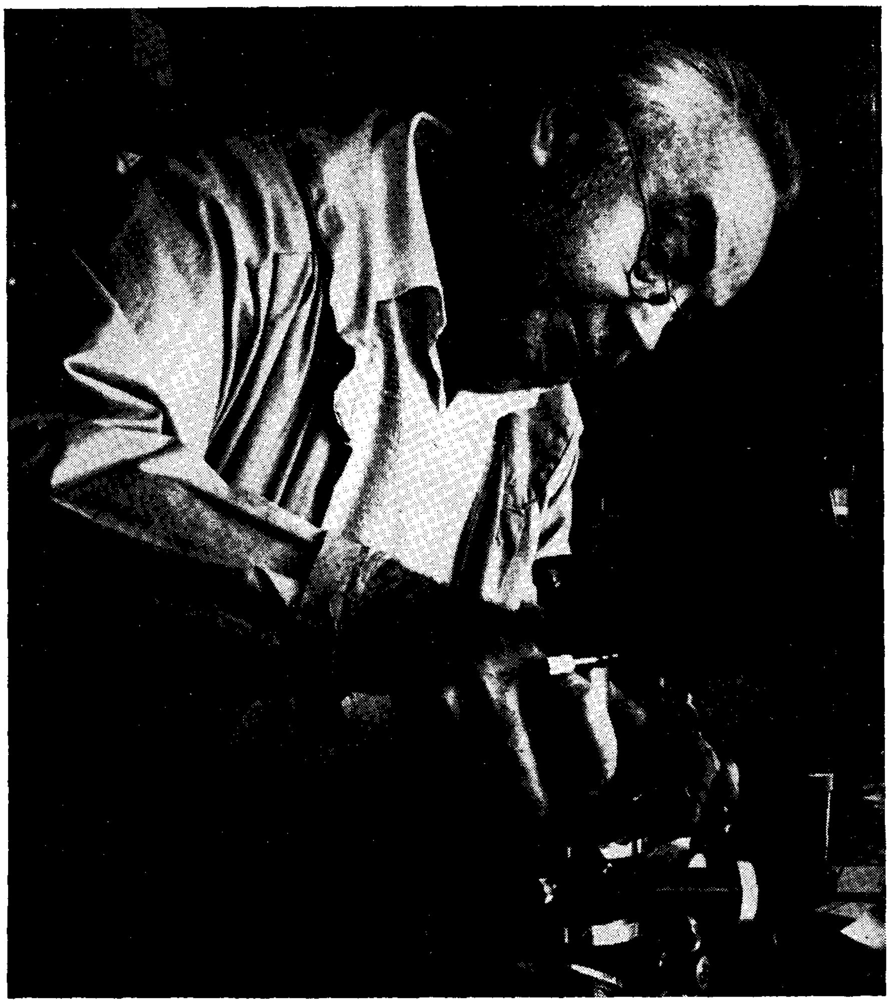
FRAGMENTS OF BEAUTY FROM THE MINIATURE WORLD OF MICROCRYSTALS

BY J. A. MANDARINO



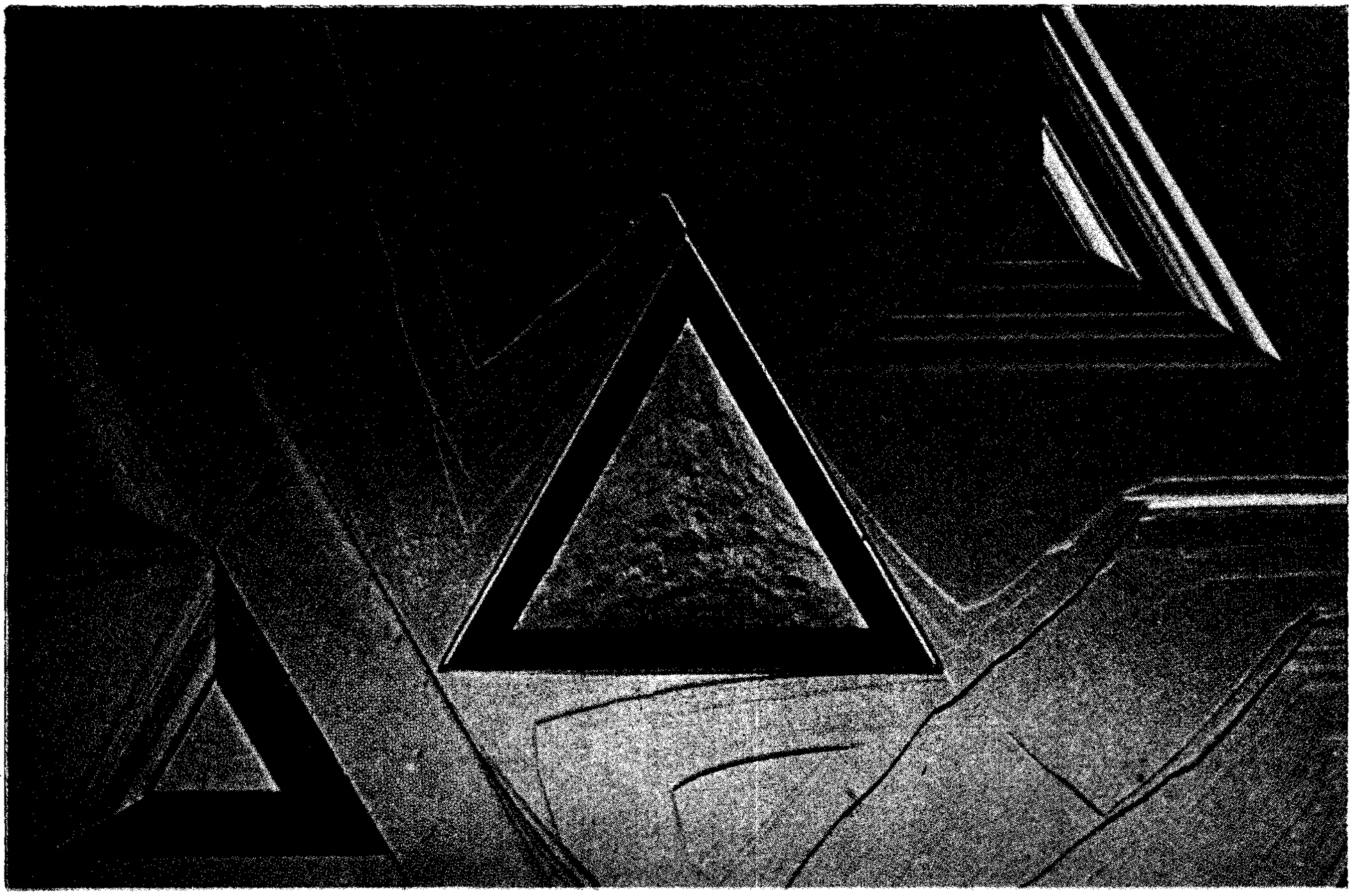
Julius Weber at work in his home laboratory in Mamaroneck, New York

The microcrystals that emblazon the following pages were captured on color film by the celebrated photomicrographer Julius Weber. They are remarkable not only for their great beauty but for their minute size: Most of the minerals pictured here are no larger than the period at the end of this sentence. You will not see minerals like these even in the finest museums. Museums, by necessity, must display only large, easily viewable specimens since they are not able to provide the public with the microscopes required to view microcrystals.

