United States in which central heating of the convection type is generally used during four to eight months of the year. It does not apply to rooms heated by radiant energy, rooms with excessive glass area or rooms with poorly insulated or cold walls.

In densely occupied spaces, such as classrooms, theaters and auditoriums, somewhat lower temperatures may be necessary than those indicated by the comfort line on account of counter-radiation between the bodies of occupants in close proximity[33].

The sensation of comfort, insofar as the physical environment is concerned, is not absolute but varies considerably among certain individuals. Therefore, in applying the air conditions indicated by the comfort line, it should not be expected that all the occupants of a room will feel perfectly comfortable. When the winter comfort line is applied in accordance with the foregoing recommendations, the majority of the occupants will be perfectly comfortable, but there will always be a few who would feel *a bit too cool* and a few *a bit too warm*. These individual differences among the minority should be counteracted by suitable clothing.

Air conditions lying outside the average comfort zone but within the extreme comfort zone may be comfortable to certain persons. In other words, it is possible for half of the occupants of a room to be comfortable in air conditions outside the *average* comfort zone, but in the majority of cases, if not in all, these conditions will be well within the extreme comfort zone as determined experimentally.

For prematurely born infants, the optimum temperature varies from 100 to 75 F, depending upon the stage of development. The optimum relative humidity for these infants is placed at 65 per cent[34]. No data are yet available on the optimum air conditions for full term infants and young children up to school age. Satisfactory air conditions for these age groups are assumed to vary from 75 to 68 F with natural indoor humidities. For school children, the studies of the *New York State Commission on Ventilation* place the optimum air conditions at 66 to 68 F temperature with a moderate humidity and a moderate but not excessive amount of air movement[35].

Satisfactory comfort conditions for men at work are found to vary from 40 to 70 deg ET, depending upon the rate of work and amount of clothing worn[36]. In hot industries, 80 deg ET is considered the upper limit compatible with efficiency, and, whenever possible, this should be reduced to 70 deg ET or less.

The summer comfort zone is much more difficult to fix than the winter zone owing to the complicating factor of sweating in warm weather. A given air condition which is comfortable for persons with dry skin and clothing may prove too cold for those perspiring, as is the case, for instance, with employees and customers in a cooled store, restaurant, or theater, on a warm summer day. The conditions to be maintained in different types of public buildings depend to a large extent upon the occupant's length of stay and upon the prevailing outdoor condition.

[33]Loc. Cit. Note 31.

[34]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, p. 383).

[35]Loc. Cit. Note 12.

[36]Loc. Cit. Note 28.

In Fig. 6 is shown the summer comfort zone for exposures of 3 hours or more, after adaptation has taken place. The average zone extends from 66 to 75 deg ET, with a comfort line at 71 deg ET, as determined at the *Harvard School of Public Health*[37]. 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 basic summer comfort zone presented in Fig. 6 prescribes conditions of choice for continuous exposures, as in homes, offices, etc., without regard to costs, prevailing outdoor air conditions, and temperature contrasts upon entering or leaving the cooled space. A great number of persons seem to be content with a higher plane of indoor temperature, particularly when the matter of first cost and cost of operation of a cooling plant is given due consideration.

According to previous investigations[38], an indoor temperature of about 80 F with relative humidities below 55 per cent, or 74.5 deg ET and lower, results in satisfactory comfort conditions in the living quarters of a residence, and while this condition is not representative of optimum comfort it provides for sufficient relief in hot weather to be acceptable to the majority of users. Experience in a number of air conditioned office buildings, including the *New Metropolitan Life Building in New York*[39], indicates that a temperature of about 80 F with a relative humidity between 45 and 55 per cent (73 to 74.5 deg ET) is generally satisfactory in meeting the requirements of the employees.

Recent studies carried out under the auspices of the Society have shown that effective temperatures of 71 F in Toronto, 72 F in Pittsburgh and Minneapolis, and 73 F in Texas, were generally found most comfortable by sedentary workers during the summer months[40]. The preferred indoor optimum varied with outdoor temperature during successive summer months[41]; and interesting data were obtained as to contrast effects between indoor and outdoor situations[42].

In artificially cooled theaters, restaurants, and other public buildings

[37]Loc. Cit. Note 31.

[38]A.S.H.V.E. RESEARCH REPORT No. 1012—Study of Summer Cooling in the Research Residence for the Summer of 1934, by A. P. Kratz, S. Konzo, M. K. Fahnestock and E. L. Broderick (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 207).

[39]The Air Conditioned System of the New Metropolitan Building—First Summer's Experience, by W. J. McConnell and I. B. Kagey (A.S.H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 217).

[40]A.S.H.V.E. RESEARCH REPORT No. 1035—Comfort Standards for Summer Air Conditioning, by F. C. Houghten and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 42, 1936, p. 215). A.S.H.V.E. RESEARCH REPORT No. 1055—Cooling Requirements for Summer Comfort Air Conditioning, by F. C. Houghten, F. E. Giesecke, C. Tasker and Carl Gutberlet (A.S.H.V.E. TRANSACTIONS, Vol. 43, 1937, p. 145). A.S.H.V.E. RESEARCH REPORT No. 1088—Summer Cooling Requirements of 275 Workers in an Air Conditioned Office, by A. B. Newton, F. C. Houghten, Carl Gutberlet, and R. W. Qualley (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 337). Cooling Requirements for Summer Comfort Air Conditioning in Toronto, by C. Tasker (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 549). A.S.H.V.E. RESEARCH REPORT No. 1127—Reactions of Office Workers to Air Conditioning in South Texas, by A. J. Rummel, F. E. Giesecke, W. H. Badgett and A. T. Moses (A.S.H.V.E. TRANSACTIONS, Vol. 45, 1939, p. 459). A.S.H.V.E. RESEARCH REPORT No. 1136—Summer Cooling Requirements in Washington, D. C., and Other Metropolitan Districts, by F. C. Houghten, Carl Gutberlet and Albert A. Rosenberg (A.S.H.V.E. TRANSACTIONS, Vol. 45, 1939, p. 577). Reactions of 745 Clerks to Summer Air Conditioning, by W. J. McConnell and M. Spiegelman (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, May, 1940, p. 317).

[41]A.S.H.V.E. RESEARCH REPORT No. 1088—Summer Cooling Requirements of 275 Workers in an Air Conditioned Office, by A. B. Newton, F. C. Houghten, Carl Gutberlet and R. W. Qualley (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 337).

[42]A.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, C. Gutberlet, R. W. Qualley, and M. C. W. Tomlinson (A.S.H.V.E. TRANSACTIONS, Vol. 44, 1938, p. 571).