The method of estimating carbon dioxide by infrared absorption is being used more intensively, and its application has been extended from the laboratory to the poliomyelitis ward, operating theatre and recovery room. It is important that one should possess a clear idea of the potential sources of error which are likely to occur under these different circumstances. This type of analyzer has been described by Woolmer (1953).

It is generally known that nitrous oxide and other gases possessing absorption bands adjacent or overlapping those of carbon dioxide, may cause false high readings. This is overcome by using the gas as an optical filter (Bracken and Sanderson, 1955). Some of the anomalies present in a recent paper (Elam, Brown and Ten Pas, 1955), appear to be attributable to this source.

A second error caused by the addition of water vapour to the expired air by the lungs is minimized by maintaining the analyzer above 38°C. In most instruments the two opposing errors, due to the dilution of the dry gas and that due to water vapour possessing similar absorption bands to those of carbon dioxide, nearly cancel out each other. The wet gas causes a discrepancy of usually not more than 0.03 per cent carbon dioxide for a 5 per cent concentration. Generally the discrepancy is barely detectable.

A third error (Stow, 1952) not widely known is that due to the broadening of the absorption bands of carbon dioxide by the diluent gas (Coggeshall and Saier, 1947; Ramwell, 1957). Such a broadening of the absorption band will increase the optical density of carbon dioxide to infrared radiation causing the analyzer to give a false high reading. Thus 5 per cent carbon dioxide in oxygen is estimated at 5.4 per cent in an infrared analyzer when the oxygen is replaced by nitrogen (fig. 1). Nitrous oxide and cyclopropane also cause a similar error but of much greater magnitude (figs. 2, 3). When the analyzer is standardized with 5 per cent carbon dioxide in oxygen, similar concentrations (prepared manometrically in tonometers—fig. 4) in nitrous oxide and cyclopropane cause the analyzer meter to read 6.2 per cent and 6.7 per cent respectively, even though the diluent gas is used as an optical filter (fig. 5).

Göpfert and Henneberg (1957) report a decrease in the value of the alveolar plateau when the subject breathes oxygen, and when air breathing is resumed the plateau returns to its normal value. This observation is probably due to oxygen causing less absorption band broadening than does the standardizing diluent gas, which presumably was air. Some authors (Collier, Affeldt and Farr, 1955) employ calibrating cylinders of special "alveolar" concentrations. These are expensive and carbon dioxide in air is cheaper and causes but little error.

The error due to absorption band broadening by the diluent gases can also be demonstrated by making up mixtures of carbon dioxide in oxygen, cyclopropane and nitrous oxide with the standard anaesthetic machine, and passing them through the analyzer in a manner analogous to that illustrated in figure 6.

During inhalation anaesthesia, the error may be overcome by standardizing the instrument with carbon dioxide in air or oxygen and employing calibration curves, previously prepared in the laboratory, for each gas mixture (fig. 2). Care must be taken to adhere to the composition of the diluent gases of the calibrating curve during the period of

* The cost of this research was defrayed in part by a grant from the Medical Research Council.
These gas mixtures were prepared in Douglas bags and passed through the analyzer at the same time as a sample was taken for estimation by Haldane's method.

**Fig. 2**
Calibration curves for carbon dioxide in oxygen, carbon dioxide in nitrous oxide and carbon dioxide in a 50:50 nitrous oxide-oxygen mixture.

**Fig. 3**
The carbon dioxide concentrations in this figure, and figures 2 and 5 were prepared by the manometric method illustrated in figure 4. In all the figures the instrument was standardized with carbon dioxide in oxygen.
Gas mixtures were also prepared by evacuating a tonometer, bleeding carbon dioxide into it via a manifold, noting the pressure drop and then bringing the system to atmospheric pressure with the appropriate diluent gas. This method was checked by Haldane's method where the nature of the diluent gas permitted.

**CONCLUSIONS**

Even when used as an optical filter, anaesthetic gases are a source of error in the infrared estimation of carbon dioxide.

The error caused by the presence of anaesthetic gases can be minimized by the choice of an appropriate calibrating gas mixture.

**ACKNOWLEDGMENTS**

I am grateful to Dr. R. P. Harbord for his encouragement, to Mr. L. Grant for his skilled technical
assistance and patience, to Professor A. Hemingway, Department of Physiology, and Dr. W. M. Pols of Utrecht for allowing their infrared analyzers to be used to confirm some of the errors.

I am grateful to the British Oxygen Company for loaning equipment and making up special gas mixtures in cylinders.

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