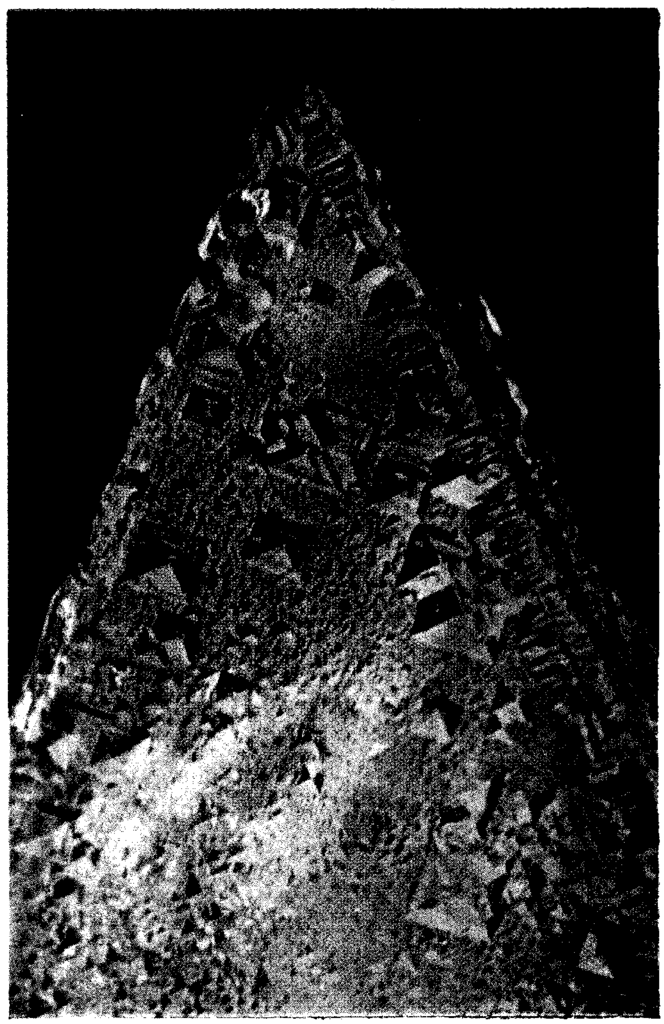
Julius Weber began his love affair with minerals fifty years ago when he attended Saturday morning classes at the Brooklyn Children's Museum. There he studied under a truly gifted teacher, Jack Boyle, who opened his eyes to the wonders of the natural world. The properties Julie learned to look for in minerals as a youngster were the same ones I was taught, on a more elaborate level, in my first college mineralogy course. We studied the minerals, with the naked eye and under the microscope, for such properties as cleavage, symmetry, color, and luster. The most important aspect of our studies, however, was crystallography.

