

explosive cycle was therefore atmospheric oxygen, and the condition of the air-currents confirmed the conclusion. Propagation failed because the chemical actions languished to extinction, due to an inadequate supply of atmospheric oxygen for the oxidations which yielded heat to carry on the distillation and other chemical changes. The fundamental difference between the path of propagation and the path in which propagation failed was in the condition of the air-currents. In one very small "split" and in return air impoverished of its oxygen the chemical processes were observed to be arrested.

Propagation was also arrested in wet places, and is explained by the fact that the product of the oxidation of hydrogen would by its contact with wet surfaces undergo a change corresponding to what takes place in the condenser of a steam-engine. The external stratum of the product coming in contact with the cold wet surfaces would be instantly condensed, leaving a vacuous space into which another stratum would fall and be condensed, and the process would be repeated so rapidly during the slow gaseous movement as to make condensation practically instantaneous. The product being liquified by surrender of heat, the temperature would fall below the distilling point, and the chemical actions come to an end.

The disaster at the Timsbury collieries originated in the main intake air-way; and, while the disastrous effects that are identified with a colliery explosion were produced from the shot to the upcast shaft on one side, there were no such effects from the shot in the opposite direction towards the downcast shaft. Observations, therefore, show that had the condition of the air-way from the shot towards the downcast also prevailed from the shot towards the upcast shaft the disaster would not have happened. The difference between the two portions of the air-way was as follows: On the upcast side it contained the full circulating current of air, which at the time of the disaster was about 13,000 cubic feet per minute, and the coal-dust was dry; on the downcast side it contained the same circulating current for a distance of 150 ft.; at that point the ventilation entered the intake from a side road, but 525 ft. beyond a door was fixed, and the air between the side road and the door was a still atmosphere. The coal-dust was more or less damp or wet at the side road, and wet up to the door. The still atmosphere was laden with water-vapour to saturation.

At the Camerton collieries the coal-dust was equally dry on both sides of the shot, and disastrous effects were produced in both directions. The propagation against the intake air-current, after being active for 3,714 ft., causing great destruction, was abruptly arrested at 2,838 ft. from the downcast shaft. The atmosphere at this point was the main intake air-current in which the 3,714 ft. of propagation had occurred, and the author made the following observations of the condition of the road where the propagation was arrested, commencing in the vicinity of the last, or No. 10, explosion:—

|                                                                         | Ft. | Ft. |
|-------------------------------------------------------------------------|-----|-----|
| Archway and fall, floor and sides dry and dusty ... ..                  | ... | 90  |
| Water and mud on floor, no dust ... ..                                  | ... | 66  |
| Floor damp between the rails, damp dust outside of rails ... ..         | ... | 24  |
| Last fall, floor and sides damp, no dust ... ..                         | ... | 21  |
| Water and mud on floor, sides wet, no dust ... ..                       | ... | 48  |
|                                                                         | —   | 159 |
| Floor damp between rails, intermittent wet spots, dust outside of rails |     |     |
| damp to dry ... ..                                                      | ... | 234 |
| Floor and sides damp and muddy ... ..                                   | ... | 24  |
| Floor and sides dry and dusty to horse-guy ... ..                       | ... | 261 |
|                                                                         | —   | 519 |

The effectiveness of wet lengths of road in stopping the propagation of an explosion is a fact of observation, and air saturated with water-vapour must, in the nature of the case, be a valuable contributory precaution.

The arrest of propagation is consequently brought about by atmospheric conditions in which heat cannot be generated for the reproduction of the distillatory and other chemical actions, because the supplies of atmospheric oxygen are inadequate; also by wet surfaces, which demand the surrender of the heat for the evaporation of their moisture.

Most of the principal phenomena of the disasters at the Camerton and Timsbury collieries have now been referred to, and the theory which the author has advanced upon his records and investigations may be shortly stated as follows: A colliery explosion in which coal-dust is the principal agent comprises numerous local explosions separate in time and in space, at irregular intervals, where the available supplies of atmospheric oxygen are greatly increased and caused by the explosive combustion of hydrogen derived from the coal-dust in the antecedent spaces by a series of chemical actions of constant sequence, which produce heat for regeneration without auxiliary intervention, and are constantly reproduced along the path of the coal-dust under the conditions named. This theory accounts for the coked residues of coal and the positions in which they were found; explains the presence of amorphous carbon in atmospheric suspension, and its characteristic deposition upon the enclosing walls throughout the fields of disaster; accounts for the practical absence of carbon-monoxide and carbon-dioxide in the gaseous products; supplies the heat for the distillatory action, for dissociation, for raising the air of the gaseous mixture to ignition temperature, and for supplementing the losses due to the contact of the products of combustion with cold surfaces; allows time for the distillation of coal, and the chemical changes in the series of actions; provides the explosive gas for producing the disruptions; explains the occurrence of the disruptions at intervals; the absence of mechanical effects in the intervening spaces, the conditions under which propagation proceeds or is arrested, the maintenance of the mechanical equilibrium of the air-current at Camerton collieries, and excludes no coal, except that which yields no combustible gases when subjected to the temperature of destructive distillation.