and then with slate dust. A mass of rock weighiug 150 to 200 tons was lifted up bodily and thrown into the quarry below, the action of the dynamite, modified by the water, having cut the hard rock, which is known as "felspathic ash," in a perfectly flat plane, just as soap might be cut by a wire. This action was probably due to the enormous friction exercised by the water on the rock, wedging itself into the fissures, describing straight lines of force and preventing the tamping from being blown out.

In a recent article on the ignition of safety fuse abstracted from a paper by M. L. Janet, in the *Annales des Mines*, several methods are described for so igniting the fuse as to prevent flame from being communicated to air impregnated with fire-damp; but no mention was made of the Macnab firing tube, which has been found very handy and effectual, especially in cases where it has been desired to fire several shots simultaneously, and an electric shot-firer was not available. This little appliance consists of a brass tube about 3 inches long and $\frac{3}{16}$ in. in diameter (surrounded by tamping), having a percussion cap at the end placed deepest in the hole, with a striker, which explodes the cap on a spiral spring, stretched by a cord, being suddenly released. A slight explosion ignites the threads placed for that purpose in the powder core of the safety fuse, but is not sufficient to communicate flame through the small tube to an explosive mixture. This firing tube is used most effectually in connection with Messrs. Bickford Smith & Co.'s multiple instantaneous fuse, which is now coming so largely into use for firing several shots simultaneously.

What is now wanted in collieries is a comprehensive system of safe blasting, which shall, at the same time, bring down the coal in as large lumps as possible, while not commencing any disintegration of the substance, to be continued by primitive and barbarous loading arrangements, and thoroughly completed by the vibration to which coal is subjected during long railway journeys, considerably reducing its commercial value. When coal shall be got and raised in large lumps, and sent to its destination by cheap water instead of expensive land carriage, for which former American engineers are now casting about to find a good method of canal-boat propulsion, then will our black diamonds be delivered to the consumer with a less percentage of loss due to breakage and a less heavy charge for carriage.

Safety Lamps and Miners' Eye-Sight.

There is at last good reason to hope that the much debated question as to the cause of the disease known as miners' nystagmus will speedily and finally be settled. All who have to do with mines and mining operations know that the one great obstacle to the universal adoption of the safety lamp in mines is the scantiness of the light it affords compared with that emitted by candles, flambeaux, and other illuminants commonly used by miners. Not only are mining operations rendered more difficult by reason of the gloom it which they are performed, but—and this is the more weighty consideration—it has been stated by miners and those who profess to represent them that the strain upon the eye-sight, the constant peering through the darkness, is responsible, if not wholly at least in a great measure, for the prevalence of the occular disease already referred to, and from which so many miners suffer. Of course, such an assertion has not been allowed to pass unchallenged, and in the interest of employers no less then in the interest of the employed, searching investigations have been made from time to time, though, up to the present, opinion in favor of the theory being about evenly balanced by that which is opposed to it, the question remains undecided. Dr. J. Court, of Staveley, who, before commencing his observations, was of opinion that the injury to the eyes was caused by the position the miners had to assume in getting the coal, after the examination of 1,000 men, 500 of whom worked with naked lights and 500 with lamps, arrived at the conclusion that the lamps were at the bottom of the mischief. Quite recently he has carried out additional investigations, and in order to further elucidate the matter he has had photographs taken of the men actually engaged in the task of winning the coal. The result of Dr. Court's observations are embodied in a paper on the subject, read by him in the opthalmological section of the British Medical Association, at Nottingham, on July 28. An abstract of the paper is given below. Upon its conclusion, at the suggestion of the president, Dr. Priestley Smith, a committee was appointed to further inquire into the subject, and the outcome of its deliberations will be, we hope, the final settlement of the question if not in one direction, then in the other.

