companying diagram. The chamber is 3.5 cm in diameter and 14 cm long. The stopcock B is very carefully ground so that it is tight without grease but does not bind. To prevent any possibility of the water in the constant temperature tank contaminating the fluid in the bath the whole stopcock is surrounded by a glass jacket. After warming to the required temperature by passage through a glass coil immersed in the tank, the bath fluid is saturated with O_2–CO_2 mixture. This is done in a 2L Erlenmeyer also immersed in the constant temperature tank and provided with a release valve. The pressure is utilized to force the fluid from the

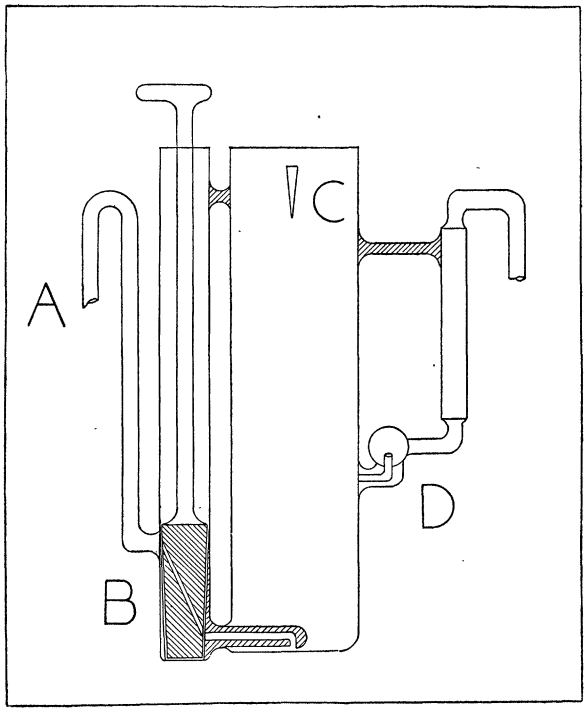

FIG. 1

Erlenmeyer into the bath through the tube A when the stopcock B is open. Fluid is allowed to flow until it reaches the glass level-marker C. When it is required to change the fluid the stopcock B is opened and more fluid allowed to flow until the syphon D operates. It will be seen that the flow through the syphon will cease before the muscle, which is suspended as low as possible in the chamber, is exposed. Because of the arrangement of the tube in the bottom of the chamber through which the fluid enters, complete displacement of the original fluid may be accomplished in two washings. This was ascertained by tests with dyes. The flow of fluid from the tube does not interfere in the least with the normal contractions of the muscle and it is impossible to tell by inspection of the kymographic record when the fluid is changed. Continuous aeration of the bath fluid may be performed, should it be desired, by allowing the level of the fluid in the Erlenmeyer to fall below the delivery tube, when the gas mixture may be passed directly through the tube A and regulated by stopcock B.

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THE MEASUREMENT OF pH IN CIRCULATING BLOOD[1]

CONTINUOUS records of changes in blood acidity were obtained with a MnO_2 electrode by Gesell and Hertzman in 1926.[2] The technique was improved by Voegtlin, De Eds and Kahler,[3] who replaced the MnO_2 electrode with a glass electrode and succeeded in more accurately estimating the pH of circulating blood. They demonstrated convincingly at that time, and again more recently,[4] the suitability of the glass electrode for pH studies in living systems.

The microvoltmeter of Burr, Lane and Nims,[5] with slight modifications, is an ideal instrument for the measurement of glass electrode potentials, not only because of its high sensitivity, but also because of its inherent stability which makes possible continuous recording over long periods of time. This has been demonstrated by Dusser de Barenne, McCulloch and Nims[6] in a study of functional activity and pH of the cerebral cortex.

In the present experiments, the pH of circulating blood was determined by means of a glass electrode, a microvoltmeter, a Leeds and Northrup potentiometer and a General Electric photoelectric recording galvanometer. Skin and other extraneous DC potentials were eliminated by placing a normal saline salt-bridge close to the glass electrode, both electrodes being in contact with the circulating blood.

This technique makes it possible to obtain, with a high degree of accuracy, the differential changes in the pH of the blood, as the conditions of the experiment are varied. Also the time relationships of such changes can be precisely determined, whether they be hours or seconds. Fig. 1 is a record of a single experiment,

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[5] H. S. Burr, C. T. Lane and L. F. Nims, *Yale Jour. Biol. and Med.*, 9: 65, 1936.

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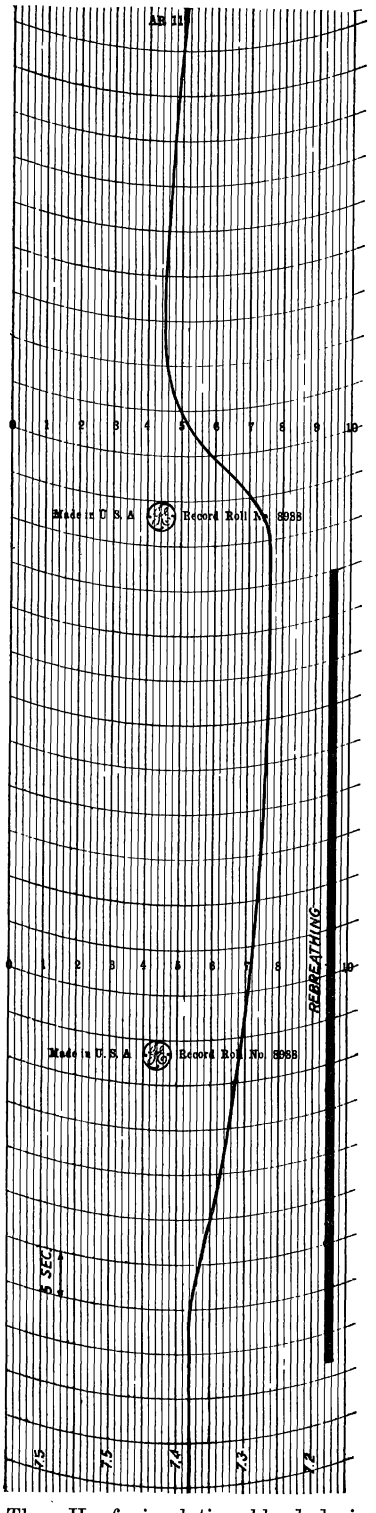

FIG. 1. The pH of circulating blood during a short period of rebreathing. Dog, male, 10 Kg. Na Amytal anesthesia, Heparin intravenously. Animal made to rebreathe by placing a surgical rubber glove over the snout. Time divisions, 5 sec.; pH units at left.

illustrating the type of information obtainable. In this experiment the electrode system was placed in the femoral artery of a heparinized dog, under sodium amytal anesthesia, and the animal was made to rebreathe its expired air for a period of 88 seconds, as indicated by the solid black line in the figure. Within 8 seconds after rebreathing was initiated, the blood began to shift to the more acid side; in 40 seconds this change amounted to 0.08 pH unit; in the remaining period, the change was 0.03 pH unit more. Five seconds after cessation of the rebreathing, the blood became with surprising rapidity less acid, passing through its original level in less than 15 seconds after the reversal began. Its new level was not attained directly, but by a process of "over-shooting" and subsequent return from a slightly higher pH. The return to a stable condition required a minute or more.

Complete details of this technique, as well as the results of other experiments on the relationship of blood pH and respiration, will be published later.

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