per cent. The sensible heat added to the air in the auditorium is 1,000 × 0.665 × 403 = 267,995 Btu per hour. The latent heat added is 1,000 × 0.335 × 403 = 135,005 Btu per hour.

Example 8. If the dry- and wet-bulb temperatures of the auditorium were 85 F and 63 F, respectively, how much heat and moisture would be dissipated to the atmosphere?

Solution. From Figs. 6 and 7, respectively, the sensible and latent heat losses per person for a dry-bulb temperature of 85 F are found to be 164 and 225 Btu per hour.

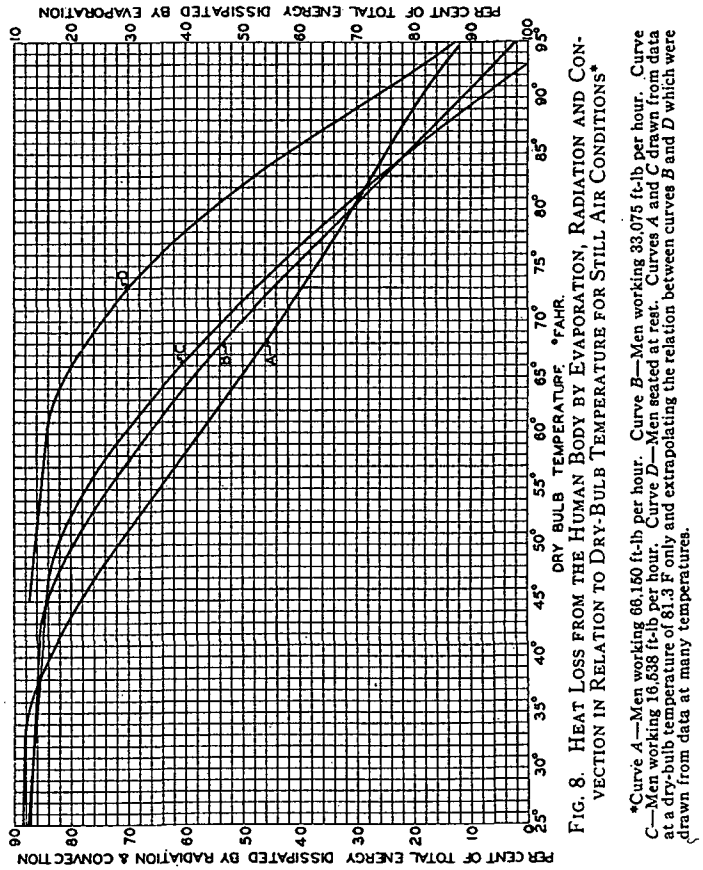

FIG. 8. HEAT LOSS FROM THE HUMAN BODY BY EVAPORATION, RADIATION AND CONVECTION IN RELATION TO DRY-BULB TEMPERATURE FOR STILL AIR CONDITIONS*

*Curve *A*—Men working 66,160 ft-lb per hour. Curve *B*—Men working 33,075 ft-lb per hour. Curve *C*—Men working 16,538 ft-lb per hour. Curve *D*—Men seated at rest. Curves *A* and *C* drawn from data at a dry-bulb temperature of 81.3 F only and extrapolating the relation between curves *B* and *D* which were drawn from data at many temperatures.

The water vapor added to the atmosphere is 1,520 grains per hour. The audience will then add 164,000 Btu sensible heat, 225,000 Btu latent heat and 1,520,000 grains or 217 lb of water vapor to the air in the auditorium per hour.

Examples 7 and 8 demonstrate that while the effective temperature, and hence, the feeling of warmth and rate of total heat loss, does not differ greatly in the two cases, the relative proportion of sensible and latent heat loss is reversed. In order to maintain the air conditions stipulated the air conditioning equipment must remove 61.6 per cent more

sensible heat in Example 7 than in Example 8; and 67.8 per cent more latent heat or water vapor in Example 8 than in Example 7. In Example 7, 66.5 per cent of the total heat loss is sensible while in Example 8 only 42.5 per cent of the total loss is sensible.

Example 9. Neglecting the gain or loss of heat to an auditorium by transmission or infiltration through the walls, windows and doors, how many cubic feet of outside air, with dry- and wet-bulb temperatures of 65 F and 59 F, respectively, (63.1 deg ET) must be supplied per hour to an auditorium containing 1000 people in order that the inside shall not exceed 75 F (dry-bulb) and 65 F (wet-bulb), respectively?

Solution. Figs. 6 and 7 give 265 Btu sensible heat and 905 grains of moisture as the additions per person with a dry-bulb temperature of 75 F in the auditorium. Therefore

TABLE 2. RELATION BETWEEN METABOLIC RATE AND ACTIVITY[a]

ACTIVITY	METABOLIC RATE BTU PER HOUR FOR AVERAGE MAN (19.5 SQ FT SURFACE AREA)	AUTHORITY
Seated at rest	384	Research Laboratory, American Society of Heating and Ventilating Engineers.
Standing at rest	431	Research Laboratory, American Society of Heating and Ventilating Engineers.
Walking 2 mph	761	Average values from (Douglas, Haldane, Henderson and Schneider) and (Henderson and Haggard).
Walking 3 mph	1049	Douglas, Haldane, Henderson and Schneider
Walking 4 mph	1388	Average values from (Douglas, Haldane, Henderson and Schneider) and (Henderson and Haggard)
Walking 5 mph	2530	Douglas, Haldane, Henderson and Schneider
Slow run	2285	Henderson and Haggard
Very severe exercise	2555	Benedict and Carpenter
Maximum exertion	3333 — 4762 +	Henderson and Haggard
Tailor	482	Becker and Hamalainen
Bookbinder	626	Becker and Hamalainen
Shoemaker	661	Becker and Hamalainen
Carpenter	762 — 963	Becker and Hamalainen
Metal Worker	862	Becker and Hamalainen
Painter (of furniture)	876	Becker and Hamalainen
Stonemason	1488	Becker and Hamalainen
Man sawing wood	1797	Becker and Hamalainen

[a]See paper entitled, *Heat and Moisture Losses from Men at Work and Application to Air Conditioning Problems*, by F. C. Houghten, W. W. Teague, W. E. Miller and W. P. Yant (*Heating, Piping and Air Conditioning*, June 1931).

265,000 Btu of sensible heat and 905,000 grains of moisture will be added to the air in the auditorium per hour.

Taking 0.24 as the specific heat of air, 2.4 Btu per pound of air will be required to raise the dry-bulb temperature from 65 to 75 F and $\frac{265{,}000}{2.4}$ = 110,400 lb of air or 110,400 × 13.4 = 1,479,000 cfh of air will be required. This is equivalent to $\frac{1{,}479{,}000}{1000 \times 60}$ = 24.7 cfm per person.

The moisture content of the inside air as taken from a psychrometric chart is 76 grains per pound of dry air and that of the outside condition is 65 grains. The increase in moisture content will therefore be 11 grains per pound of dry air. Hence $\frac{905{,}000}{11.0}$ = 82,300 lb of air at the specified condition will be required. This is equivalent to 82,300 × 13.4 = 1,103,000 cfh of air or $\frac{1{,}103{,}000}{1000 \times 60}$ = 18.4 cfm of air per person.