Dr. Court said the subject was one of very great interest in that locality. In the Midland district there were over 50,000 persons employed underground, and the total number of coal miners employed in Great Britain was over 500,000. If, therefore, the proportion of men suffering from that miners' disease was anything like what he had found to exist in that part of the country, a government enquiry into the subject was demanded. Referring to his report upon the prevalence of the desease among Derbyshire miners, Dr. Court said it had been urged that influence had been brought to bear upon the men, so that all whose eye-sight was affected put in an appearance, thus unduly raising the total average. To meet this objection he had taken fresh evidence. At two of the Staveley collieries he had examined the whole of the men, numbering 735, down in the pits. The coal-getters, which included stallmen, holers, loaders and headers, numbered 597, and of these 207 were affected, or 34¾ per cent., which was a higher average than was given in his report, the comparison being made with the same classes of miners. Among those who actually won the coal—the stallmen and holers—numbering 376, he found 172 cases of nystagmus, or an average of 45¾ per cent. It was a curious fact that the average in the house coal colliery was 53.37 per cent., whereas in the steam coal mine it was 34 per cent. In the soft coal holing it was in the middle, in the hard coal it was at the bottom. Those facts, he thought, more than confirmed the average got out in his previous investigations. Coming to the question of the alleged causes of the desease, Dr. Court said the evidence he produced was entirely opposed to the theory that position was the cause. The true cause of the disease was the insufficient light of the safety lamp, which required the miner to strain the eyes to peer into the darkness. The disease was rarer where the illumination was from a candle. Where a torch lamp, giving two and a quarter times the light of a candle, was used, there was no trouble at all. The light of the lamp, too, had an irritating effect, and miners carried a shield on their lamp, to shield their eyes from what they called the glare of the lamp. The bonnet and pedestal cut off a great deal of the light, and there had to be incessant accommodations of the eyes and body to the light. With candles there was no shadow. He was opposed to the theory first advocated by Dr. Dransart in France, and adopted by Dr. Snell, of Sheffield, that the position of the miner was the prime cause of the disease, and denied altogether that whilst undermining or holing the coal, the eyes were turned obliquely upwards. Dr. Snell's description of the position of the man, he contended, was not a true one. In 1890-1 he found that out of 524 men using safety lamps 164 had nystagmus, 127 night-blindness, and sixty-one photophobia, while among 573 men using naked lights only thirty-two had nystagmus, twelve night-blindness and one photophobia, and of these thirty-two men, twently-nine had previously worked with the lamps. If the position theory was the correct one, the results ought to have been the same with the candles as lamps. As to the upward and oblique direction of the eyes, he found in all the Derbyshire collieries he had been down, that when a man began to hole, the eyes were directed downwards and forwards, and he produced photographs of men actually engaged in holing. In Durham in September last, he found not a case of nystagmus among the men who had always used candles, while nearly a third of the Durham men using lamps were suffering. The Durham men, too, it was important to notice, never lay upon their sides to work, nor were their eyes ever turned obliquely upwards. Dr. Court further showed that the disease was also to be found among the men who load coal into the corves, also the deputies and others. Another strong argument against the position theory was the fact that numbers of miners had gone from safety lamp pits into pits better illuminated, and their eye-sight had improved although the occupation and the position were the same. Dr. Snell said cases of nystagmus were to be found among the men who used candles, but it must be remembered that they might have worked with lamps. Then it was urged that if a holer suffering from nystagmus changed his work he got better. That no doubt was true, but it was not the alteration of position at work that caused the improvement, but the fact that with the new occupation he had less strain upon his eyes. Stallmen and holers had less light than other men. Coming to the question of lights used in the mines, Dr. Court said the Marsaut lamp was a fair sample. It was perfectly safe, but as to the light it gave there was much to complain of. He had measured the light in a direct or horizontal line and found it to be equal to .75 of a miner's candle, which candle was only equal to ¾ of a standard candle. Then the total light of the lamps was reduced to less than half that of a miner's candle by the very large shadows cast by the bonnet and pedestal. He produced drawings which showed that the bonnet of the safety lamp cut off nearly ⅛th of the actual light given by the lamp, while the pedestal cut off still more, and in addition to this the brass pillars reduced the light another tenth. The light was lessened still more by the regulations respecting its position while the miner was at work. In naked light collieries the men could place the lights to suit their convenience. The candle did not vary in the light it gave, but a dirty safety lamp at the end of a working day gave only three-quarters of the light of a clean lamp. The result of his investigations showed that the greater the light used the less disease was to be found. In concluding this paper, the