The temperature of the atmosphere is due mainly to the energy absorbed from solar radiation, secondarily to that added by conduction or convection. For our consideration, the distribution of temperature in the two zones of the atmosphere nearest the earth is of interest. From the ground up to about 36,000 feet there is found a variable temperature, the average value falling off with increase in altitude, and above this level there is a region of uniform temperature known as the isothermal layer. This uniform temperature, which extends to excessively high altitudes, is reported to be relatively constant at —55° C. (—67° F.).[5] It is in this upper region that the ozone produced by absorption of ultraviolet radiation by oxygen in the outer layers is observed to gravitate in appreciable concentration. Because of the filtering action of these superior strata there is relatively little absorption of energy by the gases in the isothermal layer. Below the lower boundary of this layer, at about 36,000 feet, water vapor and solids in the atmosphere absorb energy in an appreciable amount, and the temperature rises gradually as the earth is approached until the characteristic temperature of the latitude is attained. On the other hand, owing to thermal displacement of air masses by convection and conduction of heat and by the absorption of reradiated energy from the earth's surface, there is often a great deal of random distribution of temperature. Thus, surface temperature may be colder than at several thousand feet directly above the ground, and several such inversions may be found above each other. These are found mainly over land masses and are part and parcel of the "weather." The mechanism is not important to this discussion. Further details may be found in Humphreys.[5] Local temperatures below the tropopause, or lower stratosphere level, as low as —120° F. have been recorded. It is important to point out that in contradistinction to the previous fact, aeronautical tables are calculated on the assumption that there is a constant temperature in the so-called isothermal region and that a regular increase in temperature on descent from this level to the ground is found. Thus the effect of the temperature variations on "pressure altitudes" in the atmosphere is of interest to the physiologist, who is concerned with the barometric value of any linear altitude and not with the actual height above sea level.

As far as increased pressures are concerned, it is evident that, except for heat added by compressing equipment, the temperature of the air or other gases will tend to equal that of the environment; for example, in sea water it will range upward from 28.6° F., which is the freezing point of sea water of average salinity.

While the heat conductivity of gases is not affected by pressure, certain changes in heat loss from the body are to be expected from changes in pressure of the atmosphere, since the heat capacity of the air is changed and tends to alter the temperature differential necessary to maintain constant heat transfer from the body to the environmental gases. This effect is very marked for subjects

in low-pressure chambers at "altitude," and may cause wrong interpretation of the temperature sensations.

C. CHEMICAL ACTIVITY

The chemical activity of the gases of the atmosphere relevant to the physiology of atmospheric pressure in mammals is limited to that of oxygen and carbon dioxide. This limitation is mainly due to the fact that the energy levels needed for direct chemical reaction are not feasible in living systems. All reactions of gases depend, under these circumstances, either primarily or secondarily on catalysis of some type. The metabolic involvement of hydrogen and nitrogen has been substantiated for living forms as high as bacteria,[23,24] but mammals have not been found to possess the systems necessary for either hydrogen or nitrogen activation in the gaseous state. Enzymes for the activation of gaseous oxygen and carbon dioxide are integral to the metabolic process of all mammals.[25] In common with reactions of other substances, the rate and equilibrium of the reaction of gases depend, among other factors, on the concentration of the gas, both relatively and absolutely; that is, the systems are pressure-labile within limits. This property is of utmost importance in the physiological analysis of the effects of atmospheric pressure.

In setting aside, at the beginning of Section B.5, the fact that chemical reaction affects the solution of gases, it was intended only to reserve this complication for further discussion because, as will be seen in subsequent sections, it is of great importance in the exchange of gases between the atmosphere and the body fluids.

It may be fitting to point out at this time that the widely publicized,[26] similarity between the status of flames and metabolic oxidations at altitude is a fallacious one, flames having actually only minor response to even extensive pressure changes but being markedly sensitive to relative concentration, while metabolic oxidations behave quite the opposite. The difference is in part due to the fact that in metabolic activities there exists always a solution phase between the free gas and the substance oxidized. Contrary to popular accounts[26,27] a candle flame will continue to burn in air up to a simulated altitude of 57,000 feet provided a large enough volume of air is used for the environment of the flame. A change in the character of flames at altitude[6] led to erroneous conclusions from experimental engineering data cited above.[28] The ultimate limitation on flame stability in the case of the candle results from the flame's being

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