

## CHAPTER 7

# AN ANCIENT AND DYNAMIC UNIVERSE

## WATER ON MARS?

**S**everal spacecraft have orbited Mars and taken photographs of the surface; the photos show channels and gullies. What could have caused them? Similar channels on earth are usually made by flowing water. Yet there is no liquid water on the surface of Mars right now. The photographs from orbiting spacecraft do not show lakes or rivers, and the atmosphere is so cold and thin that water would immediately freeze or evaporate. So did Mars ever have liquid water? Photographs suggest that it did, but photographs can only tell so much.

Geologists wish they could touch the Martian rocks and analyze them with their laboratory instruments the same way they do rocks on Earth. In January 2004 two rovers landed on Mars to do the same analysis robotically. The rovers, Spirit and Opportunity, rolled across the surface, stopping at rocks that geologists back on Earth wanted to study. The robots could dig holes, scrape rocks, take up-close photographs, and put pieces of rocks into spectrum analyzers. Their experiments showed that Mars used to have liquid water. Many of the rocks showed evidence of having formed in a soaking wet environment. For example, some rock crevices contained crystals that could only form under water. Many rocks showed high amounts of sulfide salts; on Earth this happens only to rocks that formed in water or were exposed to water for a long time after they formed. In other words, these rocks used to sit in salty lakes or acidic hot springs. Mars used to have liquid water on its surface.

What does this have to do with age of the universe? It is evidence that Mars was much different in the past than it is today. The atmosphere used to be much thicker and warmer, similar to Earth's, but now it is cold and thin. This dramatic change in planet-wide climate took a long time—millions or billions of years. The rocks are testifying that the planet Mars must be at least that old.