is antiparallel to that of the magnetic moment **M**. At points other than the magnetic equator and poles, **F** is neither parallel nor antiparallel to **M**.

Today, as in the past, the magnetic dipole axis is aligned approximately but not exactly with the earth's rotation axis, the angle between the two axes being 11.5°. The distance between the north magnetic pole and the geographic north pole is therefore also 11.5°. The magnetic pole wobbles around the geographic pole in an irregular manner with variable time constants ranging from centuries to about 10,000 years, producing what is called the **secular variation** of the field.

How Rocks Get Magnetized

Geophysicists who measure the paleomagnetism of rocks are called **paleomagnetists**, the deplorable synonym *paleomagician* no longer being used. Paleomagnetists prowl the earth, looking for rocks bearing decipherable magnetic imprints. Fortunately many such rocks are to be found on all of the plates. For example, the lava flows which compose the ocean floor acquired magnetic imprints of the fields that existed when they cooled. On land a typical volcano continues to erupt lava flows for hundreds of thousands of years. An ancient volcano is the geologic analog of a gigantic floppy disk containing dozens of spot readings of the ancient magnetic field.

Some rocks have good magnetic memories, others don't. Those that do have the ability to record a magnetic image in much the same way that photographic film records a light image. At the time of their formation, these rocks are magnetically sensitized so that they are able to acquire an accurate imprint of the magnetic field, even if the field is weak. Shortly afterwards, this imprint becomes locked into the mineral grains of the rock, much as a photographic image is fixed in film during the process of being developed. Once the magnetic image has been fixed, the ideal rock recorder becomes desensitized to magnetic imprinting. It seems incredible that such a complicated and convenient process should occur in nature without benefit of electronic instrumentation. Yet magnetic imprinting of rocks is going on around us all the time. Let's see how it works.