



FIGURE A1.2.

A rapidly receding light source will cause emission lines of an element to shift from their normal positions to new positions (dashed) that are always toward the red end of the spectrum.

Lawrence Livermore Laboratory in California and at the University of Chicago indicate an age of 18 billion years for the origin of the elements.<sup>1</sup> These studies thus indicate a minimum age for the Universe of 18 billion years.

It should be noted that we are speaking of the "visible universe." Preston Cloud points out that the "visible universe" is "that region of space where everything is flying outward at less than the speed of light and thus can, in theory, be observed. Whether anything lies beyond such limits can neither be affirmed nor denied."<sup>2</sup>

The farthest galaxies observable through our present telescopes are around 6 billion light years away from us. At least we assume this to be the case. It should be remembered that what we are really looking at is not the galaxies themselves but rather the light generated by these galaxies 6 billion years ago. At the present time, we don't even know if these galaxies exist. For that matter, an observer on a galaxy 6 billion light years away, could not see us because our own star, the Sun, did not come into existence until about 5 billion years ago. Six billion years would be required for the light from our Sun to reach a galaxy that was 6 billion light years away.

## RADIOACTIVE DATING

Before the advent of radioactive dating methods, geologists used to try to estimate the age of the Earth by attempting to calculate the time required for the enormous quantity of sedimentary rocks to be deposited by water and wind. Today scientists have a more precise timepiece known as the "radioactive clock." It allows the geologist to pinpoint with a fair degree of accuracy the age of rock formations in which certain radioactive elements exist.

In order to understand how the radioactive clock, or "atomic clock," keeps time, we need to know something about the structure