

ditions in Fig. 6 and determined prior to 1932, has more recently been checked; first, by occasional observations, and second, by consistent laboratory study³¹, indicating that a higher optimum of 67 deg ET, or possibly as high as 68 deg ET, is now desired by the majority of occupants.

All of these studies aimed to determine the optimum effective temperature for persons during both winter and summer, and for different geographical regions and age groups indicate a total spread in optimum conditions ranging from a low of 67 deg ET for winter heating and air conditioning, to a high of 73 deg ET for summer cooling and air conditioning.

The spread for summer cooling and air conditioning is confined entirely to an effective temperature range of from 69 to 73 deg, and it may be presumed that for winter conditioning a like spread would be had; while for inter-seasonal conditions there will be a fluctuation between these two ranges.

Recent studies³² indicate that for the average individual a temperature change of about 3 deg ET is required to change a person's sensation from *ideally comfortable* to *cool* or *warm*. From this it may be observed that necessary variations in the effective temperature of air conditioned space for optimum comfort for most persons, regardless of age or geographical location, need little differentiation for either the winter season or the summer season, and not more than about 4 deg on the average between seasons.

Acclimatization and habits of clothing and diet account for these variations. As a result of a recent analysis³³ of all of the evidence available by the A.S.H.V.E. Technical Advisory Committee on Sensations of Comfort, a variation of 3 deg spread in optimum effective temperature for summer cooling and air conditioning with geographical location has been proposed. The available information indicates rather clearly that changes in weather conditions over a period of a few days do not acclimate people to a desire for different indoor conditions, but in general, people experiencing low temperatures over an extended period of time become acclimated to desiring lower indoor temperatures, while those experiencing higher temperatures become acclimated to a desire for higher indoor temperatures. It is obvious that a person spending a considerable portion of his time in space conditioned to his comfort will become acclimated to his indoor environment. While few people enjoy air conditioning for more than a small percentage of the total time, there is some evidence that persons experiencing comfort air conditioning a large part of the time tend to become acclimated to about 70 or 71 deg ET.

The entering shock to occupants of summer cooled and air conditioned space may at times be important, and is due to the rapid evaporation of perspiration accumulated during the occupant's previous stay in the hot outside. While recent studies³⁴ show that for healthy individuals this

³¹A.S.H.V.E. RESEARCH REPORT No. 1173—Radiation as a Factor in the Sensation of Warmth, by F. C. Houghten, S. B. Gunst and J. Sucu, Jr. (A.S.H.V.E. TRANSACTIONS, Vol. 47, 1941.)

³²Loc. Cit. Note 31.

³³Comfort with Summer Air Conditioning, by Thomas Chester, N. D. Adams, C. R. Bellamy, G. D. Fife, E. P. Heckel, Dr. W. J. McConnell, F. C. McIntosh, A. B. Newton, B. F. Raber and C. Tasker. (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, October, 1941.)

³⁴A.S.H.V.E. RESEARCH REPORT No. 1102—Shock Experiences of 275 Workers After Entering and Leaving Cooled and Air Conditioned Offices, by A. B. Newton, F. C. Houghten, Carl Gutberlet, R. W. Qualley and M. C. W. Tomlinson (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 571).

shock is usually a pleasant experience, for others it may result in unpleasant or even harmful chills. This fact should be taken into consideration in applying summer cooling and air conditioning, particularly to spaces where a large number of the occupants may enter for only a short time, 15 min or less. Such occupants will be satisfied with less cooling. For long occupancy very little deviation from the optimum effective temperature is practical.

Radiation between the occupant of an enclosure and the surfaces of the room itself and objects within the room, including windows, heating and cooling equipment, and other occupants, has an important bearing on the feeling of warmth and may alter to some measurable degree the optimum

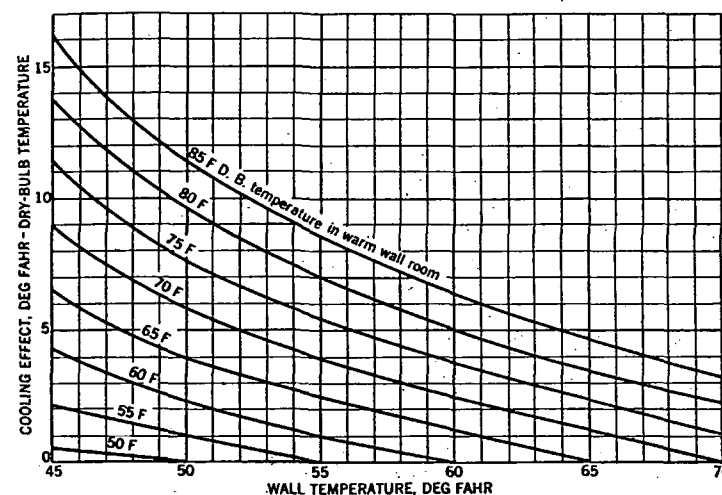


FIG. 10. COOLING EFFECT OF THREE COLD WALLS IN A SMALL EXPERIMENTAL ROOM, AS DETERMINED BY COMPARISON WITH SENSATIONS IN A ROOM OF UNIFORM WALL AND AIR TEMPERATURE

conditions for comfort indicated previously. Fig. 10³⁵ shows the necessary elevation in the dry-bulb temperature of the air to compensate for the lower temperature of three of four side-wall surfaces, which indicates that for this condition each degree reduction in the average of the three wall surface temperatures there must be an elevation of 0.3 deg in the dry-bulb temperature of the air to compensate. Recent studies by the A.S.H.V.E. Research Laboratory³⁶ on the effect of radiation within an enclosure, including the effect of panel heating, indicate that for each degree elevation or depression of the mean radiant temperature above or below the air temperature requires about 0.5 deg counterchange in effective temperature of the air. Since the mean radiant temperature of the surroundings

³⁵A.S.H.V.E. RESEARCH REPORT No. 946—Cold Walls and Their Relation to Feeling of Warmth, by F. C. Houghten and Paul McDermott. (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 83.)

³⁶Loc. Cit. Note 31.