INFLUENCE OF HUMIDITY

Recent research indicates that, from the physiological viewpoint:

1. In the *hot zone* (above a point of ideal adjustment and comfort) high relative humidity tends to prevent evaporative regulation and is exceedingly harmful. Even when evaporation of sweat maintains a successful thermal balance, the process is accompanied by marked discomfort and interference with physical efficiency; and high relative humidity sharply narrows the zone of temperature within which adjustment can take place, a rise from 0 to 100 per cent relative humidity (under conditions cited in a preceding paragraph) lowering the limit of air-temperature tolerance by 40 deg (see Fig. 2 and Table 2 giving upper limits of evaporative regulation).

2. In the *cold zone* relative humidity has comparatively slight influence, lowering relative humidity from 75-80 per cent down to 30-35 per cent increasing heat loss only by the same amount as a 1 deg fall in temperature.

For the premature infant, a high relative humidity of about 65 per cent is demonstrably beneficial to health and growth[47] until the infants reach a weight of about 5 lb. No such clear-cut evidence exists in the case of adults. In the comfort zone experiments of the A.S.H.V.E. Research Laboratory, the relative humidity was varied between the limits of 30 and 70 per cent approximately, but the most comfortable range has not been determined. In similar experiments at the *Harvard School of Public Health*, the majority of the subjects were unable to detect sensations of humidity (*i.e.*, too high, too low, or medium) when the relative humidity was between 30 per cent and 60 per cent with ordinary room temperatures which is in accord with other studies[48,49].

The limitation of the comfort zones in Fig. 6 with respect to humidity must not be taken too seriously. Relative humidities below 30 per cent may prove satisfactory from the standpoint of comfort. In mild weather comparatively high relative humidities are entirely feasible, but in cold weather they are objectionable on account of condensation and frosting on the windows. Information on this subject is given in Chapter 3.

A degree of atmospheric humidity sufficiently high to cause deposition of moisture in the clothing may perhaps increase the chilling effects of cold air; but little or no exact information is available on this point. The dividing line at which humidity has no effect upon warmth varies with the air velocity and is about 46 F (dry-bulb) for still air and about 50, 56 and 60 F for air velocities of 100, 300 and 500 fpm, respectively.

As to the effects of dryness of the air, *per se*, and irrespective of thermal effects, there is a common belief that dry air in itself exerts a harmful effect upon the skin and mucous membranes; but there is no convincing evidence that the increase of atmospheric moisture which can practically be introduced by humidification into the air of cool occupied rooms has any effect upon health and comfort. All controlled experiments on this point have yielded negative results; and the respiratory membranes of industrial workers exposed to hot moist air are distinctly more abnormal than those of workers exposed to hot dry air[50].

[47] Loc. Cit. Note 34.

[48] Humidity and Comfort, by W. H. Howell (*The Science Press*, April, 1931).

[49] Effect of Variation in Relative Humidity upon Skin Temperature and Sense of Comfort, by U. Miura (*American Journal of Hygiene*, Vol. 13, 1931, p. 432).

[50] Loc. Cit. Note 12.

INFLUENCE OF AIR MOVEMENT

The problem of the influence of air movement is a highly complex one as illustrated in Fig. 10, where heat losses per unit of body surface by radiation, convection and evaporation are plotted against air temperature for three different rates of air movement (with 50 per cent relative humidity). It will be noted that:

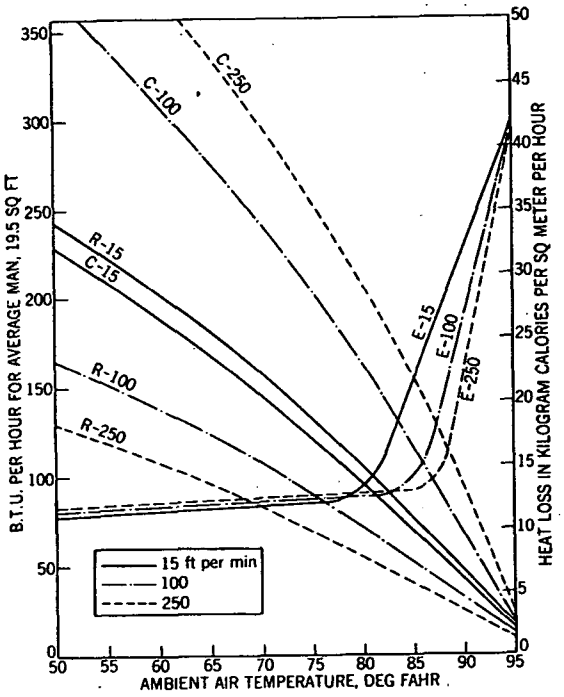

FIG. 10. CHANGES IN DISTRIBUTION OF HEAT LOSS BY RADIATION, CONVECTION, AND EVAPORATION AT VARIOUS AIR TEMPERATURES WITH THREE DIFFERENT AIR MOVEMENTS

1. Evaporative heat loss is constant and minimal at air temperatures below 80 F and is relatively uninfluenced in this area by air movement. With low air movement, sweat secretion begins to rise at 80 F, but with very high air movement only the rise does not begin until 87 F (because, with high air movement, the body cools more readily by convection and hence the sweat secreting mechanism need not operate at so low an air temperature). Above this critical point, evaporation increases very sharply with increasing air temperature.

2. Heat loss by radiation is *decreased* as air movement increases because the greater influence of convection, when air movement is high, lowers the skin temperature and thus lowers radiation which depends on the differential between walls and body surface.

3. Convection rises at all points sharply with increased air movement, according to a relation discussed in a succeeding paragraph.