Microscopy provided some of the earliest insights into the spatial relationships between soil microorganisms and the physical components of their environment (Starkey, 1938). Soil biologists have a long history of using microscopy for identifying and quantifying soil fauna, and studying the autecology of both free-living and symbiotic bacteria and fungi. When the concept was developed that soil microorganisms could be significant sources and sinks for nutrients, researchers used microscopy, along with other methods, to measure the magnitude of the biomass. Concurrent with the interest in measuring soil biomass, microscopy has been used to address the long-standing problems of how to quantify fungal biomass, how to distinguish between dead and viable microbial cells, and how to differentiate between physiologically active and dormant cells.

Despite the inherent limitations to microscopic methods, they continue to play a vital role in the detection and enumeration of specific organisms, and serve as a tool to validate the findings generated with other methods. Unfortunately, soil remains one of the most difficult of natural environments upon which to practice microscopy and the literature describes many “variations-on-a-theme.”

In this chapter, I do not plan to discuss the use of electron microscopic techniques for studying soil microorganisms in situ. I draw the reader’s attention to the work of R.C. Foster, CSIRO Division of Soils, Adelaide, South Australia, Australia. This work has been summarized as an excellent collection of electron micrographs (Foster et al., 1983).

**6–1 SAMPLING OF SOIL FOR MICROSCOPIC OBSERVATION**

Although many of the general issues about soil sampling have been covered elsewhere (see chapter 1 by Wollum and chapter 2 by Parkin and Robinson in this book), three important details are worth emphasizing.