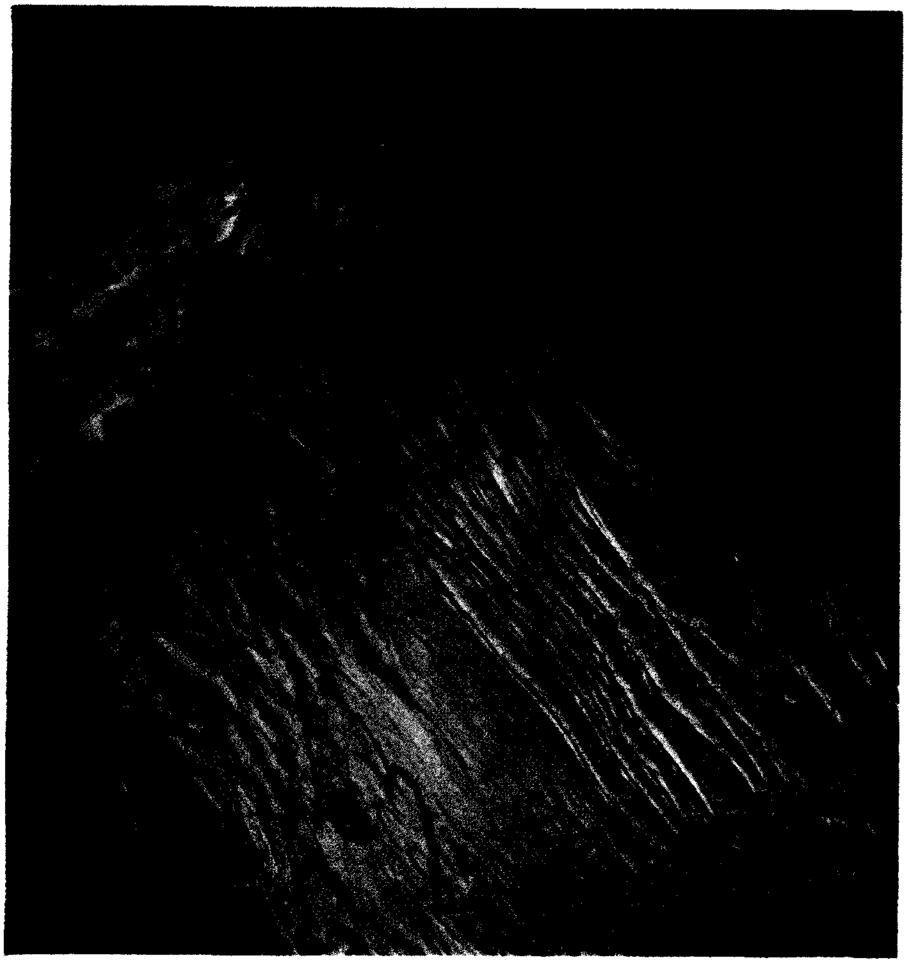
The crystal face of a mineral reflects its internal arrangement of atoms, much as a human face reflects the shape of the bones beneath it. A mineral the size of a pinhead might contain some eighty trillion atoms, arranged in a precise, three-dimensional latticework. (Almost all minerals display an orderly internal structure.) The kinds and arrangements of the atoms are responsible for all the physical characteristics of the mineral, such as luster and hardness. For example, one three-dimensional arrangement of carbon atoms forms graphite, which is used in the manufacture of lead pencils and in certain lubricants. Graphite is a black, opaque mineral that is soft and greasy and that splits easily into thin sheets. Another arrangement of carbon atoms, however, forms a totally different mineral, a transparent, colorless, high-luster stone that is extremely hard and that breaks or cleaves along four planes: the diamond. How could two such dissimilar minerals, the lowly graphite and the gem diamond, materialize from the same kind of atom? It is rather like the way the notes of a musical scale can be arranged into a rock tune or a Bach fugue.

Athough Julie Weber has cherished minerals since his days at the Brooklyn Children's Museum, for twenty-five years he worked primarily in the medical sciences. The techniques he helped develop in photomicrography have been responsible for any number of advances in medicine. About fifteen years ago, Julie came upon the rela-

