same temperature. The temperatures of the uniform environments are referred to as equivalent temperatures.

Data given in Fig. 3 shows that while the air temperature at the 30 in. level is the same for the three convectors and the one large-tube cast-iron radiator, in position No. 3 in the test room, the equivalent temperature is 1.5 F lower than the air temperature in the case of the three convectors, and the same as the air temperature in the case of the radiator. The difference between the minimum and the maximum amount of heat required to maintain the common air temperature at the 30 in. level is of the order of 13 per cent.

In Fig. 4 are shown the results of tests made with the same three convectors and the one large-tube cast-iron radiator, so adjusted in size that each gave approximately the same equivalent temperature in the

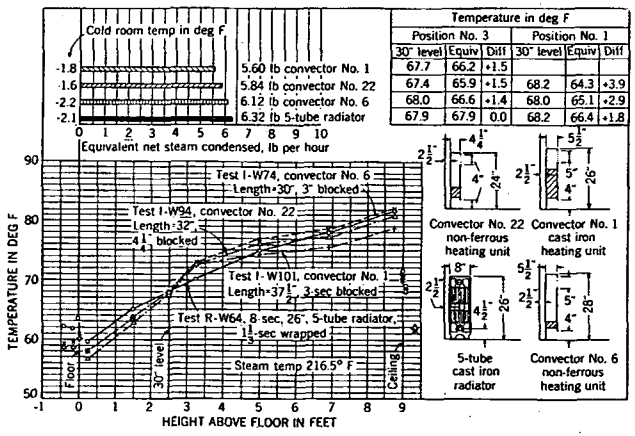

FIG. 3. ROOM TEMPERATURE GRADIENTS AND EQUIVALENT TEMPERATURES FOR A DIRECT C. I. RADIATOR AND THREE CONVECTORS WITH A COMMON 30-IN. LEVEL TEMPERATURE

No. 3 position in the test room. The difference between the miminum and the maximum amount of heat required to maintain the common equivalent temperature is of the order of 7 per cent. The following conclusions are given from the results of these tests:

1. The eupatheoscope affords a means of evaluating the combined effect of radiation and convection in a given environment in terms of a standard environment and in some terms related to human comfort.

2. Future investigation should be undertaken to correlate the readings of the eupatheoscope with a more definite standard of comfort based on a consideration of all of the physical and physiological aspects of the problem.

3. The readings of the eupatheoscope serve as a means of ranking various heating units in the order of the relative heating effects produced.

4. The steam condensation obtained when the equivalent temperature is maintained at 68 F at the 30 in. level is a measure of the effectiveness of different types of heating units in providing for human comfort; lower condensations corresponding to greater effectiveness.

5. The proximity of cold walls has an appreciable effect on the degree of comfort as determined by the eupatheoscope.

The Kata thermometer[4], the thermo-integrator[5, 6], and the globe[7] thermometer are other instruments which have been used to measure the influence of air temperature, air movement and radiation in an environment.

The following statements applying to the use of radiators are based on experience and test results:

1. The heating effect of a radiator cannot be judged solely by the amount of steam condensed within the radiator.

2. Smaller floor-to-ceiling temperature differentials can be maintained with long, low, thin, direct radiators, than is possible with high, direct radiators.

3. The larger portion of the floor-to-ceiling temperature differential in a room of average ceiling height heated with direct radiators occurs between the floor and the breathing level.

4. The comfort level (approximately 2 ft-6 in. above floor) is below the breathing line level (approximately 5 ft-0 in. above floor), and temperatures taken at the breathing

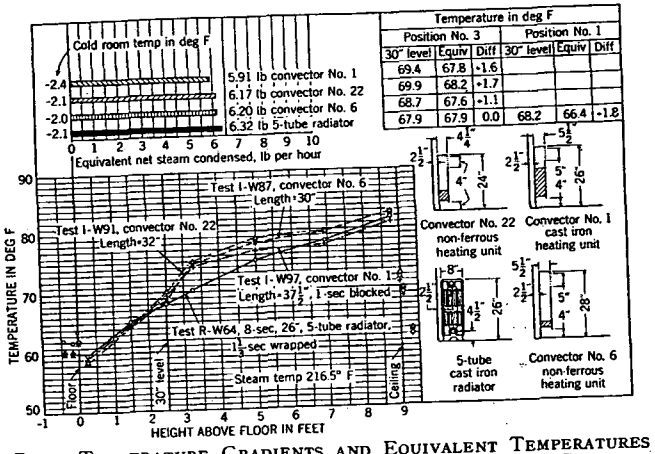

FIG. 4. ROOM TEMPERATURE GRADIENTS AND EQUIVALENT TEMPERATURES FOR A DIRECT C. I. RADIATOR AND THREE CONVECTORS WITH A COMMON EQUIVALENT TEMPERATURE

line may not be indicative of the actual heating effect of a radiator in the room. The comfort-indicating temperature should be taken below the breathing line level.

5. High column radiators placed at the sides of window openings do not produce as comfortable heating effects as long, low, direct radiators placed beneath window openings.

HEATING UP THE RADIATOR AND CONVECTOR

The maximum condensation occurs in a heating unit when the steam is first turned on[8]. Fig. 5 shows a typical curve for the condensation rate

[4]The Kata Thermometer Its Value and Defects, by W. J. McConnell and C. P. Yagloglou. (Reprint No. 953 from *U. S. Public Health Service Report*, pp. 2293-2337, September 5, 1924).

[5]The Thermo-Integrator—A New Instrument for the Observation of Thermal Interchanges, by C.-E. A. Winslow and Leonard Greenburg (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 149).

[6]The Calibration of the Thermo-Integrator, by C.-E. A. Winslow, A. P. Gagge, L. Greenburg, I. M. Moriyama and E. J. Rodee. (*The American Journal of Hygiene*, Vol. 22, No. 1, July, 1935, pp. 137-156.)

[7]The Globe Thermometer in Studies of Heating and Ventilation, by T. Bedford and C. G. Warner. (*The Journal of Hygiene*, Vol. 34, No. 4.)

[8]A.S.H.V.E. RESEARCH REPORT No. 1067—The Cooling and Heating Rates of a Room with Different Types of Steam Radiators and Convectors, by A. P. Kratz, M. K. Fahnestock and E. L. Broderick (A.S.H.V.E. TRANSACTIONS, Vol. 43, 1937, p. 389).