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EXPLOSIVE MINE GASES AND DUSTS
WITH SPECIAL REFERENCE TO
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BY
ROLLIN THOMAS CHAMBERLIN

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NOTES ON EXPLOSIVE MINE GASES AND DUSTS, WITH SPECIAL REFERENCE TO EXPLOSIONS IN THE MONONGAH, DARR, AND NAOMI COAL MINES.

By ROLLIN THOMAS CHAMBERLIN.

INTRODUCTION.

CHARACTER OF THE REPORT.

The studies herein reported were begun as a part of researches undertaken by the United States Geological Survey looking to the more efficient utilization of the coal in the United States through the reduction of waste in its extraction, and were continued as part of further researches having regard to the conservation of the fuel resources of this country and to the lessening of injuries and fatalities in coal mining.

Among other phases of the general problem to be studied were the origin of the gas which escapes into coal mines, its modes of occurrence in the coal and rock strata, and the conditions governing its outflow into the mines. The subject of relative danger from destructive explosions due to gas and coal dust in different mines belonging to different coal fields was to be one of the principal lines of investigation.

But this work was barely under way when the series of unusually disastrous explosions in the Naomi, Monongah, and Darr mines of Pennsylvania and West Virginia, in December, 1907, afforded an exceptional occasion to observe the behavior of explosions on a large scale. Because of the opportunities for study afforded by these terrific explosions, the inquiry originally planned was diverted to the more specific investigation of the conditions in these mines, and the examinations have been directed toward finding those qualities of gas and dust which were concerned in these explosions. The following discussion, therefore, consists essentially of a report on that subject; but it is far from being exhaustive, and is to be regarded as a preliminary outline of investigations which are still in progress.

EXPLOSIONS STUDIED.

The first of the three mine explosions mentioned occurred in the Naomi mine of the United Coal Company, near Bellevernon, Pa., on Sunday, December 1, at 7.40 p. m. All the men who were within the mine at the time, fortunately only 34, were killed.

Less than a week later there occurred in mines Nos. 6 and 8 of the Fairmont Coal Company at Monongah, W. Va., the most disastrous mine explosion yet recorded in the annals of American mining. The mines were comparatively new and well laid out. Mine No. 8 had been in operation only about two years and was the pride of the Fairmont Coal Company. Mine No. 6 was first opened about four years earlier. In order to make it possible, in case of emergency, for either mine to be ventilated by the ventilating system of the other, the two sets of workings were connected underground. The F face heading of mine No. 6 led directly into No. 2 north heading of No. 8 mine. On Friday, December 6, at about 10.30 in the morning, an explosion of unusual violence swept completely through both mines, pursuing its course throughout the numerous ramifications and bursting out of the two pit mouths, located 1¼ miles apart, nearly simultaneously. The slope of mine No. 6 was only slightly damaged, but at the mouth of No. 8 the destruction was very great. The fan was wrecked, the engine house was demolished, and mine timbers were blown across Monongahela River. As nearly as can be determined, 361 men were killed in the two mines by the explosion.

While the inspection of the Monongah mines was still in progress, on Thursday morning, December 19, at about 11.20, a similar explosion wrecked the Darr mine of the Pittsburgh Coal Company at Jacobs Creek, Pa.; 238 men lost their lives in this explosion, which in number of casualties is second only to the Monongah disaster in the history of American mining. Of all the men in the mine at the time of the explosion, only one man, who happened to be within 100 feet of the surface on an old manway in a wet, unexploded portion of the mine, succeeded in escaping alive.

The underground investigation of these mines was made in cooperation with Clarence Hall and Walter O. Snelling, of the United States Geological Survey, and James W. Paul, now of the Survey but at that time chief of the department of mines for West Virginia, to all of whom the author is greatly indebted for valuable assistance, suggestions, and advice. Mr. Paul will report on the nature of these explosions, the precipitating causes, their destructiveness, and the general conditions in these mines following the disasters. The present report is confined essentially to the laboratory examination of some of the explosive materials collected from these mines directly after the explosions.

GASES FOUND IN THE MINES.

METHODS OF COLLECTING.

As soon as practicable after these explosions samples of the mine atmosphere were collected at the coal faces and from the return air ways in various parts of the mines. It was hoped that something as to the nature of the after damp might be determined, but as the exploration of the mines could be carried only where there had been a certain amount of ventilation, the samples of after damp were necessarily greatly diluted with air. With the aid of breathing helmets and compressed-air cylinders attempts were made to collect after damp in the tight places where there appeared to have been little ventilation, but the subsequent analyses have shown that the proportion of after damp remaining was small. Other samples were taken to determine the accumulation of fire damp in the workings.

The samples of air and gas from these mines were collected for analysis in glass tubes of 125 cubic centimeters capacity. These tubes were drawn out to a 5-millimeter bore at each end, over which was slipped a piece of red antimony rubber tubing 5 to 6 centimeters in length. Before entering the mine each tube was filled with water, and a tight-fitting plug of glass rod was inserted in the rubber tubing at each end. To take a sample of the mine air the glass plugs were removed from the ends of the tube, allowing the water to run out and be replaced by air, after which the ends of the tube were securely closed by the plugs and the rubber connections tightly wired with copper wire. Glass tubes thus sealed were found to hold gas samples for several weeks without apparent change from leakage or diffusion. However, as a thin film of water always remains upon the walls of the tube when the gas is collected in this manner, it is inevitable that a small amount of carbon dioxide be absorbed. Haldane[a] has called attention to the fact that when gas samples are collected in glass tubes whose walls are moist, a small amount of carbon dioxide is absorbed by the sodium silicate of the glass. If the water used be clear, the gas sample loses a small amount of carbon dioxide, but if the water used be dirty, the sample may gain carbon dioxide from the action of bacteria. The samples of gas collected in the Naomi, Monongah, and Darr mines are all subject to these criticisms. Clear water was used in every tube but one, No. 26, which had to be refilled from a pool of standing water in the mine. Whenever the sample could not be analyzed within a few days after it was collected, the rubber connections were completely coated with paraffin, thus preventing with certainty any passage of gas through the rubber.

The samples of gas obtained from these mines were for the most part selected either from points in the workings where there appeared

[a] Foster, Sir Clement, and Haldane, J. S., The investigation of mine air.