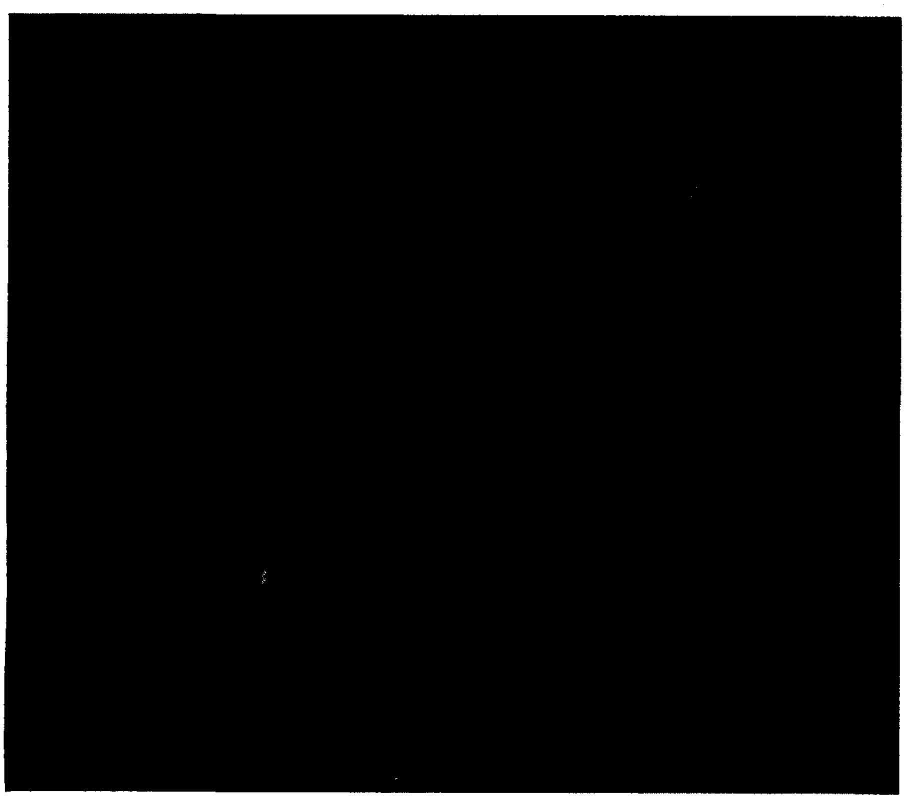


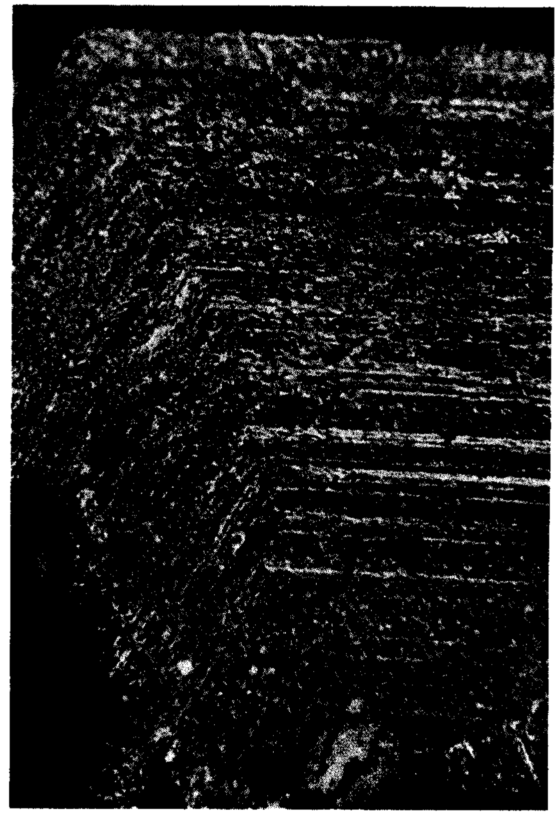
The triangles above are growth trigons on a natural diamond, magnified 125 times. The crystal was photographed through a Francon-Yamamoto interference microscope; the varying colors represent changes in height and depth, distinctions made possible by the optics of the system. The same system was used for sperrylite (below), a platinum ore. The fluorite pyramid at right was shot under a Wilde microscope.

