STUDIES IN RESPIROMETRY

IV. The Use of a Comparator System in Refractovolumetric Respirometry

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(Accepted for publication, February 12, 1935)

A respirometer dependent upon measurement of change in volume and refractivity of a closed system has been described previously\(^1\) and its use under various conditions indicated,\(^2\) among which were measurement of continuous respiration (O\(_2\) and CO\(_2\)) without chemical absorption in wet or dry systems. In these studies the CO\(_2\) measurements for small time intervals are obviously more reliable than those of the corresponding O\(_2\) changes. This appeared to be due largely to sudden although small variations in pressure which could not be followed readily with a barometer. The object of the present communication is to report the result of later work, where we have used a comparator system to compensate for such variations in similar studies of oxygen and carbon dioxide respiratory rates of newts.

The respiratory apparatus was the same as in former work except that the respiratory chamber containing the newts was a low flat vessel of pyrex glass (460 ml. capacity) with a portal for admission of the newts and delivery tubes for sealing (with mercury) into the respirometer in the usual manner.\(^1\)\(^,\)\(^3\) It contained 25 ml. of water, the newts being about half submerged. The total gas volume in the closed system at the beginning was approximately 1.034 liters, and the temperature ranged between 30.09 and 30.31°C. As a comparator system we used a glass burette (50 ml.) in horizontal position provided at the end remote from the stop-cock with a stopper through which was attached a micro burette, also horizontal, containing a small drop of kerosene. A small drop of water was introduced into the body of the large burette to provide a water-saturated atmosphere as in the respirometer, and small pieces of rubber tubing were placed at intervals.

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\(^1\) Thompson, W. R., *J. Gen. Physiol.*, 1932–33, 16, 5.
about the burette as insulation so that the rate of temperature change of the comparator system approximated that of the respirometer under the conditions of use. The residual errors from failure to exactly compensate in this manner were reduced by the thermoregulation of the room as described previously.\(^1\) Readings of volume change in the comparator could thus be made simultaneously with those of the burette of the respirometer; but, in order to facilitate this, a stop-cock was provided at the remote end of the micro burette which when closed practically inhibited motion of the kerosene drop while reading was made. Thus its closure at the instant of reading the respirometer burette made possible a good compensation for variations due to sudden pressure change.

In Text-fig. 1 are given the results of an experiment where the respiration of 20 American newts was followed without change to fresh air over a period of 4 hours, with observations every 20 minutes. It may be noted that the oxygen curve is much smoother than in the

![Respiratory rates](image)

**Fig. 1.** Continuous respiration of American newts partly immersed in water.
former work,² ³ and the respiratory quotient (indicated on a sub-graph in the same figure) is fairly stable, in spite of the fact that the changes measured are only about half as great.

The temperature-pressure change factor is obtained directly from the volume variation in the comparator. This gives a correction not only in an extremely simple form, but one which closely represents the condition at the time of measurement of the volume of gas in the respirometer. A possible improvement might be to have a comparator chamber sealed within one of the conduits of the respirometer with only a small portion protruding, the horizontal micro burette with kerosene bead and stop-cocks.

In work where relative humidities between 0 and 1 are required, long horizontal tubes partly filled with an equilibration mixture, e.g. solid salt under a saturated salt solution, may be introduced into the circulation system and into the pipe line through which fresh air is drawn at the beginning.