Dry-Bulb Temperature. The temperature indicated by any type of thermometer or thermocouple not affected by the water vapor content of the air, or by radiation.

Thermodynamic Wet-Bulb Temperature. The temperature at which liquid or solid water, by evaporating into air, can bring the air to saturation adiabatically at the same temperature.

Consider an adiabatic system as shown in Fig. 2. Unsaturated air at the state h_1, W_1, enters the system at section 1, and saturated air at the state h^*, W^*, leaves the system at section 2. Liquid water at the state h_w^*, corresponding to the temperature of the saturated air leaving the system is supplied. Then, since no work is done and the system is strictly adiabatic, the energy equation becomes

$$h_1 + (W^* - W_1)h_w^* = h^* \tag{8}$$

where

* indicates condition at thermodynamic wet-bulb temperature.

Table 1. Magnitudes of f_s for the Range 0 to 125 F
(Standard Barometric Pressure, 29.921 in. Hg)

Temp. F	f_s	Temp. F	f_s
0	1.0048	70	1.0045
10	1.0046	80	1.0047
20	1.0046	90	1.0048
30	1.0045	100	1.0050
40	1.0044	110	1.0053
50	1.0044	120	1.0055
60	1.0044	125	1.0057

Note: The original source[1] gives f_s to seven significant figures over the temperature range −208 F to + 202 F and over the pressure range 20 to 35 in. Hg.

The temperature corresponding to h^* for given values of h_1 and W_1 is called the thermodynamic wet-bulb temperature, or the temperature of adiabatic saturation.

The temperature indicated by an ordinary wet-bulb thermometer is affected by a number of factors not accounted for in Equation 8, and hence, may be quite different from the theoretical temperature obtained from its use. The measured wet-bulb temperature is influenced by (*a*) radiation from the surroundings to the wick; (*b*) conduction of heat along the stem of the thermometer; and (*c*) impact of the air on the wick or bulb of the thermometer. Arnold[3] has developed a theory which makes possible the calculation of the true thermodynamic wet-bulb temperature from observed data through the use of suitable corrections to be applied to the readings of the wet-bulb thermometer. However, unless extreme precision is required, the observed temperature may be taken equal to the theoretical temperature for most engineering problems, if no attempt is made to shield the wick from radiation and the air velocity past the wick is about 1000 fpm.

Dew-Point Temperature. The saturation temperature corresponding to a given combination of humidity ratio W and barometric pressure is called the dew-point temperature. It is the lowest temperature at which the given humidity ratio can exist at the corresponding barometric pressure. At this temperature condensation will first start to form when moist air is cooled.

Perfect Gas Relationships

Hypotheses, based on experimental observation of the physical behavior of gases, which were advanced by Boyle, Charles, Gay-Lussac, Dalton, Gibbs, Joule, Kelvin and others, were reduced to reasonably simple mathematical expressions and came to be regarded as physical laws. However, as scientific knowledge increased, and as more precise methods of measurement were developed, it became apparent that these simple equations did not describe the behavior of the mixtures of actual gases and vapors accurately.

The original statements have been found to be useful tools, nevertheless, in many cases. For example, the behavior of common diatomic and triatomic gases at low pressures follows these equations closely enough so that they may be used for some types of engineering problems. The practice of engineering is an art, and not an exact science, and many useful engineering works have been constructed through the use of approximations. The degree of approximation, however, which may be tolerated in engineering design must be decided by the engineer, based upon his study and experience in the field.

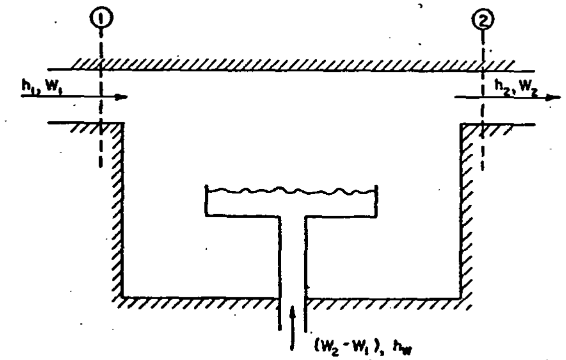

Fig. 2. Illustration of Adiabatic Saturation

Boyle's Law. One of the original observations of the physical behavior of gases was made by Robert Boyle who noted that, if a constant weight of gas is compressed with the temperature held constant, the volume V varied inversely as the absolute pressure P. Stated mathematically,

$$PV = \text{constant} \quad \text{(temperature constant)} \tag{9}$$

Charles' Law. Experiments made independently by Charles and Gay-Lussac led to the formulation of what is now known as Charles' Law: If a constant weight of gas is heated or cooled at constant volume, the absolute pressure P varies as the absolute temperature T; if a constant weight of