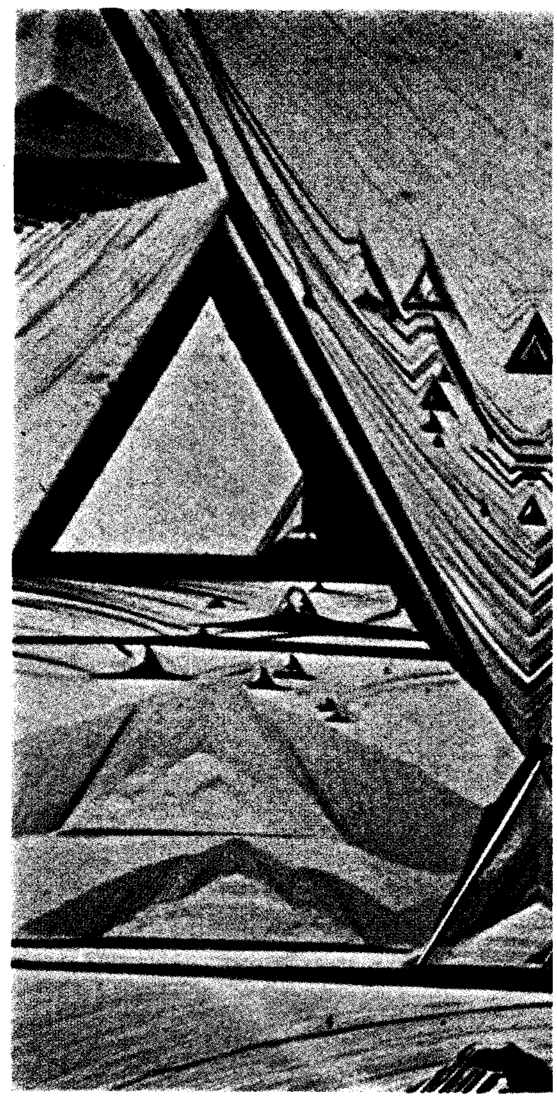




The quartz crystal above, magnified fifty times, displays the pattern of stress in the mineral's structure. It was photographed with a Francon-Yamamoto interference microscope. Autunite (below) is one of the uranium ores that is fluorescent. It was photographed under a Wilde microscope and illuminated by a quartz ultraviolet source. This specimen is also magnified approximately fifty times.

