Investigating rocks

The first systematic book on mineralogy was written by Agricola (p. 8), in the 16th century. Written in Latin, it was called De Natura Fossilium. The word "fossil" then meant "things dug up," and included chiefly minerals and rocks. Agricola based his writings on his own observations, rather than using the speculative or hopeful reasoning that had characterized the writings of the ancient Greeks, and, later, the alchemists. In the 18th century the Age of Enlightenment encouraged many thinkers to contemplate the origin of the Earth and of rocks. A controversy raged between the Neptunists, led by Abraham Werner, and the Plutonists, who believed the origin of some rocks was undoubtedly volcanic, led by James Hutton (p. 8). Europe's scientists were divided into two camps. Towards the end of the 18th century travel became easier, allowing scientists to observe directly many different types of rocks in different places. In 1830 Charles Lyell (p. 62) published his influential work, Principles of Geology. This book influenced other geologists who responded to Lyell's theories about the slow, gradual nature of the Earth's processes.

Geologists in the field

Geologists fall into many categories such as paleontologists, petrologists, and geochemists, but they all study the Earth, and the place to start is in the rocks. In the field, geologists record their observations in notebooks, take photographs, and collect specimens. The specimens are labeled and wrapped for transport back to the laboratory.

TOOLS OF THE TRADE
A geologist uses a hammer to break off rock samples fresh from the solid bedrock. This ensures that the samples collected have truly come from the solid rocks of the place being mapped. The small hammer is used for trimming rock samples. A chisel helps in splitting rocks. The hand lens is used to look in detail at the texture of rock, and to see if any fossils are present.

MINERALS IN ROCKS
A coarse-grained granite shows the mineral grains that make it up. Even with the naked eye, the fieldlenses can be spotted easily. Fieldlenses usually have sharp crystal outlines because they crystallized first in the cooling magma (p. 25). Filling the spaces in between, because a crystalized later, is grayish glassy quartz. Mica is a flaky mineral which shows up as bright flakes due to its high reflectivity.

CONTACT GONIOMETER
The orderly arrangement of atoms inside crystals is unique to each mineral. The internal pattern shows in specific angles between the faces on the outside of the crystal. These angles can be measured with a contact goniometer. Most crystals are far too small for use with such a cumbersome measuring instrument, so some other method such as X-rays is needed to tell crystals apart. Crystal faces also have markings on them which are distinctive. These might be fine lines or striations, or triangle-shaped markings.

X-RAYING CRYSTALS
To see finer details, radiation with a wavelength shorter than light is needed. This may involve using X-rays where the ray has a wavelength similar to the spacings between the layers of atoms making up a crystal. The spacings diffract the X-ray beam to many different angles. In certain directions the scattered beams are in phase, where they reinforce each other and so make a black point on photographic film. The result is a unique diffraction pattern for each mineral relating to its internal spacings.

SMITH'S MAP (1819)
The first geological maps were published at the beginning of the 19th century. Geological maps show relief features such as mountains or roads, as well as the different rocks that appear at the surface, and use different colors to show their different ages. William Smith (p. 22) published the first geological map of Britain in 1815.

THIN SECTION
Before this sample of granite rock can be looked at through the petrological microscope, it must be cut into a very thin slice. First, the rock is crushed extremely thinly, using diamond wheels. This rock slice is glued onto a strip of glass and then ground further on a rotating plate. When it is uniformly thin and transparent, a glass cover is put over the top and the slice is labelled.

PETROLOGIST'S MICROSCOPE
This microscope uses polarized light to study rocks. One polarizer is below the rock slice, the second is above. The way crystals alter the light is unique to each mineral type, so optical properties can be used as a means of identification.

Using polarizers: When thin sections of rock using polarized light to see the colors, textures, and interrelationships of minerals. From this information, they can identify the rock. Adding a second, crossed, polarizer shows interference colors which help further with the identification.