wants to know how nitrate of soda, sulphate of ammonia, and shoddy, compare in his own land and climate, the only way of ascertaining the fact is by field experiments repeated through many years, till the influence of an average season is ascertained.

R. W.

COLLIERY EXPLOSIONS AND COAL-DUST.

AT a meeting of the Physical and Chemical Section of the Bristol Naturalist Society, on January 26, a paper was read, by Mr. Donald M. D. Stuart, upon "The Chemistry of Colliery Explosions due to Gases derived from Coal-dust," in which the researches of Faraday, Verpilleux, Vital, Marreco, Mallard, Le Chatelier, and others were given, and attention was drawn to the points they emphasised. Faraday observed in his report upon the Haswell Colliery explosion: "There is every reason to believe that much coal-gas was made from the coal-dust in the very air itself, by the flame of the fire-damp; . . . and that much of the carbon in this dust remained unburnt only for want of oxygen." M. Vital concluded that—"Very fine coal-dust rich in inflammable constituents, will take fire when raised by an explosion, and that portions are successfully decomposed, yielding explosive mixtures with air, whereby the fire is carried along." Marreco remarked—"The coal-dust is in part submitted to destructive distillation"; and Mallard and Le Chatelier found that gaseous matters were evolved from the coal-dust by the action of the fire-damp explosion. Mr. Stuart observed. These physicists and chemists found that the coal-dust did undergo dry distillation while in atmospheric suspension in a mine passage, after the originating explosion; and the educts added to the explosive effects. He had carefully observed the effects of explosions not only at the point of origin, but throughout the field of the disturbances, and found Faraday's hypothesis of the dry distillation of coal-dust essential to account for the phenomena observed through thousands of yards of mine passages. He observed that the disruptive effects of an explosion of methane and air were necessarily limited to the immediate vicinity of the explosive mixture; but the disruptions beyond and to remote distances required an explosive agent coextensive in distribution, and this agent was coal-dust.

The fields of disturbance exhibited the effects of gas-explosion at separate points of space, with intervals of no explosion but of heat, partial combustion, and dissociation; requiring, for explanation, a chain of chemical changes liberating quantities of heat, and accumulating an explosive mixture at the place of explosion. The question arose whether a given volume of air could hold in suspension, as dust, a sufficient weight of coal to give, by its resolution into gas, more gas than the given volume of air was capable of burning or exploding; and investigation showed that the coal yielded a quantity of combustible gases, not less than one half the volume of the air in which it was suspended. In these conditions there could be only partial combustion, until a place was reached where the mine passage emerged into a capacious chamber in which the unconsumed gas found sufficient atmospheric oxygen, and was exploded by the flame in the partial combustion referred to. The disruptive effects were located in places of large air capacity in the paths of coal-dust.

At the point of origin, the coal-dust was reduced to coke, the residue of dry distillation; and this phenomenon was of frequent recurrence in the paths of the propagated explosions. Amorphous carbon was found universally deposited in the field of explosions, chiefly upon the vertical side-walls; it was also in copious suspension in the stagnant atmosphere in the passages, and the effluent gases at the shafts. Combustible bodies, as timber, cotton fabrics, and candles, forming obstructions in the paths of coal-dust and between the explosions, were not consumed or burned. The bodies of the victims in these intervals were blistered to various degrees; the cotton fabrics retained their external form, but had been deprived of their volatile matter, the candles had melted and run together, and the adjacent coal-dust and lumps of coal had undergone dry distillation. These effects upon the coal, men, calico, and candles disclose the fact that the atmospheric oxygen in the mine passages was not more than adequate to supply a portion of the educts of the coal undergoing distillation; consequently there was no oxygen available for the chemical requirements of other combustible bodies, as timber, clothes, cotton fabrics, and candles.

The chemical changes in the intervals from explosion to explosion caused considerable diminution in the atmospheric pressure, indicating a very small production of permanent gases, and the employment of the atmospheric oxygen to form readily condensible gas.

The explosions at the non-gaseous Camerton and Timsbury Collieries were originated by the heat in the products of the exploded blasting powder. The temperature of fired powder of a similar composition was determined by Abel and Noble at 1800° to 2000° C.; the products, therefore, struck the coal-dust in the immediate vicinity while at an exalted temperature, certainly higher than that of the gas retort, which is below 1000° C. The educts of the coal-dust would consequently be similar to ordinary illuminating gas. The composition of London gas is given (by Frankland) at 51·24 per cent. free hydrogen, 38·84 per cent. gaseous hydrocarbons, and some other bodies.

Upon the foregoing and other data, Mr. Stuart advanced the following rationale of a colliery explosion:—The educts of the coal are in excess of the relative combination volumes of atmospheric oxygen present; therefore the large proportion of nascent free hydrogen present, seizes the principal part of the oxygen, liberating heat in the combination. Some of the hydrocarbons obtain the remaining oxygen, causing a limited combustion, as in the preparation of diamond black, disengaging more heat, and placing amorphous carbon in suspension. At the temperature of burning hydrogen, the hydrocarbons that have not undergone change, for want of oxygen, are dissociated, placing more amorphous carbon in suspension, and yielding free hydrogen for disruptive effects.

The heat in the products of the exploded powder, therefore, instituted a series of chemical actions in the coal-dust, in which large quantities of heat were disengaged, and free hydrogen placed at disposal for disruptive action. This series is regenerative by virtue of the heat liberated, which instituted a similar series in the adjacent coal-dust; and these activities are of constant and similar reproduction along the paths of coal-dust until a place is reached, which supplies a large quantity of atmospheric oxygen, in which the accumulated hydrogen diffuses, and the mixture is ignited by the flame in the partial combustion, causing an explosion. This explosion liberates more heat, and re-establishes a similar chain of chemical changes in the coal-dust beyond, closing in a second explosion at the next abnormal supply of air, and propagation proceeds along each path of coal-dust so long as adequate oxygen is available, and wet surfaces do not intervene to reduce the temperature below the point at which the coal undergoing distillation yields sufficient free hydrogen to supply by its oxidation enough heat to make the actions continuous. The paper was illustrated with limelight slides, and was followed by an interesting discussion. Upon the motion of the President, Mr. Stuart was cordially thanked for his paper.

A NEW DIPHTHERIA ANTITOXIN.

A RECENT number of the *Archives des Sciences Biologiques*, issued by the Imperial Institute of Experimental Medicine in St. Petersburg, contains a highly important communication from Dr. Smirnow, on a new method of obtaining a diphtheria antitoxin of great therapeutic value. For the last three years Dr. Smirnow has been working on this subject, and the present memoir places experiments, which before were only in a tentative stage, on what now appears to be a sound and practical basis.

As is well known, the preparation of curative diphtheria serum involves not only great expense, but also a great deal of time; the raising of a horse's serum to the requisite pitch of immunising properties requiring many weeks. Dr. Smirnow has been endeavouring to produce an antitoxin, the preparation of which is less costly and less cumbersome. The method adopted was that of electrolysis, and in the first instance ordinary serum was electrolysed; but as this led to nothing, virulent diphtheria broth cultures were substituted for serum, and the results obtained were highly encouraging. These electrolysed cultures were found to contain an antitoxin of great efficacy, and, even when employed in smaller quantities than the therapeutic serum, it entirely protected animals from the effects of diphtheria poison. "Le traitement par cette antitoxine marche d'une manière remarquablement satisfaisante: malgré les périodes les plus avancées de la maladie, il suffit d'un demi