by the ordinary tests; but they suffered physiological sensations that ended in unconsciousness. They observed the atmosphere laden with particles of soot, and compared it to the condition produced by "turning a bed-tick inside out and shaking it in the air." The author observed that this suspended matter had been universally deposited upon the walls and timber of the roads throughout the fields of disaster, and, upon examination, found it to be amorphous carbon, such as may be obtained by burning hydrocarbons in limited quantities of air. The carbon obtained by holding a glass rod in an illuminating gas-flame, and the compact form of the deposit, are well known; the carbon at the Camerton and Timsbury collieries proved, upon investigation, to be the same in substance, but differed in the form of deposition. In numerous places in the mines the carbon upon the timber and strata was in gossamer-like form, and gave the surfaces a veined appearance. The author collected these striated filaments upon paper; but, however carefully preserved, they broke down into powder under the slightest pressure. The general deposit was a loosely-built-up and dilated stratum, which, when touched with a flat surface, shrank to a fraction of its original thickness. It was obviously the accumulation of successive settlements of particles originally in atmospheric suspension, and that condition of the atmosphere in the mines immediately after the disasters is a fact of observation. These depositions of carbon were therefore distinct in structure from the deposition that arises from the impingement of a hydrocarbon flame upon a cold surface. The origin of this carbon is not far to seek: the residues of coked coal already referred to are the evidence of distillation, showing that hydrogen and gaseous hydrocarbons flowed into the atmosphere of the workings; and these hydrocarbons provided the amorphous carbon, of which it formed the solid constituent.

The separation of this carbon of the educts involves questions in thermo-chemistry which cannot be dealt with in this paper beyond saying that the processes that caused its separation were the sources of heat upon which the explosive phenomena depended.

The author suggests the following theory to explain the phenomena now recorded: The products of the mining powder with their unexpended heat were projected through the planes of ruptured strata in fan-like sheets, striking the coal-dust on the floor, and setting up destructive distillation. The educts flowed into the atmosphere of the mine, but could not undergo explosive combustion, although an ignition temperature was at command, because the atmospheric oxygen was inadequate, or not within reach to make an explosive mixture. In the loose dust and *débris* and in interstitial spaces there was necessarily some oxygen, which would be seized by the free hydrogen, and by the hydrogen constituent of gaseous hydrocarbons in the educts, its oxidation liberating the carbon of the latter in solid form to float in the atmosphere. The temperature reached by the oxidation of hydrogen being about 2,000° Cent., and there being a large quantity of heat generated in that process, the remaining hydrocarbons that had not previously undergone change would at that temperature, and in the absence of atmospheric oxygen, undergo dissociation, placing free hydrogen at disposal for disruptive action where oxygen could be obtained, and leaving more of the fine carbon in atmospheric suspension.

A series of chemical actions of constant sequence was therefore established in the immediate vicinity of the shot, in which there was the partial oxidation of hydrogen referred to generating heat, which instituted a series of chemical changes identical with those which the heat supplied by the products of the mining powder had originated, and these regenerative activities were of constant and similar reproduction along the path of the coal-dust, free oxygen undergoing constant accumulation, until a place was reached in the workings where the available quantity of air was greatly increased, and, the partial combustion taking place, the accumulated hydrogen was oxidized with explosive violence, causing the disruptive effects observed at the *loci* of the initial local explosions.

The quantities of heat generated in the initial local explosions greatly exceeded the total quantity of heat in the products of the mining powder, and it will be readily understood that an advancing series of similar changes to those described was again established in the coal-dust beyond, producing secondary explosions at points farther away, where the conditions for the oxidation of the accumulated hydrogen were fulfilled; consequently, the explosions would be propagated along every path of the coal-dust, so long as atmospheric oxygen was available, and there were no wet spaces to bring down the temperature.

This theory satisfies the demand for chemical changes, causing a constant regeneration of heat, and places an explosive gas at disposal for disruptive action without the production of carbon-monoxide or carbon-dioxide, and which did not yield these gases as products. It accounts for the practical absence of carbon-monoxide and carbon-dioxide from the atmosphere in the fields of disaster with the fact that the carbon constituent of the hydrocarbons was not oxidized, but disseminated in the atmosphere, where it was found in copious suspension by the exploring parties, and from which it had been deposited upon the vertical faces of the enclosing walls in dilated layers and in striæ, giving the faces of stone and timber the veined appearance already referred to.

It is not difficult to understand why there was an absence of mechanical effect upon the ventilating-power at the Camerton collieries when it is remembered that the gaseous hydrocarbons that were being constantly added to the atmosphere of the mine were almost immediately eliminated by the oxidation of the hydrogen constituent, and that the volume of the incoming air was being constantly diminished by the removal of its oxygen, forming one-fifth of that volume for oxidation of the hydrogen in the explosions and antecedent actions in successive productions of steam, undergoing eventual liquefaction by surrender of heat, and that by means of this exhaustion the mechanical equilibrium of the air-current was maintained.

The terminations of the explosive phenomena admit of explanation. Propagation of the explosions was observed to have been abruptly arrested in roads where dry coal-dust abounded, and at these places observations disclosed the presence either of coked coal-dust or amorphous carbon, indicating chemical activity that supplied heat and ignition temperature. The absent factor in the