a fatal drawback, but in this respect I must differ with him entirely. Benzolene or, as it is sometimes called in England, colzalene (also benzine in translations from the German) has been and is still very extensively used as an illuminant, and judging from a long experience with it, I can say that it may be applied with perfect safety in a safety lamp, if the lamp is properly constructed to burn a volatile oil or spirit. Lamps thus supplied are not quite so economical in the cost of lighting as when using paraffin, or oil mixtures, but it is cleaner, and gives a good illumination with the minimum of attention. The greatest danger arising from its use is in the filling of the lamps, and they ought not to be filled to a greater degree than the sponge or cotton wool will absorb. Then the lamp itself should be of the best construction, and in my paper I called attention to two distinct risks which are attached to the Wolf class of lamp, viz.: 1st, the double air admission, that is from below the flame as well as from above the flame,-this construction was proved by the English Mines Accidents Commission of 1886 to be a far from safe mode of feeding the flame with air, and confirmed the experiments previously made by M. Marsaut; 2ndly, the igniting apparatus, which if brought into use whilst the lamp is full of gas mixture will originate an explosion and propel the flame straight through the gauzes. Therefore, I say that benzolene may be a perfectly safe and an excellent illuminant, if applied under a safe cover.

For gas testing purposes, and if applied in lamps of the Gray type, .t is one of the best and handiest means of testing for lower percentages than can possibly be detected by an oil flame. I enclose



FIG. I.—Ashworth's patent tri-wick safety lamp, for burning petroleum spirit, and fitted with the Wolf patent relighter.—Illumination equal to 11 standard sperm candles.

you a photo of one of my Gray oil vessels constructed to use benzolene and fitted with a Wolf igniter, for the use of firemen and examiners, Fig. 1.

Mr. Hardie's remarks at also an extremely interesting chemical review of the dangers arising from mixtures of coal dust and firedamp, and are worthy of the closest attention. He says that he most carefully examined the East mine of the South West Virginia Improvement Co. to find traces of firedamp, but he does not say what lamp he used. This point is of the first importance because he goes on to prove that the lamps in use, and as used by men in general, will not indicate much less, if any, than three per cent. His report after examining the same mine with the Ashworth-Gray type, using alcohol as the testing flame, or with the hydrogen gas test introduced by Dr. Clowes and myself, Fig. 2, would be very valuable for comparison. With regard to the percentages of firedamp which safety lamps will detect, I may say that I purpose testing ordinary safety lamps in measured mixtures of gas and air, and in course of a few weeks I may be in a position to reply more directly to Mr. Hardie's enquiry as to



FIG. II.—Ashworth-Gray safety lamp with Ashworth, Clowes & Co.'s hydrogen gas-testing attachment.

the percentages represented by certain caps, but in the meantime I may make the following general statement :---

If $\frac{1}{6}$ in. of "cap" is seen on a testing flame which is $\frac{1}{6}$ in. high, and the total height of flame from the top of the wick tube is a full $\frac{1}{4}$ in., it would probably indicate $2\frac{1}{2}$ per cent. of firedamp. In like manner a $\frac{1}{4}$ in. "cap" would, if of a total height of $\frac{3}{6}$ in. above the top of the wick tube, indicate the presence of $\frac{3}{2}$ to 4 per cent. of firedamp, and a $\frac{1}{4}$ in. "cap," with a total height above the top of the wick tube of $\frac{5}{6}$ in. would indicate about 5 per cent. of firedamp.

To give a list of "cap" heights with corresponding percentages of firedamp applicable to all types of safety lamps is impossible, as the height of the "cap" is entirely ruled by the heat of the testing flame, its non-luminosity, and the surroundings of the flame. The truth of this will be rendered clear by a comparison of the "caps" produced



FIG. III.—Ashwor: lin-Gray, with Stokes' alcohol spirit gas-testing attachment.