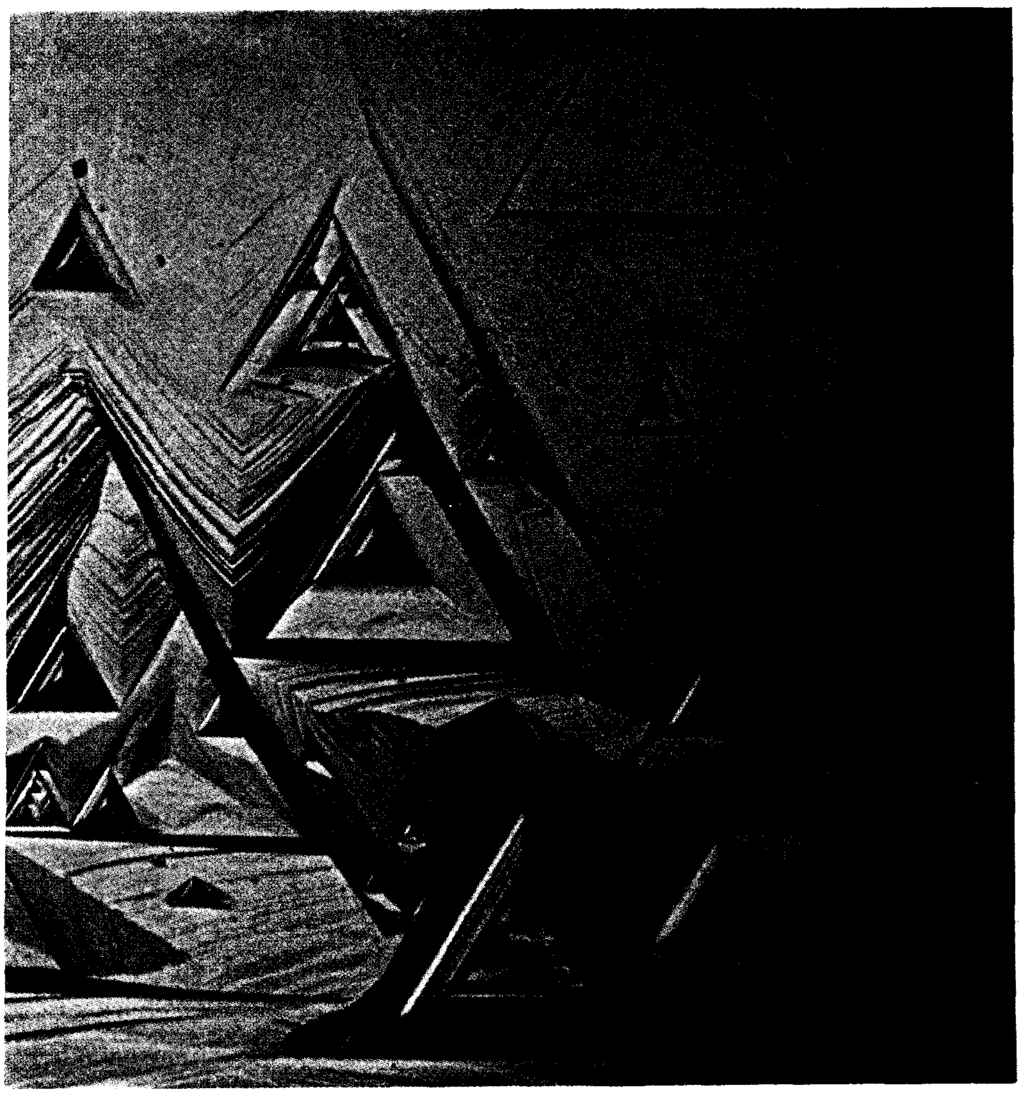






The hematite crystal at left and *the diamond below were both* photographed under the Francon-Yamamoto system. The flower-like cluster above consists of three uranium ores: curite, torbernite, and soddyite. Curite, an ore of uranium and lead, is red in color.

Torbernite, an ore of uranium and copper, is green, and soddyite, a uranium silicate, is yellow. The three are usually found together in their natural state. They were illuminated by electronic-flash fiber-optic probes under a Wilde microscope.



tively new technique of micromounting. Micromounts are small groups of crystals, no larger than one cubic inch, which are viewed through a stereomicroscope. Julie saw this technique as a superb opportunity to apply his knowledge of photomicrography to minerals. First he had to devise a holder to protect the fragile crystal groups while he was turning them under the microscope. Then he had to find a way to pinpoint light on a single crystal face. No simple camera setup would perform these functions. Julie combined the most sophisticated components, enlisted the aid of a master machinist to hand-tool special attachments, and custom-tailored an apparatus of his own design.

