

—a summary of the experiments of the Commission on the various explosives, concludes with these words: "After the experiments just described, the author is of opinion that the use of the actually-known blasting-explosives in the presence of firedamp, and more particularly in workings containing coal-dust, is much more dangerous than has hitherto been usually believed, and the prohibition of the use of powder and analagous explosive substances would have but an insignificant influence on the number of explosions of firedamp or coal-dust."

The Prussian Commission did not spend much time in considering the best means of firing the explosion. Some experiments were made in May and August, 1887, with safety-fuse. The experimental gallery was filled with mixtures of air, firedamp, and coal-dust, in which the firedamp varied from 4 to 6½ per cent. One of the ends of the fuse was inserted in a shot-hole, the outer end cut off, and the free end then ignited inside the gallery. Nothing occurred when the mixture only contained 4 per cent. of firedamp; when this proportion was exceeded an unsteady flame existed for some seconds, very feeble, bluish or yellowish, in the upper parts of the gallery, adjacent to the fuse; with 6½ per cent. a feeble explosion occurred repeatedly; with 10 per cent. an explosion immediately occurred.

The Prussian like the English Commission sought to ascertain if it was possible to insure security by using explosives in any particular method. They only experimented with water-cartridges, previously proposed by Sir Fredrick Abel. Cartridges containing 7·05oz. dynamite were placed in the middle of the "Settle water-cartridge," filled with water and laid on the floor of the gallery. Under these conditions it was impossible to ignite the gas even with high percentage of firedamp, and on firing three such cartridges at once. In one experiment ten 3·53oz. cartridges of dynamite, each enclosed in its water-cartridge were fired at once in a 10-per-cent. mixture of firedamp without igniting the gas. Ignition of the explosive mixture could only be effected with 2·2lb. of dynamite divided into seven water-cartridges laid on the floor of the gallery and covered with coal-dust.

The Settle water-cartridges are paper bags 1ft. 8in. in length and 1½in. in diameter for ordinary cartridges, and for larger cartridges 1½in. in diameter. In order to insure the complete surrounding of the cartridge by water a wood plug is slipped into the bottom of the bag, and a tamping of clay is placed above the water before closing the mouth of the bag.

The Prussian Commission gave much attention to the part played by dusts, either alone or in combination with firedamp. Two members of the sub-Commission—MM. Mallard and Le Chatelier—have already studied the Prussian experiments from this point of view, and have shown that they seem rather to confirm the opinion which they had already upheld and supported by independent researches—namely, that coal-dust only plays a subordinate part in mine-explosions. Sir F. Abel, in a recent paper before the London Institution of Civil Engineers, has just given the support of his high authority to this opinion. The inflammability of mixtures of air and coal-dust is, moreover, far inferior to those of air and firedamp, and it is universally agreed that similar mixtures can only be ignited by the influence of intensely hot flame. It has therefore been considered a complication of slight value in the experiments to place coal-dust in a state of suspension in a gaseous mixture.

Some experiments, however, were made with dusts, and are quoted here to avoid repetition. It was ascertained that dynamite exploding unconfined in the presence of coal-dust—very fine and very inflammable—did not ignite these dusts. Dynamite burning without explosion did, on the contrary, ignite the dust, as has been shown by placing a charge of 772 grains of dynamite in a cylindrical hole bored in a block of wood covered with coal-dust, the dynamite being ignited with a Bickford fuse, without a detonator. A dynamite charge of 772 grains, placed in a tin-tube 0·98in. internal diameter and 1·57in. external diameter stemmed 5in. deep with very fine coal-dust, did not ignite firedamp.

Appointment of Commission.

In consequence of the first series of experiments made by the Prussian Commission, which seemed to attribute an almost complete safety to the use of certain explosives, the Minister of Public Works appointed, on the 12th February, 1887, a Commission, consisting of M. Hatton de la Gompilliere, Inspector-General of Mines; President Sarrau, Engineer-in-Chief of Explosives; MM. Mallard, Lorieux, and Aguillon, Inspectors-General of Mines; and Le Chatelier, Engineer of Mines, Secretary. This Commission was charged with the study of questions relative to the use of explosives in firey mines.

From its earliest sittings this Commission considered it necessary to repeat the experiments of the Prussian Commission. After consultation between the Ministers of War and Public Works, it was decided that the Explosive Substances Commission, appointed by the Minister of War, should be charged with this experimental investigation. MM. Mallard, Aguillon, and Le Chatelier were temporarily attached for this purpose. This sub-Commission settled the programme of experiments, which were continued from the 4th April, 1887, without interruption, with the following results:—

Description of Apparatus and Methods of Experimenting.

The experiments would have been of little interest if they had been a repetition of the researches of the Prussian Commission, which were made as nearly as practicable under actual working conditions. It was determined to conduct the observations under conditions as exactly defined as possible, and to carry on the researches as a scientific investigation. It was hoped thus to account for the anomalies noted in the Prussian experiments, and even to be able to formulate laws whose results would be immediately applicable in practice.

Not possessing a natural source of firedamp, recourse was had to marsh-gas artificially made, and the most convenient process employed—that is to say, the action of heat on a mixture of acetate of soda and soda-lime—lime slacked with a solution of caustic soda. It was intended to fire the explosives in a closed vessel, so as to be able to make an exact measurement of the amount of firedamp mixed with air, to be able to study completely the conditions of the detonation of the explo-