downwards at its inner edge, somewhat (say ¼in.) less in diameter than the internal diameter of the glass. This would prevent the gas when ignited under the gauze diaphragm, from being in immediate contact with the glass, and so would retard, if it did not prevent, the formation of cracks in the glass.

A great objection to the use of a bonnet on a safety-lamp is that it prevents a workman, after he has received his locked lamp, from satisfying himself that all the gauze caps are in the lamp, or, in the event of gas firing in the top of the lamp, from seeing the state of the gauze. This objection might be removed without risk by providing the bonnet with two vertical slits at opposite sides, each about ⅛in. wide and 1in. long, closed by plates of mica firmly secured to the bonnet by metal frames. As the bonnet is not liable to any considerable rise of temperature, the objection to the use of mica does not apply here.

The principal danger to Gray's lamp appears to be the liability to fracture of the glass from the heat produced by the gas burning at the cylindrical strip of gauze immediately under it. In currents of low velocity this ignited gas heats the lower edge of the glass strongly, and in currents of high velocity a stream of ignited gas passes completely across the lamp from the windward side, and plays directly on to the glass at about the middle point of its height on the lee side. This, of course, speedily cracks the glass. The substitution of a horizontal gauze ring for the cylindrical gauze strip partially removes this defect; and this, with the introduction of a thin cylinder of refractory glass, placed loosely in the lamp, so as to leave an annular space between it and the outer glass, while diminishing the risk to the latter from burning gas, reduces the light by only about 10 per cent. The top of Gray's lamp requires some modification, as in its present form the lamp may easily be tampered with. As the supply of air in this lamp is drawn nearly from the top, it would seem to be particularly suited for searching for firedamp.

Automatically-closing lamps, which, by the action of a spring and a filament which becomes burned by the ignited gas, close either the inlet or outlet or both, have been invented, but they seem somewhat complicated, and not of so permanent and simple a nature as would enable them to withstand the dust-laden atmosphere and rough usage likely to be met with in a mine. The locking of safety-lamps is a question which must obviously be of the greatest importance; and, although magnetic and pneumatic locks have been examined, the report gives the palm to the "lead-plug" lock, which consists of an ordinary lead rivet connecting the oil-vessel with the lamp-case, and stamped with a letter or mark which may be varied from day to day.

The following extract from the report is worthy of attention, as it deals a blow at a time-honoured custom among firemen and others whose duties have led them to search for gas: "Mr. J. B. Marsaut has drawn attention, in his valuable work entitled 'Étude sur la Lampe de Sûreté des Mineurs,' to a source of danger attending the use of certain safety-lamps in a still atmosphere which had not previously been investigated. When a lamp is raised into a cavity containing pure gas, or air mixed with a large proportion of gas, the flame is speedily extinguished if the lamp is allowed to remain in the highly-vitiated atmosphere; but if the lamp is quickly lowered again into comparatively pure air the extinction of the flame may be prevented. In thus raising a lamp into gas, especially if the lamp is constructed to draw the air for the maintenance of the flame into the part of the lamp above the flame, the upper part of the lamp will become filled with a mixture of gas and air, containing too much gas to be explosive or even inflammable. When the lamp is lowered into pure or nearly pure air, this gas-mixture will become rapidly diluted with air, and so become inflammable. It is therefore possible that the greater part of a lamp may, by this process of raising and lowering, become nearly filled with a highly-explosive mixture without the flame being extinguished: an explosion inside the lamp must then follow. The intensely-heated gases (or vapours) resulting from this internal explosion necessarily undergo considerable expansion, and a portion must pass out of the lamp through the gauze with a velocity which increases, for a given volume exploded, as the area of the gauze decreases. If, then, its area in a lamp of given volume is sufficiently restricted, the heated gas will pass out so rapidly that the gauze will be unable to cool it below the temperature at which an explosive mixture will ignite. Supposing this event to happen when the gauze is surrounded by the inflammable mixture of gas and air which must exist near the mouth of the cavity, this mixture will become ignited and an explosion will be produced outside the lamp which may be attended with serious results. If the flame be very small, greater facility is afforded for the formation of an explosive mixture in a large part of the lamp, and an internal explosion is more likely to occur than when the flame is of its ordinary size."

Experiments carried out by the Commission verified the conclusions arrived at by Mr. Marsaut.

The proper testing of safety-lamps before being taken into a mine is obviously of the greatest importance, and the report points out that the simple examination of a safety-lamp is a very imperfect test of its safety, and that even plunging it into an explosive mixture is not sufficient. The Commissioners therefore suggested that a vertical metal cylinder about 8ft. high and 8in. to 10in. in diameter should be provided, near the bottom of which are a number of concentric burners with spaces between them, through which air can be drawn by the ascending gas. By proper regulating means a fairly uniform and highly explosive mixture may be maintained in the cylinder. When a lighted lamp is lowered into the cylinder not too rapidly, if perfect it will be extinguished; if imperfect it will almost certainly ignite the surrounding gas-mixture.

As previously stated, the Commissioners devote considerable attention to the subject of illuminants for safety-lamps, and give the following information: "The conclusions to which we have been led are that a seal-oil of good average quality is decidedly superior in point of general burning qualities (*i.e.* duration of uniformity in the height of flame produced) to refined rape (or colza) oil; and that by the admixture with either, but especially with seal-oil, of petroleum or paraffine-oil of a flashing-point not lower than 80° Fahr., in the proportion of not more than one