temperature and velocity of air movement, and the relationship of this error to these factors is shown in a paper entitled *The Temperatures of Evaporation of Water into Air*, presented by W. H. Carrier and D. C.

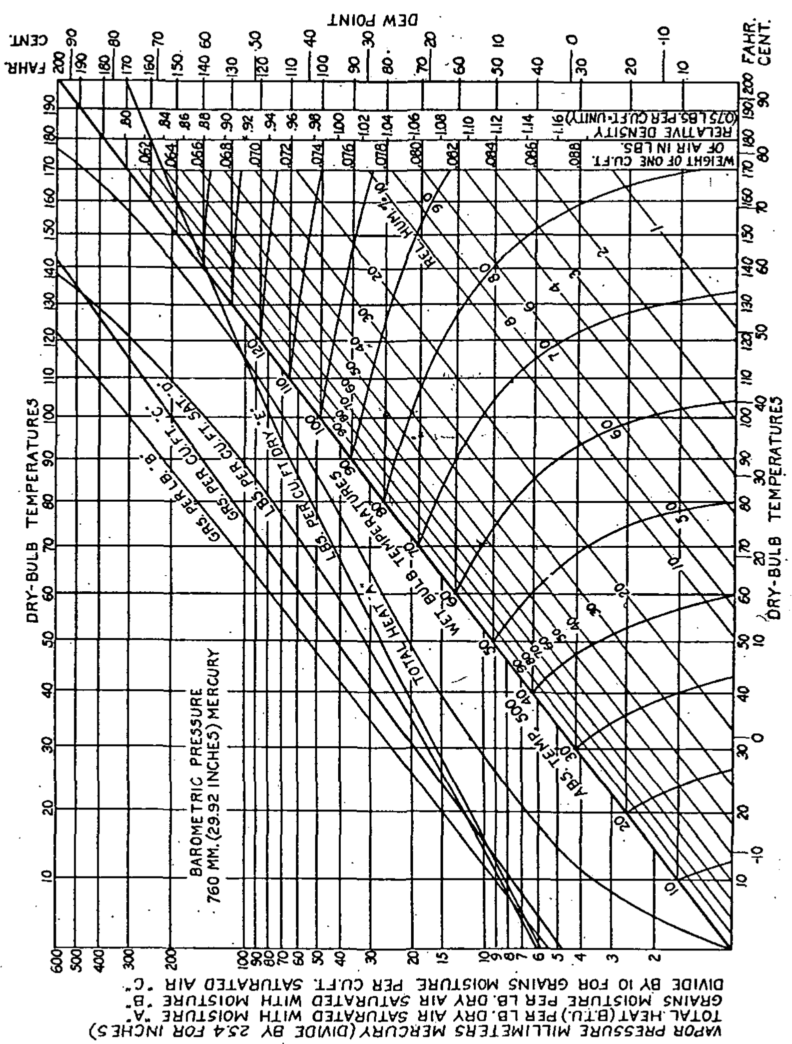

FIG. 1. PSYCHROMETRIC CHART

Lindsay, before the *American Society of Mechanical Engineers* in 1924.

From the foregoing, four fundamental principles in air conditioning may be stated.

1. When dry air is saturated adiabatically the temperature is reduced as the absolute humidity is increased, and the decrease of sensible heat is exactly equal to the simultaneous increase in latent heat due to evaporation.

2. As the moisture content of air is increased adiabatically, the temperature is reduced simultaneously until the air is saturated, when no further heat metamorphosis is possible. This ultimate temperature may be termed the temperature of adiabatic saturation.

3. When an insulated body of water is permitted to evaporate freely in the air, it assumes the temperature of adiabatic saturation of that air and is unaffected by convection, *i.e.*, the true wet-bulb temperature of air is identical with its temperature of adiabatic saturation.

4. The true wet-bulb temperature of the air depends entirely on the total of the sensible and the latent heat in the air and is independent of their relative proportions. In other words, the wet-bulb temperature of the air is constant, providing the total heat of the air is constant.

It will be obvious in considering the foregoing process, that a formula relating the latent heat change to the sensible heat change establishes the relationship of this theoretical wet-bulb temperature to the temperature and moisture of the air. This was first pointed out by W. H. Carrier in the Rational Psychrometric Formula:

$$r^1 (W^1 - W) = C_{pa} (t - t^1) + C_{ps} W (t - t^1) \qquad (4)$$

in which

$(t - t^1)$ = the true wet-bulb depression.

$(W^1 - W)$ = the moisture absorbed per pound of pure air when it is adiabatically saturated from an initial dry-bulb temperature t_0 and an initial moisture content W.

C_{pa} = mean specific heat of air at constant pressure between temperature t and t^1.

C_{ps} = specific heat of steam at constant pressure between t and t^1.

r^1 = latent heat of evaporation at wet-bulb temperature t^1.

Knowing any two of the three important values of t, t^1 or W, the third may be solved.

This is an exceedingly useful relationship, not only in air conditioning and the drying of materials but in the psychrometry of air or other gases to which it directly applies. It is evident that if the wet-bulb temperature of air of a known dry-bulb temperature but unknown moisture content be determined experimentally with the wet-bulb thermometer, it will be possible to calculate directly the moisture content of that air from the relationship.

PSYCHROMETRIC CHART

The Bulkeley Psychrometric Chart[2] (Fig. 1) shows graphically the relationships expressed in Equation 4. It also gives the grains of moisture per pound of dry air for saturation, the grains of moisture per cubic foot of saturated air, the total heat in Btu per pound of dry air saturated with moisture, and the weight of the dry air in pounds per cubic foot. Fig. 2 shows the procedure to follow in using the Bulkeley Chart. The directrix curves above the saturation line are as follows:

[2]The Bulkeley Psychrometric Chart was presented to the Society in 1926. (See A.S.H.V.E. TRANSACTIONS, Vol. 32, 1926.) Fig. 1 has been reproduced from the original chart but with the secondary cross-section lines omitted.