Heating the air inside a "hot-air" balloon raises the air's temperature, causing it to expand and forcing air out the opening at the bottom. The reduced amount of gas inside means its density is lower, so there is a net buoyant force upward on the balloon. In this Chapter we study temperature and its effects on matter: thermal expansion and the gas laws. Most important is the ideal gas law and its expression in terms of molecules.

CHAPTER 13

Temperature and Kinetic Theory

This Chapter is the first of three (Chapters 13, 14, and 15) that are devoted to the subjects of temperature, heat, and thermodynamics. Much of this Chapter will be devoted to an investigation of the theory that matter is made up of atoms and that these atoms are in continuous random motion. This theory is called the *kinetic theory*. ("Kinetic," you may recall, is Greek for "moving.")

We also discuss the concept of temperature and how it is measured, as well as the experimentally measured properties of gases which serve as a foundation for the kinetic theory.

13–1 Atomic Theory of Matter

The idea that matter is made up of atoms dates back to the ancient Greeks. According to the Greek philosopher Democritus, if a pure substance—say, a piece of iron—were cut into smaller and smaller bits, eventually a smallest piece of that substance would be obtained which could not be divided further. This smallest piece was called an **atom**, which in Greek means "indivisible."[†]

Atomic theory—the evidence

Today the atomic theory is generally accepted. The experimental evidence in its favor, however, came mainly in the eighteenth, nineteenth, and twentieth centuries, and much of it was obtained from the analysis of chemical reactions.

[†]Today we don't consider the atom as indivisible, but rather as consisting of a nucleus (containing protons and neutrons) and electrons.