

CO<sub>2</sub> down to 1 per cent., it would be necessary for about 1,400 cubic feet of fresh air per man per minute to be delivered at that face. From the foregoing it is evident that a quantity standard should be supplemented by a quality standard as a basis for legislation; and it would be also advisable, for the purpose of fixing the quantity standard, that mines should be classified according to the amount of noxious gases produced by them, and according to the temperature of the surrounding rocks. The minimum amount of air passing into a mine should be such amount and of a specified quality proportionate to the number of men employed underground.

#### *Quality Standard.*

The object of a quality standard is to fix the permissible amount of air-vitiation by the quantity of carbon-dioxide and of oxygen present. It has been recognized that carbon-dioxide is the best objective criterion of the sufficiency of ventilation. In Victoria and Western Australia a quality test has been fixed for metal-mines, and in Transvaal a similar test has been recommended by a Royal Commission (1910). These standards are apparently based upon that which regulates the ventilation of factories in the United Kingdom, upon the recommendation of a Home Office Factory Ventilation Committee (1900) consisting of Dr. J. S. Haldane, F.R.S., and Mr. E. H. Osborn. This Committee recommended that the maximum permissible quantity of carbon-dioxide, when gas or oil is used for lighting, shall not exceed 20 parts by volume in 10,000 parts of air in factories. The above-mentioned oversea countries have fixed or recommended the following standards for metal-mines:—

Victoria: 25 parts CO<sub>2</sub> by volume in 10,000 parts of air, with not less than 20 per cent. of oxygen.

Western Australia: 25 parts CO<sub>2</sub> by volume in 10,000 parts of air, except for thirty minutes after blasting, when a greater (but specified) percentage is permitted.

Transvaal: 20 parts CO<sub>2</sub> by volume in 10,000 parts of air.

It will be observed that the recommendations of the British Factories Ventilation Committee have practically been adopted by these countries.

It is important to note, however, that the factories standard is not adopted in the mines of the United Kingdom, and that the British Royal Commission on Mines (1909), which included amongst its members Dr. J. S. Haldane (who formed one of the Factory Ventilation Committee of 1900, previously referred to), considered that there was no good reason for such a standard in mines, and they recommended one less strict and which they considered would be thought reasonable by those familiar with mining conditions, as follows:—

The standard of ventilation ought to be such that a lamp or candle will not burn dimly or produce any appreciable effect on the breathing of the men employed. We also think that any air found by analysis to contain less than 19 per cent. of oxygen, or more than 1¼ per cent. of carbon-dioxide, should be regarded as below this standard.

Such a standard would rightly be regarded as unduly lax if the impurities in the air were derived largely from respiration, or lights, or blasting, and were thus liable to be accompanied by other vitiation of a serious kind. The available evidence shows, however, that in collieries and other mines in Great Britain the impurities are derived almost solely from mineral sources. There thus seems to be no good reason for a stricter standard, and we believe that the standard which we recommend is one which would generally be regarded as reasonable by those familiar with mining conditions.

As a result of the above recommendation a section has been incorporated in the British Coal-mines Act, 1911, providing for a quality standard of not less than 19 per cent. of oxygen or more than 1¼ per cent. of carbon-dioxide.

We have given a considerable amount of attention to the question of a maximum percentage of carbon-dioxide, and a great number of samples were recently taken for analysis under the various conditions of mining from nearly every metal-mine in the Dominion. With the exception of the sample from the Thames 1,000 ft. crosscut previously alluded to, where 3.31 per cent. of ground carbon-dioxide was present, the maximum percentage of CO<sub>2</sub> obtained in any