drying. Low temperature dryers are heated either by steam or hot water directly or indirectly and the temperatures are below the boiling point. In high temperature dryers the range is above the boiling point and the heat is maintained directly or indirectly by electricity or heated oil, direct introduction of flue gases, by high pressure steam or special air heaters. Dryers are usually termed intermittent or continuous, depending on whether they are charged for the complete drying period of whether the material to be dried is continuously admitted and removed. As compartment dryers consist of an enclosure to direct the air movement and control the heat, the current of heated air flowing through the drying cabinet is under accurate and uniform control of temperature and humidity. The selection of the compartment or continuous type of dryer depends upon the most practical method of handling the material rather than upon the drying process. The use of the continuous dryer is customary whenever the drying period is less than 6 hours or where the continuous drying process is required for 24 hours at a time. The efficient operation of the continuous dryer requires that it function at full capacity. The continuous dryer will be found in a variety of forms those principally used being the tunnel, drum, rotary and spray types. In a tunnel dryer the product being kept in trays or loaded on cars moves along by gravity or by means of an endless belt conveyor and the air usually moves in the opposite direction from the material in order to get the maximum drying efficiency. Drum dryers are used for liquids or solids such as paper, cloth and materials that will pass over the drum in a continuous sheet.

A rotary type of dryer consists of revolving drums through which material and air intermingle, the drum being inclined to facilitate the movement of the material and is generally used where the product to be dried is in a moist or semi-moist condition. Spray drying consists of sending a fine solution of the material into a current of warm air and is limited to products which can be handled in liquid form.

The relative advantages of the different types of dryers are dependent on the nature of the material, the space available and the capacity of the apparatus.

The variety of the products to be dried include many of animal or vegetable origin and many possess exceptional hydroscopic or absorptive properties. When they are of colloidal nature, successful processing is more difficult. Frequently it is necessary to expose the material to a series of different conditions beginning with a minimum temperature and maximum humidity, the temperature being increased and the relative humidity decreased as the work progresses. Where material contains both free and hydroscopic moisture, humidity conditions must be carefully adjusted so that during the period when the free moisture is being removed case hardening or surface drying does not occur. The air circulation is another important factor and the velocity which is used should be high enough to constantly remove the heavy film of saturated air which surrounds the material as soon as it begins to dry.

The temperature in which a product is to be dried should be as high as can be used without injury to the material. The accompanying tabulation will give the conditions that are usually found satisfactory.

Material	Temp. Deg. F.	Time
Apples	140–180	6 hours
Cocoanut	175–200	4–6 hours
Sugar	150–200	20–30 minutes
Coffee	160–180	24 hours
Mixed Stock Feed	220	20–30 minutes
Starch	180–200	12 hours
Glue	70–90	2–4 days
Thin Leather Hides	90	2–3 days
Thick Sole Leather	90	4–6 days
Shade Cloth	240	1–2 minutes
Rubber	80–90	1–2 weeks
Soap	100	2 days
Wall Board	200–250	12–24 hours
Gypsum Board	180–280	24–48 hours

In any system where there are no critical temperatures the permissible maximum working temperature is that above which the actual gain in speed or output due to the increase temperature is less in proportion than the increase speed of operation due to the increased temperature. In the case of some fruits and vegetables a relatively low temperature and high velocity is better than too high temperature, but, a too low temperature and too long drying period result in a tough product.

The evolution of the compartment and tunnel dryer design is very interesting and inumerable means have been used to secure the proper heating effect, air distribution and moisture removal. In dryer design it should be noted that there are three important objectives to be attained: to secure an adequate supply of air so distributed that it circulates evenly over the radiators and trays; to secure a rapid air movement so that moisture is absorbed from the material to be dried, and to effectively remove the moisture from the saturated air. The quantity of air that should be supplied by the fan and the number of air changes in the drying compartment will vary with the type of installation and is affected by the rate at which moisture is given up by the material to be dried.

The theoretical amount of moisture which the air will remove is directly proportional to the difference between the wet-bulb and dry-bulb temperature of the entering air, while the actual amount absorbed by a given quantity of air is measured by the drop in dry-bulb temperature between the air entering and leaving the dryer, less a slight correction for radiation. For the same reason the higher the temperature of the entering air (for a given initial moisture content) the greater will be the amount of moisture removed per given quantity of air and the greater the economy of the dryer.

The temperature of the air will drop approximately 8½ deg. for each grain of moisture absorbed per cu. ft. of air measured at 70 deg., or 0.64 of a deg. for each grain of moisture absorbed per pound of air. Approximate calculations may be based on air volume, but for eaxct determinations the weight of air handled should be used, on account of it being a fixed quantity at all temperatures. Knowing the rate of drying desired and the amount of moisture to be removed, it is a simple matter to determine the quantity of air required.

It is generally found that about 2 lb. of steam are required to evaporate