penetrating into the rarified air with a speed of many yards per second produces a first mixing, increasing by the re-entry of air from the same points after shutting off the connection with the gasometer. This re-entry of air is effected by opening the cocks placed at the ends of the boiler. The atmospheric pressure being restored in the interior of the boiler, all the cocks are shut, and the ejector-flange is replaced by a solid cap.

An experiment can now be made. The composition of the gaseous mixture is then obtained by deduction from the volume of gas used. The conducting-wires are attached to the little rods in the lid, by which the explosives are introduced and the circuit is closed. When the explosive tested causes ignition of the gaseous mixture it is indicated by the heating of the boiler-plates, as well as by the considerable pressure which immediately follows the ignition of the air and firedamp, and which is followed by a depression when the water-vapour is condensed. It was intended that the pressure should be registered by means of a recording pressure-gauge analogous to that which had been used in the experiments by MM. Mallard and Le Chatelier on explosive gaseous mixtures, but the readings of the gauge being unreliable, and delaying experiments, its use was given up.

Description of Gas used.

The combustible gas produced in the retorts and stored in the gasometer was analysed as follows: Air, 10·8 per cent.; gases absorbed by bromine, 7·9 per cent.; firedamp, by difference, 81·3 per cent. No tests were made for hydrogen. A second analysis gave nearly the same result.

The presence of air is explained by the fact that, for economical reasons, the gas produced during the first period of heating was used, and which brought over with it the air with which the retorts was filled at the commencement. Except for this quantity of air, which must be taken into account in the preparation of the mixture introduced into the boiler, the gas is almost pure marsh-gas, and should have the same properties. The combustibility, it is true, should be increased by the presence of higher hydrocarbons which are absorbed by bromine, but this increase cannot be considered as very material: indeed, the speed of propagation of ignition in a tube is sensibly the same for this gas as that previously determined by MM. Mallard and Chatelier for firedamp. Besides, it appears possible that natural firedamp contains a notable quantity of hydrocarbons absorbable by bromine, and it seemed advantageous, as regards the accuracy of the conclusions, that the gas used should be a little more combustible than that found in practice.

Nearly the whole of the experiments have been made with a mixture formed by introducing into the boiler a volume of gas producing a pressure of 46·46in. in the water-gauge. With gas containing 10 per cent. of air, the mixture thus found contains about 10·3 per cent. of marsh-gas. This is nearly the most explosive mixture. The mixture formed by the introduction of a volume of gas corresponding to a pressure of 27·56in. of water, or a proportion of 6·1 per cent. of marsh-gas, developed in burning a feeble pressure, and was near the lower limit of ignition. As regards the facility of ignition by explosives, no marked difference was found between mixtures containing 12·5 per cent. and 6·1 per cent. of gas. This is in accordance with the fact ascertained by MM. Mallard and Le Chatelier for hydrogen and carbon monoxide—that the temperatures of ignition of mixtures that these gases form with do not materially vary with the introduction of other gases, notably, of excess of nitrogen and oxygen.

Explosives suspended in midst of Gaseous Mixtures.

Experiments have been made with the following explosives already known and used: (1.) Ordinary blasting-powder. (2.) Military gun-cotton, containing nitrogen corresponding to the production of 0·81 cubic of NO_2 per grain of material; in an analysis of Schlossing process; strongly compressed into cubes of 432gr. (3.) Mining gun-cotton, containing nitrogen corresponding to 0·76 cubic inch of NO_2 per grain of material; strongly compressed into cylindrical cartridges of 463gr. (4.) Gun-cotton, still less nitrogenous, equal to 0·68 cubic inches of NO_2 per grain of material; in compressed cartridges of 772gr. (5.) Dynamite No. 1., Vonges, containing 25 per cent. of randanite. (6.) Dynamite No. 0, of Paulilles. (7.) Ammonia-dynamite, of Paulilles. (8.) Blasting-gelatine, of Paulilles. (9.) Gelatine-dynamite, of Paulilles. All these dynamites are in cartridges of 772gr. (10.) Favier explosive. (11.) Hellhoffite. (12.) Pyroxiline powder, from Moulin-Blanc, similar to schultze-powder, containing gun-cotton and nitrate of barium; in strongly compressed cartridges of 772gr. (13.) A powder of similar composition, made at the Belgian Powder-mills at Wettem. (14.) An explosive, again, of similar composition, formed by a mixture of gun-cotton and nitrate of barium. (15.) Bellite, recently introduced by Mr. Lamm.

Blasting-powder.—The ease with which the deflagration of ordinary powder ignites firedamp is well known that it seemed of little use to make experiments on that point. It has been proved that a cartridge of 463gr. of powder, suspended in the middle of a kind of cylindrical bag of impermeable paper filled with water—the Settle cartridge—has ignited firedamp on explosion. The numerous devices proposed at different times to avoid the danger of powder in firing mines by tamping with water thus appears condemned in a decisive manner.

Dynamite No. 1, Vonges, and No. 0, Paulilles.—The No. 1 dynamite from Vonges, and the No. 0 from Paulilles, consist of a mixture of 75 per cent. of nitro-glycerine and 25 per cent. of siliceous earth. They behave in an identical manner. These explosives, when unconfined, are easily fired by the use of one plugged cap of 23gr. of fulminate, and ignite the gaseous mixture in which the cartridge is suspended. All the very numerous experiments have given the same result. Besides, it has been ascertained that a cartrige of 772grs. of dynamite placed in the midst of a Settle cartridge filled with water ignited firedamp out of two trials.

Ammonia-dynamite, of Paulilles.—Ammonia-dynamite is a mixture in various proportions of nitro-glycerine, nitrate of ammonium, and carbonaceous matter intended to use up, in burning, the excess of oxygen produced by the detonation of the dynamite and that of the nitrate. The Paulilles ammonia-dynamite, on detonation, ignited the gas mixture when the proportion of firedamp was above 6·1 per cent.—that is to say, when it became clearly inflammable.