

As the rebreathing of air continues, the alveolar CO_2 rises, the discharge of CO_2 decreases; the R. Q. exceeds unity in the first period, but quickly falls in the second and third periods. The total volume of the lung-bag system increases during the first period, decreases thereafter. These volume changes explain the difficulties experienced by certain workers in demonstrating the uniform percentage concentration of an inert gas in a lung-bag system,^{2, 3} and also the inadequacy of any mixing criteria which are based on percentage concentration of the inert gas without due consideration of the concomitant changes in total volume.

8075 P

The Factor of Recirculation in Acetylene Method for Determination of Cardiac Output.

SIDNEY A. GLADSTONE.* (Introduced by B. S. Oppenheimer.)

From the Medical Service of Dr. B. S. Oppenheimer, The Mount Sinai Hospital, New York City.

Hamilton, Spradlin, and Saam¹ on the basis of animal experiments have concluded that the results of the acetylene method² for determining the cardiac output are vitiated by the return of acetylene to the lungs before the procedure is completed. After using the Marshall-Grollman method for one year,³ the present writer felt the necessity of studying this question in human subjects. If and when recirculation of acetylene-laden blood occurs in appreciable amounts, it will become manifest by a reduction in the rate of diffusion from the lungs into the blood, a reduction in the diffusion constant K of the system, and a rise in the calculated arterio-venous oxygen difference. In 11 rebreathing experiments on 2 subjects, these data were obtained for successive short intervals during each experiment by drawing several alveolar samples, the breathing and sampling being directed by an accurately timed phonograph record.

² Lundsgaard, C., and Schierbeck, K., *Am. J. Physiol.*, 1923, **64**, 210.

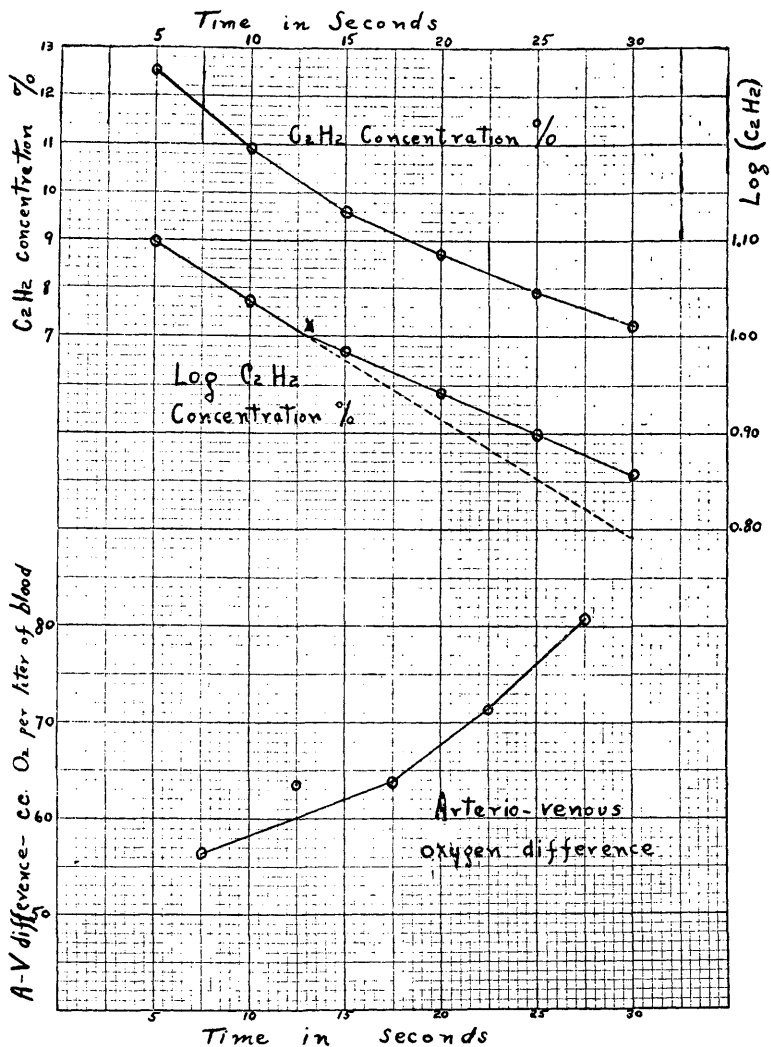
³ Grollman, A., and Marshall, E. K., *Am. J. Physiol.*, 1928, **86**, 110.

* Richard and Ella Hunt Sutro Fellow for Cardiovascular Research.

¹ Hamilton, Spradlin, and Saam, *Am. J. Physiol.*, 1932, **100**, 589.

² Grollman, A., *The Cardiac Output of Man in Health and Disease*, Baltimore, 1932.

³ Gladstone, S. A., *Arch. Int. Med.*, 1935, **55**, 533.



The results of one typical experiment are graphically presented. If the blood flow through the lungs is fairly constant during the rebreathing experiments, the rate of diffusion of the acetylene from lungs to blood should be proportional to the constantly decreasing alveolar concentration of the gas. Charted as the ordinate against time as the abscissa, the concentration of C_2H_2 should follow an exponential or logarithmic curve, and the logarithms of the concentration should follow a straight line, the slope of which will indicate the rate of diffusion of the gas. In the experiments performed, the break in this line with flattening of the curve indicating a depression in the rate of diffusion of the gas due to recirculation in appreciable

amounts, has occurred at 10 seconds or promptly thereafter. This rapid recirculation is undoubtedly due to the increase in blood flow through the lungs occasioned by the deep rapid breathing of the procedure. The increased blood flow is also indicated by the volumes of O_2 ⁴ and C_2H_2 removed from the lungs during the first 10 seconds before recirculation begins. There can be no doubt that recirculation occurs in the Marshall-Grollman procedure not only before the test is over (23 seconds) but even before the first sample is drawn (at 15 seconds). The ability to obtain good checks with the Marshall-Grollman procedure (an ability which has differed widely in the hands of different workers) will depend on timing the samples in exactly the same way in repeated experiments so that the errors due to recirculation (which are partly compensated by the error due to abnormal quickening of the blood flow beyond the metabolic needs of the tissues with consequent increase in the O_2 content of the mixed venous blood) will be fairly constant. The writer has been gradually and unwillingly forced to the conclusion that the results of the Marshall-Grollman method are heavily weighted with errors which compensate each other to a varying degree under different conditions, rendering the absolute figures obtained sometimes correct but never completely reliable, and rendering the method insensitive to the detection of small differences, because the size of the errors involved may vary even more than the function to be measured.

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A Modified Foreign-Gas Method for Determination of Cardiac Output in Man.

SIDNEY A. GLADSTONE,* (Introduced by B. S. Oppenheimer.)

From the Medical Service of Dr. B. S. Oppenheimer, The Mount Sinai Hospital, New York City.

The application of the foreign-gas principle for the determination of the arteriovenous oxygen difference and cardiac output in man is beset by two difficulties; first, the attainment of a homogeneous mixture in the gaseous system with which the arterial blood is assumed to be in equilibrium; second, the termination of the pro-

⁴ Preceding publication.

* Richard and Ella Hunt Sutro Fellow for Cardiovascular Research.