

Various firemen and others of the minor officials having testified, Mr. Francis Henry Sheppard, civil and mining engineer, was sworn and gave long interesting testimony from the expert point of view. The witness stated that the bulk of his testimony rested on examination after the two explosions at Cumberland and Fernie, but it was evidently also based on a long period of research. The condensed result, said Mr. Sheppard, of those two examinations was that a dangerous condition of the temperature of the mine might exist and yet be very hard to detect; combined partly with dust in the atmosphere and a low percentage of fire-damp. These conditions were very difficult to detect. Probably as low as one and a half per cent. of gas, if the other conditions are ripe, is sufficient to cause an explosion under some exciting cause, such as a sudden shot; and if very ripe, it had been asserted that the sudden shutting of a door would cause an explosion. Another source of danger is the simultaneous firing of shots, or rapid succession of shots, which witness knew to be fully as dangerous as blown-out shots. The rapid succession of shots has a result on the atmosphere very similar to the blown-out or windy shot. As to dust, the greatest source of danger was the newly created dust along the working faces; this was gathered from observations at Fernie.

The greatest zone of violence was along the working faces; the dust on the hauling roads did not enter into it at all. There was very little coking at Fernie away from the line of working faces. Any system of watering should be carried to where the danger lies—the working faces. Services of water should be laid in proximity to the working faces under a head so as to be thoroughly sprayed. The whole of the places in a dry and dusty mine should be continually watered to render the atmosphere safer. A lamp that would detect a lower percentage of carburetted hydrogen or fire-damp would be too delicate for use by the ordinary miner or in examinations, but would be of great service in expert hands. Some instrument should be supplied to the ordinary fireman and miner which would detect 1.5 per cent. and also to determine the dusty condition of the atmosphere of the mine, which should be known to the officials. Only by these means could precautionary measures be taken. Under the present system it is simply a matter of opinion; the inspector might determine a mine as dry and dusty which might not be particularly dangerous—it is simply a matter of his judgment. It should not be taken out of the hands of the inspector, but given all the importance it is possible to give; he should have some strong counsel or advice in determining whether a mine is dry and dusty and sufficiently dangerous. It had been suggested that if a delicate gas test had been in use at Fernie the explosion there might not have occurred. Quoting from his report on the Fernie disaster as applicable generally to the present enquiry, the witness stated the ordinary safety lamp will indicate about two and a half per cent. of C.H. 4, and while there are lamps and instruments which will indicate as low as one-quarter of one per cent. they are so delicately con-

structed as to be of no practical use to the ordinary miner.

Probably the cause that contributed more largely than any other to the explosive condition of the Fernie mine as a whole, is the fact that these mines were working a double shift. The explosion took place about the middle of the second shift, and the dusty condition naturally had increased all day, and cooling or settling intervals had intervened, and instances are on record which go to show that the second shift following immediately upon the first produces conditions in a dusty mine which are dangerous. The inference to be drawn from the evidence of force, direction and zone of greatest violence, is that the greatest danger lay, not in the hauling roads or old workings, but in the newly created dust of the working faces. The atmosphere passing through the faces is no doubt charged to some extent with a low percentage of C.H. 4, and while this may be to some extent dangerous in itself, it is much more likely to become so under some exciting cause, similar to that which probably caused the explosion, viz., an explosion of fire-damp and dust combined. The fact that dust may be created as freely, where blasting conditions do not obtain, to wit, where coal is soft and friable, as in room 7 off McDonald's level suggests that watering precautions may be necessary, irrespective of those provided for in the Mining Act, governing blasting conditions.

Some practical method or appliance is much needed to determine the condition of mine atmosphere, both with regard to low percentage of fire-damp, and dangerous conditions as to the presence of dust. The installation of a thoroughly efficient watering appliance in dry and dusty mines should be more imperative.

While the use of the ordinary blasting powder does not appear to have contributed to this explosion, its continued use under conditions prevailing in portions of No. 2 mine will always be a source of danger and the substitution of more modern and safer explosives is suggested. As to tamping, no dust or similar inflammable material should be used in tamping; but clay or decomposed shale should be always employed; ordinary clay would be too dry. Holes should be entirely clean of cuttings or coal dust. Blown-out holes are very dangerous and a blown-out hole would ignite dust even without gas present under certain conditions.

This danger was intensified in a narrow way. Coal dust has exploded without the presence of gas, notably at the Brancepeth Colliery, where the coal hopper exploded, killing three men. A great deal depends on the chemical condition and fineness of the dust; dust in lignite mines does not seem to be very dangerous—explosions are seldom heard of. The chemical analysis of anthracite was such that it did not supply the dangerous volatile dust. Any coals of high and fixed carbon like anthracite, 82 and 85, witness would not consider dangerous. Fernie was about 70, leaving room in the analysis for volatile hydro-carbon. In some of the lignites the analysis