The usual procedure, in determining the moisture content of a representative sample of the material, is to weigh this sample before it has had a chance to lose weight by evaporation, then dry it to a water-free basis in an oven heated to a temperature slightly above the boiling point (about 215 deg. fahr.) until it has reached constant weight, then take a second weight record, and subtract the second weight from the first to determine the weight of the water. This figure can then be multiplied by 100 and divided by either the first weight or the second weight to obtain the percentage based on the original or final weight of the sample. Ovens used for this purpose are usually heated by steam or electricity and thermostatically controlled to prevent overheating.

Time of Drying

In Table 1, the average temperature range and drying time for a number of representative materials are given. The figures do not represent the maximum speeds attainable nor necessarily the optimum temperature conditions but are fairly typical of general commercial practice. In materials in which no capillary movement of free water can take place,

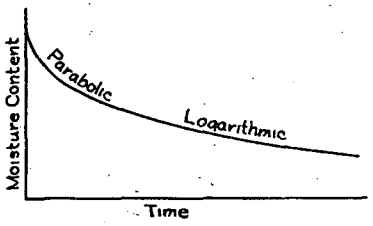

FIG. 3. TYPICAL TIME-MOISTURE CURVE FOR MATERIALS IN WHICH NO CAPILLARY FLOW OF FREE MOISTURE OCCURS

the speed is limited by the rate of transfusion through the material which is again determined by the critical temperatures and maximum gradients which can be used without injuring the material. In this case, theoretical analysis according to Lewis shows that in the early stages the time of drying is proportional to the square of the thickness and to the square of the total moisture lost, and the time-moisture curve is a parabola. In the later stages, after all free water has been evaporated, the curve becomes logarithmic. The form of this drying curve will, in general, resemble that shown in Fig. 3. On the other hand, in drying materials in which free water can flow by capillary action at a sufficient rate to keep pace with surface evaporation, the time is proportional to the first power of the thickness and the rate will be governed by the drying conditions of the air and the area of surface exposed.

DRYER DESIGN

Methods of Calculations

A psychrometric chart applying to atmospheric pressure and plotted in units convenient for use in dryer calculations, is given in Fig. 4. The amount of moisture in the air, H, is given in pounds of water per pound of dry air. With this choice of units, changes in H represent directly the

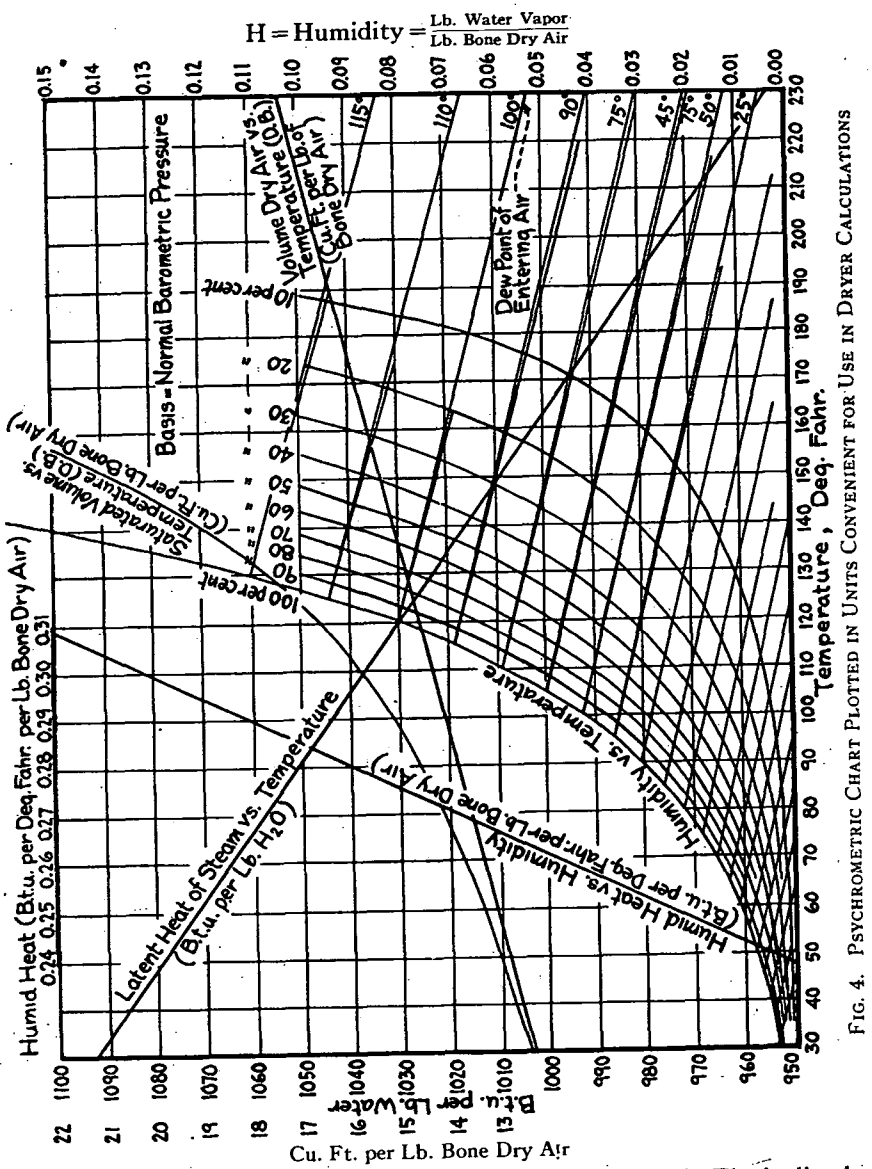

FIG. 4. PSYCHROMETRIC CHART PLOTTED IN UNITS CONVENIENT FOR USE IN DRYER CALCULATIONS

moisture picked up by the air from the material being dried. The inclined straight lines are adiabatic cooling lines for air in contact with water at its wet-bulb temperature, and also represent the cooling of air in the adiabatic drying of any stock, the sensible heat of which is negligible in comparison with the heat of vaporization of the water in it.