can never kindle the gas. As for the force of the explosion generally, it is more than sufficient; the worker will be satisfied if the new and safe explosion which will be given him does not cost more per unit of force than the explosive now in use. But it is easy to show that not only does the unit of force cost no more, but that the price may be materially diminished. Take, for example mixtures of dynamite and nitrate of ammonia. It is evident on examining the results of fig. 5 for the mixture of 80 per cent. of nitrate, the quantity, *f*, which measures the pressure obtained is 477 foot-pounds, the same quantity, *f*, for dynamite alone being 680 foot-pounds. The useful effect of the mixture, therefore, is about three-fourths that of dynamite; but if the selling-price of nitrate of ammonia is 4¾d. per pound and that of dynamite is 1s. 1d. per pound, the selling-price of the mixture will be 6·4d. per pound—*i.e.*, less than half that of dynamite.

It is true that the fixed duty of 8·6d. per pound slightly modifies the result and raises the price to 1s. 9½d. per pound for dynamite and to 1s. 3d. per pound for the mixture; but the ratio between these two costs is little less than three-fourths, and doubtless the proportion of nitrate might be increased. The unit of useful effect can therefore be obtained at less cost with this dual explosive than with dynamite. It is true that effects of a great intensity cannot be produced, but these effects are useless and can even become injurious in the working of coal in mines.

Possible Influence of Aqueous Vapour contained in Air on the Inflammability of Firedamp.—In conclusion, an observation which became evident as soon as the atmosphere became high, and which possibly may have a certain importance, should be mentioned. On two occasions—the 19th of May and 4th of the June—experiments were made in warm and sultry weather—on the 19th of May especially; the experiments were made in the morning, the weather was oppressive and seemed to presage the thunderstorm which burst in the evening. Explosives which had never ignited firedamp either before or since did ignite it on this day. Thus, pyroxyline-powder, which produced ignition twice consecutively, has never reproduced the same effect since. On the 4th of June the stormy character of the weather was less pronounced than on the 19th of May, but still it was very marked, and the mixture of 67 per cent. of dynamite and 33 per cent. of ammonia-alum, which had not ignited gas either on the 24th of April or the 1st of June, ignited firedamp on that day; pyroxyline-powder, however, remained unaffected.

It is not believed that the rise in temperature was the only cause of the increase in the inflammability of the firedamp, for on the 1st of June the temperature was higher than on the 19th of May or the 4th of June; but the weather was very dry, and the result in question was not observed. One is inclined to believe that the aqueous vapour, which is present in the air in considerable quantities in warm and stormy weather, would be the preponderant factor. It is possible that the retardation in the ignition of the firedamp may diminish with the increase of the aqueous vapour contained in the air; indeed, it is recognised, and an English chemist (Mr. Dixon) in particular has thrown a light on this phenomenon, that carbon monoxide does not combine with oxygen under the influence of the electric spark when those gases are perfectly dry. A similar fact for firedamp mixtures would be of great importance in mines where the air is most frequently saturated with moisture. Laboratory experiments which are in progress, but not yet completed, can alone make this question clear.

Summary.—In reviewing the first part of the researches, it may be said, without entering anew into details of the experiments, that they demonstrate that it is possible, by mixing certain substances with explosives whose detonation ignites firedamp, to lower the temperature of this detonation so that the resulting gases do not ignite—at least, under ordinary conditions—the firedamp mixtures amongst which they are detonated unconfined. Among the mixtures tested by the Commission, those which are most worthy of examination, are:

(1.) The pyroxyline-powder of Moulin-Blanc, which, however, under circumstances perhaps rather exceptional, has twice ignited firedamp, the total number of trials being nineteen.

(2.) The mixture of 20 per cent. of gun-cotton, low in nitrogen, with 80 per cent. of nitrate of ammonia, whose theoretical temperature of ignition is 3,488° Fahr., with $f = 542$ foot-pounds, which, in seven trials, did not once cause ignition.

(3.) The mixture of 20 per cent. of dynamite with 80 per cent. of nitrate of ammonia, whose theoretical temperature of ignition is 2·732° Fahr., with $f = 453$ foot-pounds, which has not produced ignition of gas, although only two trials were made.

(4.) Bellite, whose composition is not known with certainty, whose detonation is difficult when unconfined, is incomplete, even with 46gr. of fulminate, and which, under these conditions, has only been thrice tested, and did not ignite firedamp. With the composition as given by the inventor, the temperature of detonation would theoretically be 3,967° Fahr., with $f = 217$ foot. pounds.

(5.) Lastly, the Favier explosive, whose theoretical temperature of detonation is 3,848° Fahr., and which apparently does not explode at all when unconfined, even with heavy charges of fulminate, whose practicability of detonation under working conditions is not well known, whose intermediate detonator, such as has been proposed by the inventor, should be suppressed, and which reduced, it is true to a state of fine powder has once ignited a gaseous mixture.

The trials made with bellite and the Favier explosive cannot be considered as finished. It has been thought proper to mention these two explosives here, because the experiments already made do not appear unfavourable, and they seem to theoretically be among the class of substances incapable of igniting firedamp mixtures. The substance which appears the most suitable for diminishing the temperature of detonation of explosives such as dynamite and gun-cotton is nitrate of ammonia.

The other substances which may be mixed with the explosives, such as hydrated carbonate of soda, and hydrated sulphate of soda, ammonia-alum, and sal ammoniac, are only very partially decomposed by the detonation, and their action is, for that reason, most uncertain.