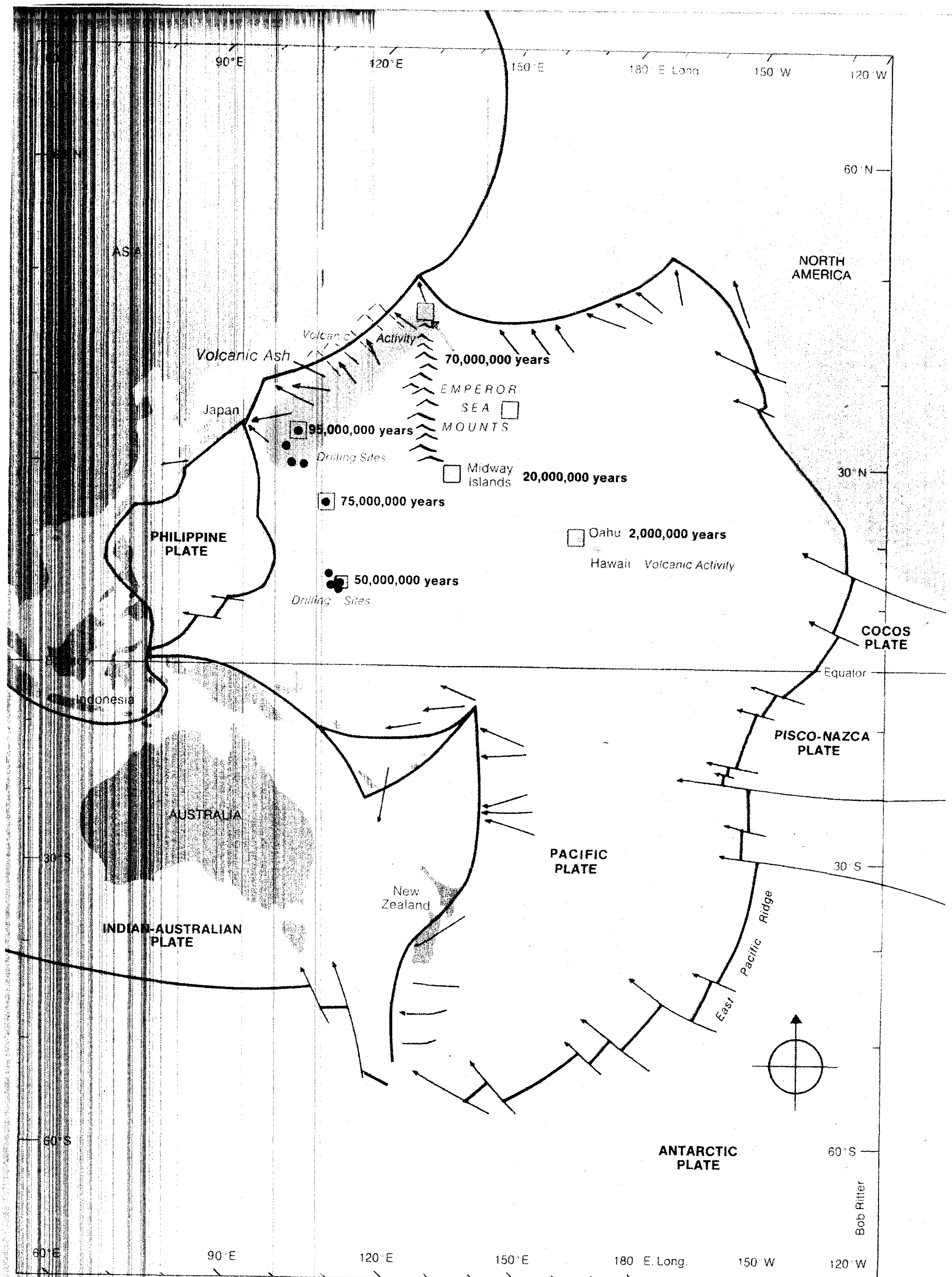
Why go to all this trouble? The answer is simple: Large crystals are rarely as well formed as microcrystals are. Crystals often grow so large that one or more of their faces are obliterated. Imagine one edge of a crystal shaped like the letter A: The bar and the legs represent three faces of the crystal at an early stage of growth. As the crystal continues to grow, however, layer upon layer of material is added, and the legs gradually squeeze the bar between them until it eventually disappears. Where there once were three faces, there are now only two. Also, crystals take a long time to grow, and the larger ones have a greater chance of trapping impurities from the surrounding environment. Finally, light is absorbed more easily in a large crystal than in a microcrystal. You could read a newspaper through a glass filled with an inch of water, but try it through a pitcher of water.

Of course, the main reason for going to so much trouble is to produce a photograph like any of those shown here. Julie says he took these pictures "so that everyone can see how much beauty there is in the earth."

He was delighted when he recently heard that the New York Board of Education is planning to introduce the study of earth sciences into the public school curriculum starting with the lower grades. He hopes to see this movement spread nationwide. Then "ecology" and "conservation" would not seem strange and alien abstractions, as they do to many people today, but would be recognizable and workable concepts to future generations.

Julie has stated his personal philosophy succinctly: "The microscope is neutral. It accepts equally either of the two common areas of our search for understanding: the tiny bit of tissue with its living cells or the tiny bit of earth that nurtures life. There is no distance between the two fragments any longer."

Dr. Mandarino is curator of mineralogy at the Royal Ontario Museum in Toronto.


90°E
120°E
150°E
180° E Long.
150°W
120°W
60°N
30°N
Equator
30°S
60°S
ASIA
NORTH AMERICA
Volcanic Activity
Volcanic Ash
70,000,000 years
EMPEROR SEA MOUNTS
Japan
95,000,000 years
Drilling Sites
Midway Islands
20,000,000 years
75,000,000 years
PHILIPPINE PLATE
Oahu
2,000,000 years
Hawaii
Volcanic Activity
50,000,000 years
Drilling Sites
COCOS PLATE
Indonesia
PISCO-NAZCA PLATE
AUSTRALIA
PACIFIC PLATE
New Zealand
INDIAN-AUSTRALIAN PLATE
East Pacific Ridge
ANTARCTIC PLATE
Bob Ritter
60°E
90°E
120°E
150°E
180° E. Long.
150°W
120°W