PHYSICS APPLIED
Weather

Air is saturated with water vapor when the partial pressure of water in the air is equal to the saturated vapor pressure at that temperature. If the partial pressure of water exceeds the saturated vapor pressure, the air is said to be **supersaturated**. This situation can occur when a temperature decrease occurs. For example, suppose the temperature is 30°C and the partial pressure of water is 21 torr, which represents a humidity of 66% as we saw in Example 13–18. Suppose now that the temperature falls to, say, 20°C, as might happen at nightfall. From Table 13–3 we see that the saturated vapor pressure of water at 20°C is 17.5 torr. Hence the relative humidity would be greater than 100%, and the supersaturated air cannot hold this much water. The excess water may condense and appear as dew, or as fog or rain (Fig. 13–24).

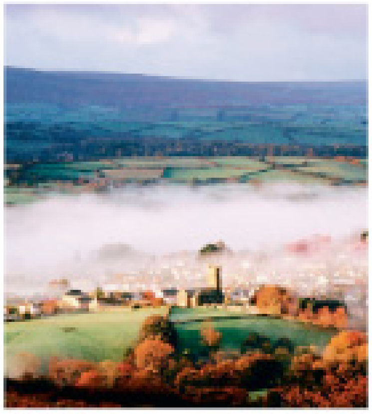

FIGURE 13–24 Fog or mist settling over a low-lying village where the temperature has dropped below the dew point.

When air containing a given amount of water is cooled, a temperature is reached where the partial pressure of water equals the saturated vapor pressure. This is called the **dew point**. Measurement of the dew point is the most accurate means of determining the relative humidity. One method uses a polished metal surface in contact with air, which is gradually cooled down. The temperature at which moisture begins to appear on the surface is the dew point, and the partial pressure of water can then be obtained from saturated vapor pressure tables. If, for example, on a given day the temperature is 20°C and the dew point is 5°C, then the partial pressure of water (Table 13–3) in the 20°C air was 6.54 torr, whereas its saturated vapor pressure was 17.5 torr; hence the relative humidity was $6.54/17.5 = 37\%$.

* 13–14 Diffusion

If you carefully place a few drops of food coloring in a container of water as in Fig. 13–25, you will find that the color spreads throughout the water. The process may take several hours (assuming you don't shake the glass), but eventually the color will become uniform. This mixing, known as **diffusion**, is further evidence for the random movement of molecules. Diffusion occurs in gases too. Common examples include perfume or smoke diffusing in air, including the odor of something cooking, although convection (moving air currents) often plays a greater role in spreading odors than does diffusion. Diffusion depends on *concentration*, by which we mean the number of molecules or moles per unit volume. In general, *the diffusing substance moves from a region where its concentration is high to one where its concentration is low.*

Diffusion occurs from high to low concentration

Diffusion can be readily understood on the basis of kinetic theory and the random motion of molecules. Consider a tube of cross-sectional area A containing molecules in a higher concentration on the left than on the right,

FIGURE 13–25 A few drops of food coloring spreads slowly throughout the water, eventually becoming uniform.

(a) (b) (c)