

TABLE 2

Solubility of Atmospheric Gases in Water and Olive Oil at 28° C.¹⁸

Gas	Solubility (ml./ml.)		Oil-water ratio
	Water	Olive oil	
Oxygen	0.023	0.112	4.9 :1
Nitrogen	0.0127	0.0667	5.24:1
Helium	0.0087	0.0148	1.7 :1
Argon	0.026	0.1395	5.32:1

equilibrium a large amount of gas may be stored in the fatty tissues. The role of fat in aeroembolism is similar to that in decompression sickness. More will be said of it in the following sections. As far as other substances in the body are concerned, the capacity of the body for simple solution of gases is almost wholly due to the water or fat content, and no further distinction need be made here for this property.

The solution of gases in the body, including oxygen and carbon dioxide, was not readily analyzed by experiment until recently, although much work on the use of gases for estimating cardiac output and lung function is in the literature. The converse, or desaturation, has been studied intensively in developing a means of obviating caisson disease and aeroembolism. Data on nitrogen elimination^{16,18} are shown graphically in Figure 2 and indicate the involvement of a system of at least two components; fat and water, for which an empirical approximation was developed. It has been shown further by Smith and Morales^{18,22} that

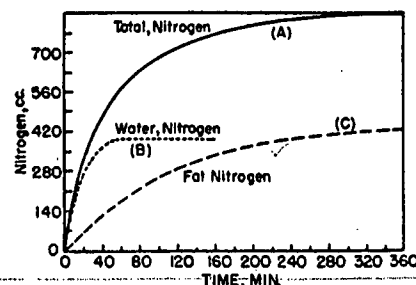


Figure 2. Elimination curve for nitrogen.¹⁸ Total nitrogen (A) represents the average of the values for nitrogen elimination from three men (average weight 64 kg.) who breathed pure oxygen at atmospheric pressure. Water nitrogen (B) and fat nitrogen (C) are hypothetical curves showing the absorption or elimination of nitrogen by the body solvents. The values for nitrogen on (A) are approximately the sum of corresponding values on (B) and (C).

¹⁸ L. A. Shaw, A. R. Behnke, A. C. Messer, R. M. Thomson, and E. P. Motley, *Ann. N.Y. Acad. Sci.*, **112**, 545 (1935).

¹⁹ R. E. Smith and M. F. Morales, *Bull. Math. Biophys.*, **6**, 125 (1944).

²⁰ R. E. Smith and M. F. Morales, *Bull. Math. Biophys.*, **6**, 133 (1944).

certain refinements in the consideration of physical constants of the various media for the accumulation of gases, the avenues of saturation and desaturation, and so forth, enable them to set up a general theoretical expression for the gain or loss of gases from the whole or any portion of the body. They consider the effects of blood volume, blood flow, tissue volume, surface presented, permeability, solubility, and gas concentration. This analysis is shown in Figure 3 to fit well

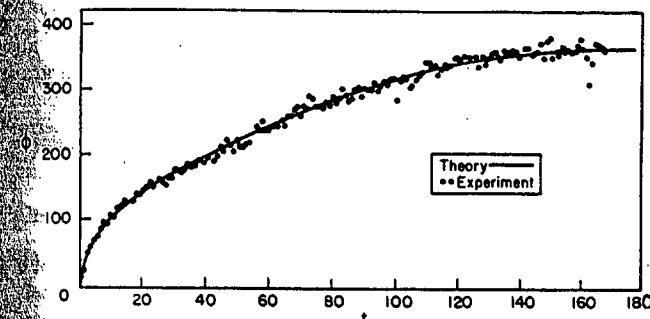


Figure 3. Total nitrogen gas uptake by limb tissues.²⁰ ϕ , a function of total nitrogen absorbed at any time t , is the counts of radioactive krypton at one minute intervals.

with experimental data, and it is apparent that a rational and basically sound approximation has been developed.

6. Temperature of the Atmosphere, Its Origin and Variation

Since we are dealing generally with body temperature under conditions of reasonable functional integrity, it would not seem that the environmental temperature plays any major role in the response to atmospheric pressure change. The greatest variation in body temperature lies probably between 28 and 40° C. In this range the solubility of gases generally falls with increased temperature, though the magnitude of the change is relatively small. The temperature coefficient of simple chemical reactions *in vivo* is found to be of a moderate order and is given by the Arrhenius relation, which states that the rate of reaction is doubled or trebled for every 10° C. rise.²¹

On the other hand, certain physiological responses to temperature changes of a minor extent are exceedingly marked and important to the economy of gases in the body, though by indirection. A consideration of atmospheric temperature variation must be included here to be drawn upon later in explanation of certain responses to alterations in pressure at altitude.²²

²¹ H. L. Blum, *Photodynamic Action and Diseases Caused by Light*. Reinhold, New York, 1934.

²² H. G. Armstrong, *Military Surgeon*, **79**, 133 (1936). H. G. Armstrong, *Principles and Practice of Aviation Medicine*. Williams & Wilkins, Baltimore, 1938.