and cannot be used on exhaust grilles because of static pressure differences at the location of the jet and the instrument case.

While hardly a quantitative instrument, smoke is very useful in studying air streams and currents. The application of a more accurate instrument is often made more exact by a preliminary exploration with smoke. A mixture of potassium chlorate and powdered sugar in equal portions gives a very satisfactory non-irritating smoke. It is fired by a match, and since considerable heat is evolved, it should be placed in a pan away from inflammable objects.

AIR CHANGE MEASUREMENTS

Atmospheric air contains a certain amount of carbon dioxide. Its concentration is increased within enclosures by the carbon dioxide given off by occupants. The total air change through open windows, infiltration, and mechanical ventilation, may be measured by the carbon dioxide concentration[26]. Since occupants also give off moisture, the increase in humidity may also be used as an index of ventilation within a space. Neither method is used at the present time, and more direct methods of measuring air supply and air distribution are in favor.

MEASUREMENT OF RELATIVE HUMIDITY

Wet- and dry-bulb mercurial thermometers are usually used to determine relative humidity. The sling psychrometer is a common mounting of the thermometers to permit swinging. The wet-bulb wick and water for wetting it must be clean, and the temperature of the water should preferably be slightly above the wet-bulb temperature. An air stream velocity of 900 fpm is recommended, although velocities from 300 fpm to 1000 fpm have been found satisfactory for passage over the wet-bulb wick. The velocity may be obtained by whirling the thermometer or by aspirating air over the wet-bulb. In ducts, the air flow itself gives the proper evaporating conditions. Several observations should be made until the minimum temperature is reached. Relative humidity may be obtained from tables or psychrometric charts[27]. Although it is common practice to use the charts which are based on a barometric pressure of 29.92 in. Hg, a correction for barometric pressure is necessary for extreme accuracy. This correction is made by multiplying the relative humidity as determined from the chart by the ratio of the observed barometric pressure and the standard barometric pressure.

For temperatures below 32 F, the water on the wick is allowed to freeze, during which time the temperature will drop below the true wet-bulb. A thin film of ice is more desirable than a thick one, and it is satisfactory to remove the wick and freeze a thin film directly on the bulb. Care must be taken to read the temperatures accurately due to the slight wet-bulb depressions. Tables for ice conditions must be used[28].

[26] A.S.H.V.E. RESEARCH REPORT No. 959—Indices of Air Change and Air Distribution, by F. C. Houghten and J. L. Blackshaw (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 261).

[27] Psychrometric Tables for Vapor Pressure, Relative Humidity and Temperatures of the Dew-Point (*U. S. Department of Agriculture*, Weather Bureau, Washington, D. C.).

[28] A Review of Existing Psychrometric Data in Relation to Practical Engineering Problems, by W. H. Carrier and C. O. Mackey (*A.S.M.E. Transactions*, January, 1937, p. 33; Discussion, *A.S.M.E. Transactions*, August, 1937, p. 528).

The dew-point apparatus for humidity measurements consists of a polished plated container cooled by the evaporation of a volatile liquid within. The temperature at which the first slight water vapor forms is the dew-point. If the temperature is below 32 F, the deposit will appear as frost. Another method of determining humidity is by chemical means in which the water vapor is removed by a drying agent and weighed on a chemical balance. A thermal conductivity method is available for temperatures above 212 F or for extremely low humidities[29].

DUST DETERMINATION

The measurement of dust is complicated by the many kinds involved. Some of the collecting methods are impingement on viscous surfaces, impingement at high velocity under water, collection on porous crucibles through which air passes, and electric precipitation. Determination may be by direct weighing of samples or by microscopic counting. The most commonly used methods are the modified Hill dust counter using microscopic count, the Smith-Greenburg impinger which collects samples in water and which are counted under a microscope in a Sedgwick cell[30], and the Lewis sampling tube with the analytical determination of the increase in weight of a porous crucible. All reports should state the method of sampling and counting. The A.S.H.V.E. Code for Testing and Rating Air Cleaning Devices Used in General Ventilation Work specifies the porous crucible method[31].

HEAT TRANSFER THROUGH BUILDING MATERIALS

The A.S.H.V.E. Standard Test Code for Heat Transmission Through Walls[32] describes the construction and use of the guarded hot box for determining over-all heat transmission coefficients of built-up sections.

In June, 1942, the A.S.H.V.E. adopted a standard test procedure for determining the conductivity of materials by the use of a guarded hot plate[33]. The Nicholls heat meter is very useful for determining the heat flow through walls of buildings[34].

MEASUREMENT OF HEAT EXCHANGE FOR COMFORT CONDITIONS

Several instruments have been devised to measure the effect of various factors as they relate to the comfort of the body[35]. The principal ones are the Kata-thermometer, Dufton's eupatheoscope, Vernon's globe thermometer, Winslow and Greenburg's thermo-integrator, and Yaglou's

[29] Gas Analysis by Measurement of Thermal Conductivity, by H. A. Daynes (*Cambridge Press*, 1933).

[30] Public Health Bulletin, No. 144, 1925, (*U. S. Public Health Service*).

[31] Testing and Rating of Air Cleaning Devices Used for General Ventilation Work, by S. R. Lewis (A.S.H.V.E. TRANSACTIONS, Vol. 39, 1933, p. 277).

[32] A.S.H.V.E. Standard Test Code for Heat Transmission Through Walls (A.S.H.V.E. TRANSACTIONS, Vol. 34, 1928, p. 253).

[33] Standard Method of Test for Thermal Conductivity of Materials by Means of the Guarded Hot Plate (Tentative). Reprints of this code are available at $ .10 a copy.

[34] A.S.H.V.E. RESEARCH REPORT No. 685—Measuring Heat Transmission in Building Structures and a Heat Transmission Meter, by P. Nicholls (A.S.H.V.E. TRANSACTIONS, Vol. 30, 1924, p. 65).

[35] Measurement of the Physical Properties of the Thermal Environment, by D. W. Nelson, F. R. Bichowsky, L. M. K. Boelter, R. S. Dill, A. P. Gagge, John A. Goff, A. E. Hershey, F. C. McIntosh, F. W. Reichelderfer, G. L. Tuve and C. P. Yaglou (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, June, 1942, p. 382).