From there on, it decreases smoothly into the vapor region. The region to the ~~right~~ left of the saturated liquid is called *subcooled* liquid to indicate that its temperature is below the boiling point that corresponds to its pressure. For example, at A the temperature is T_1, lower than the saturation temperature (T_2) that corresponds to pressure P_A. Alternatively, it is called *compressed* liquid to indicate that pressure is higher than the saturation pressure that corresponds to its temperature (the terms subcooled and compressed liquid are used interchangeably). Vapor to the right of the saturated line is *superheated* because its temperature is higher than the boiling temperature that corresponds to its pressure. At B, for example, temperature (T_4) is higher than the saturation temperature (T_1) that corresponds to its pressure (P_B).

The organization of information on the PV graph can be better understood by conducting a heating or cooling process and following the path on the graph. Suppose we add heat under constant pressure starting with liquid at state A, which is at pressure P_A and temperature $T_A = T_1$. The process is depicted by the line AB, drawn at constant pressure P_A. Between states A and L, heating causes the volume to increase somewhat but the increase is relatively small because the thermal expansion of liquids is small. At point L the liquid is saturated and at the verge of boiling. Adding heat at this point causes liquid to evaporate and produce more vapor, moving the state along the line LV. During this process both pressure and temperature remain constant (line LV is both an isotherm and an isobar). At point V all the liquid has evaporated and the system is saturated vapor. Adding more heat causes temperature and molar volume to increase and moves the state along the line VB. If we start at state B and perform a constant-pressure cooling process, we will observe the reverse course of events. During BV, the vapor is cool. At point V, the state is saturated vapor at the verge of condensation. Removing heat at this point causes vapor to condense until the steam becomes 100% saturated liquid (state L). Upon further cooling, the system moves further into the subcooled region.

NOTE

Boiling in Open Air

If the heating/cooling process that is described here is conducted in an open container, for example, by heating water in an open flask at atmospheric pressure, the behavior will be somewhat different than the one described here. In an open container, water forms vapor at any temperature below boiling, not just at the boiling point. The important difference is that in an open container we are dealing with a *multicomponent* system that contains not only water, but also *air*. A vapor-liquid mixture with two or more components behaves differently from the pure components. Multicomponent phase equilibrium is treated in the second part of this book and until then, it should be understood that we are dealing with pure fluids. The process described by the path *AB* may be thought to take place inside a sealed cylinder fitted with a piston and initially filled with liquid containing no air at all.