ture and 70 F inside air temperature, will have an inside surface temperature of 55 F. The reverse effect will be experienced by occupants of rooms having extensive high-temperature surfaces in them. In such cases, a lower air temperature is required to compensate for heat radiated to the occupant.

The effective temperature index for persons doing medium or heavy muscular work, in still air, has also been determined at the A.S.H.V.E. Research Laboratory[19].

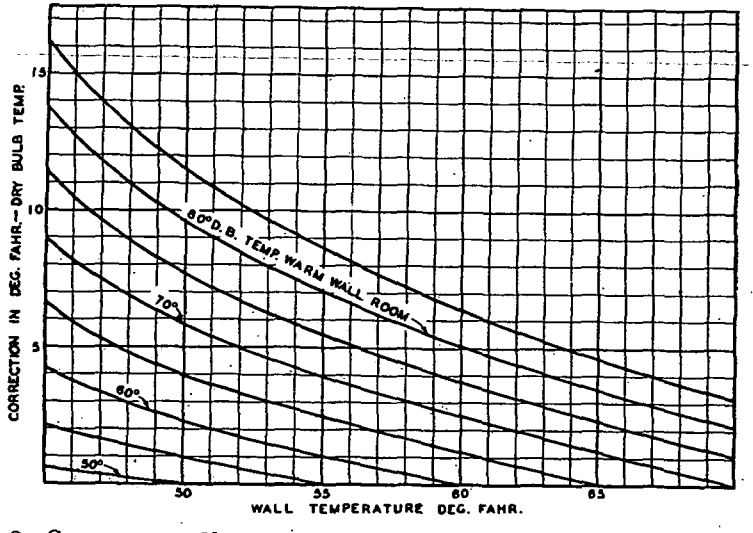

FIG. 2. CORRECTION TO VARIOUS DRY-BULB TEMPERATURES IN A WARM-WALL ROOM FOR THE SAME FEELING OF WARMTH IN ROOMS HAVING THREE COLD WALLS. TEMPERATURES INDICATED BY SHIELDED THERMOMETERS 30 IN. ABOVE THE FLOOR

OPTIMUM AIR CONDITIONS

No single comfort standard can be laid down which would meet every need. There is an inherent individual variation in the sensation of warmth or comfort felt by persons when exposed to an identical atmospheric condition. The state of health, age, sex, clothing, activity, and the degree of acquired adaptation seem to be the important factors affecting the comfort standards.

Since the prolonged effects of temperature, humidity and air movement on health are not known to the same extent as their effects on comfort, the optimum conditions for health may not be identical with those for comfort. On general physiologic grounds, however, the two do not differ greatly since this is in accordance with the efficient operation of the heat regulating mechanism of the body. This belief is strengthened by

[19]Effective Temperature for Persons Lightly Clothed and Working in Still Air, by F. C. Houghten, W. W. Teague and W. E. Miller (A.S.H.V.E. TRANSACTIONS, Vol. 32, 1926).

results of studies on premature infants over a four-year period[20]. By adjusting the temperature and humidity so as to stabilize the body temperature of these infants, the incidence of diarrhœa and mortality was decreased, gains in body weight increased and infections were reduced to a minimum.

Comfort Chart; Comfort Line; Comfort Zone

Fig. 3 shows a comfort chart, developed at the A.S.H.V.E. Laboratory, on which the average and extreme comfort zones have been superimposed. The *extreme comfort zone* includes air conditions in which one or more of the experimental subjects were comfortable. The *average comfort zone* includes those air conditions in which the majority of the subjects (50 per cent or more) were comfortable. That particular effective temperature at which the maximum number of subjects was comfortable was called the *comfort line.*

The *average winter comfort zone* as determined at the A.S.H.V.E. Laboratory ranges from 63 deg to 71 deg ET (effective temperature). In winter while at rest, a large percentage of persons normally clothed were found to be comfortable at 66 deg ET and this temperature has been accepted by a committee of the Society[21] as the *winter comfort line* or *optimum effective temperature.*

The comfort line separates the cool air conditions to its left from the warm air conditions to its right. Under the air conditions existing along or defined by the comfort line, the body is able to maintain thermal equilibrium with its environment with the least conscious sensation to the individual, or with the minimum phsyiologic demand on the heat regulating mechanism. This environment involves not only the condition of the air with respect to temperature and humidity, but also the condition of the surrounding objects and wall surfaces. The comfort zone tests were made in rooms with wall surface temperatures approximately the same as the room dry-bulb temperature. For walls of large area having unusually high or low surface temperatures, however, a somewhat lower or higher range of effective temperature is required to compensate for the increased gain or loss of heat to or from the body by radiation[22].

The *average summer comfort zone* for exposures of 3 hours or more ranges from about 66 deg to 75 deg ET, based on studies made at the Harvard School of Public Health[17]. The probable optimum effective temperature (for exposures of 3 hours or more) is 71 deg. These effective temperatures average about 4 deg higher than those found in winter when customary winter clothing was worn. The variation from winter to summer is probably due partly to adaptation to seasonal weather and partly to differences in the clothing worn in the two seasons.

The best effective temperature (for exposures lasting 3 hours or more) was found to follow the average monthly outdoor temperature more closely than the prevailing outdoor temperature. It remained at approxi-

[20]Application of Air Conditioning to Premature Nurseries in Hospitals, by C. P. Yaglou, Philip Drinker and K. D. Blackfan (A.S.H.V.E. TRANSACTIONS, Vol. 36, 1930).

[21]How to Use the Effective Temperature Index and Comfort Charts (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932).

[22]Cold Walls and Their Relation to the Feeling of Warmth, by F. C. Houghten and Paul McDermott (A.S.H.V.E. Journal Section, *Heating, Piping and Air Conditioning*, January, 1933, p. 53).