

the detonation of the less sensitive explosives, such as mixtures of cellulose—low in NO_2 —and nitrate of ammonia, pyroxyline powder, &c. On the other hand, by increasing the diameter of the string, there is, perhaps, the risk of too much enlarging the pipe which is formed by the string in the stemming, and which it widens on detonation. The gases resulting from the detonation of the explosive might escape by this orifice, and cause the ignition of the firedamp mixture outside. This idea has therefore been abandoned—at least, until more complete experiments may have been made on this subject.

Friction-detonators. — Lieut.-Colonel Lauer, of the Austrian Engineers, has recently proposed to fire explosives stemmed at the bottom of a shot-hole by a friction-detonator. This detonator, sunk into the cartridge, is set in action by means of a metallic wire enclosed in a small tube embedded in the midst of the stemming. This system is already exclusively employed in a number of Austrian mines, where it would appear to be giving satisfaction. As soon as a number of Colonel Lauer's detonators are available, experiments will be made upon them, and a report made to the Commission.

Conclusions.

The conclusions warranted by the researches of the Commission are as follows:—

(1.) Blasting-powder, even fired in the midst of water, can ignite mixtures of air and firedamp.

(2.) Most of the known explosives, detonating unconfined, are liable to ignite firedamp mixtures. Dynamite; military or mining gun-cotton, particularly the latter; blasting-gelatine; gelatine-dynamite; and ammonia-dynamite, of Paulilles, are in this category.

(3.) It is possible, however, to find explosives which detonate at a temperature low enough not to provoke—at least, in the great majority of instances—detonating unconfined, the ignition of firedamp mixtures. Among the explosives tested by the Commission which realise these conditions more or less perfectly may be mentioned: (a.) Intimate mixtures of 50 per cent. of dynamite with 50 per cent. of crystallized carbonate of soda, sulphate of soda with ten equivalents of water, ammonia-alum, or sal ammonia. (b.) The pyroxyline-powder from Moulin Blanc. (c.) The mixture of 20 per cent. dynamite (75 per cent.) with 80 per cent. of nitrate of ammonia. (d.) The mixture of 20 per cent. of gun-cotton (= 0.68 cubic inches of NO_2 per grain) and 80 per cent. nitrate of ammonia. (e.) Bellite, the composition of which is not known with perfect certainty, and which, as yet, has undergone an insufficient number of tests. (f.) Favier explosive, made of about 90 per cent. of nitrate of ammonia and 10 per cent. of mononitro-naphthalene, which appears to equal bellite as regards safety, but whose intermediate detonator, such as has been submitted to the Explosive Substances Commission, should be suppressed, and upon which further experiments should be made.

(4.) By reason of the complexity and the lack of certainty of the phenomena which may attend the detonation of unconfined explosives, it will always be prudent to avoid firing shots—even charged with one of the explosives considered the safest—at a point where the mixture of firedamp and air may be inflammable. The choice of these explosives should be considered as considerably lessening the danger of explosion it should not be considered as absolutely suppressing it.

(5.) Explosives must always be used under the conditions which allow them to develop the maximum of useful work; both economy and safety agree in recommendation of this rule; consequently, the explosive must be carefully stemmed at the bottom of the shot-hole, which must be deep enough. The leaving of an empty space either in front of or behind the cartridge or on one side, must be avoided. Contact must be avoided between the explosive and the Bickford fuse, if the detonator is fired by that means, the danger of which is besides serious enough to make it desirable to replace it by a safer means of firing.

The Commission had not to consider matters of management. It may be seen, however, that the preceding conclusions tend to the abandonment of blasting-powder in fiery mines, and even to throw suspicion on ordinary dynamite, blasting-gelatine, and ammonia-dynamite, as now manufactured, blasting-gelatine appearing to be the most dangerous of all these substances. The explosives which can best be recommended as regards safety are dual mixtures of an explosive such as dynamite, gun-cotton, or dinitro-benzol with nitrate of ammonia. The mode of manufacturing these mixtures, the manner in which they can be protected from atmospheric moisture, and the greater or less duration of their resistance to this influence, ought to be tested. It will also be necessary to test the useful effect of these mixtures in practical experiments—the manner in which they act in breaking down stone, and more particularly coal. The study of these questions will require experiments, most of which can only be made at the mine and by the managers.

The Commission express the desire that the Government powder-mills should manufacture a sufficient number of cartridges of these various explosive mixtures, to be distributed to managers, who would be willing to try them in a practical way. The trials finished, there would remain the question of the manufacture on a large scale. For some of the mixtures which appear to possess good enough guarantees of safety, such as gun-cotton and nitrate of ammonia, the Government powder-mills have the monopoly of manufacture. The mining industry, moreover, would only gain from the establishment of an active competition in the manufacture of the explosives—at present, almost an actual monopoly. The advantage will be still greater when it is a question of mixtures the comparative safety of which depends upon the exact proportion of the mixed substances, which is difficult to regulate. The Commission therefore express the view that the Government powder-mills should take measures to supply to the trade those mixtures, based on gun-cotton, recognised as advantageous as regards the safety of fiery mines.

A second report was made by the Commissioners, and the conclusions arrived at were as follows:—