Indeed, it seemed that the natural world, as seen through the eyes of physicists, was very well explained. A few puzzles remained, but it was felt that these would soon be explained using already known principles.

It did not turn out so simply. Instead, these puzzles were to be solved only by the introduction, in the early part of the twentieth century, of two revolutionary new theories that changed our whole conception of nature: the *theory of relativity* and *quantum theory*.

Physics as it was known at the end of the nineteenth century (what we've covered up to now in this book) is referred to as **classical physics**. The new physics that grew out of the great revolution at the turn of the twentieth century is now called **modern physics**. In this Chapter, we present the special theory of relativity, which was first proposed by Albert Einstein (1879–1955; Fig. 26–1) in 1905. In Chapter 27, we introduce the equally momentous quantum theory.

Classical vs. modern physics

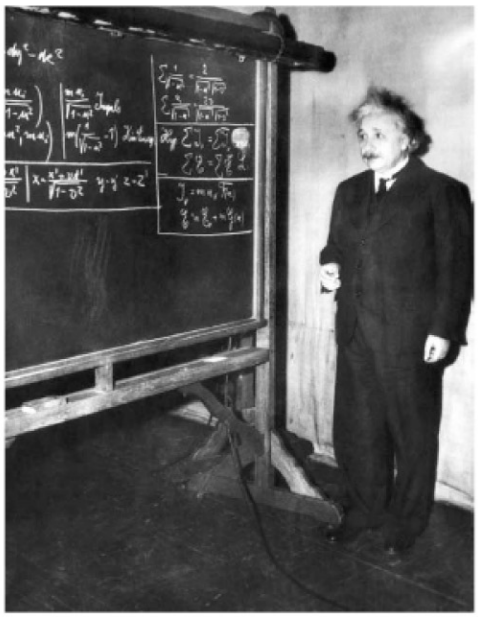

FIGURE 26–1 Albert Einstein (1879–1955), one of the great minds of the twentieth century, was the creator of the special and general theories of relativity.

26–1 Galilean–Newtonian Relativity

Einstein's special theory of relativity deals with how we observe events, particularly how objects and events are observed from different frames of reference.[†] This subject had, of course, already been explored by Galileo and Newton.

The special theory of relativity deals with events that are observed and measured from so-called **inertial reference frames** which (as discussed in Chapter 4) are reference frames in which Newton's first law is valid: if an object experiences no net force, the object either remains at rest or continues in motion with constant speed in a straight line. It is easiest to analyze events when they are observed and measured from inertial frames. The Earth, though not quite an inertial frame (it rotates), is close enough that for most purposes we can consider it an inertial frame. Rotating or otherwise accelerating frames of reference are noninertial frames[‡], and won't concern us in this Chapter (they are dealt with in Einstein's general theory of relativity—Section 33–4).

Inertial reference frame

[†] A reference frame is a set of coordinate axes fixed to some body such as the Earth, a train, or the Moon. See Section 2–1.

[‡] On a rotating platform (say a merry-go-round), for example, an object at rest starts moving outward even though no body exerts a force on it. This is therefore not an inertial frame. See Appendix C, Fig. C–1.