

## The definition of "mineral", Part II: The 1900s

James Dwight Dana's *Manual of Mineralogy* went on to be, for some years, the *Textbook of Mineralogy* written by his son Edward Salisbury Dana and by William E. Ford, both professors at Yale. The fourth edition in 1932 stated that

**"A Mineral is a body produced by the processes of inorganic nature, having usually a definite chemical composition and, if formed under favorable conditions, a certain characteristic atomic structure which is expressed in its crystalline form and other physical properties."**

Dana and Ford went on to add that "a mineral must be a *homogeneous* substance" and that "minerals are, as a rule, limited to *solid substances*, the only liquids included being metallic mercury and water." These seemingly ancillary thoughts would be incorporated in later definitions. The inclusion of "characteristic atomic structure" in the early 1900s reflected both the development of the concept of the atom and the recognition from X-ray diffraction that minerals were crystalline (i.e., consisting of ordered arrangement of atoms). Dana and Ford also asserted that "mineral substances which have been produced through the agency of organic life are not included among minerals", a provision that tried to maintain the division between animal or vegetable and mineral, even though it had become apparent that some "mineral substances" were produced by organisms.

In later editions of Dana's book, which again became the *Manual of Mineralogy*, the definition of a mineral incorporated some of the provisions included as addenda by Salisbury and Ford, and the notion of liquid minerals disappeared. Thus in the nineteenth edition published in 1977, Cornelius Hurlbut and Cornelis Klein wrote

**A mineral is a naturally occurring homogeneous solid with a definite (but generally not fixed) chemical composition and an ordered atomic arrangement. It is usually formed by inorganic processes.**

One group very concerned about the definition of a mineral was the Committee on New Minerals and Mineral Names (CNMMN) of the

International Mineralogical Association, because the Committee has to decide which newly described phases can be formally named as minerals and which will be denied that status. As a result, Ernest Nickel in 1995 published a paper called "The definition of a mineral" that he described as the "end-product of active discussion of the subject within the CNMMN over a period of several years, and [which] represents a general consensus of the CNMMN membership." The definition presented in Nickel's 1995 paper was

**"A mineral is an element or chemical compound that is normally crystalline and that has been formed as a result of geological processes."**

"Normally" here meant "in the case of most minerals", not "under most conditions" or "most of the time", and in fact Nickel went on to spell out "the bases for accepting a naturally occurring amorphous phase as a mineral." Liquid water was specifically excluded as a mineral, even though Nickel conceded that liquid mercury "is recognized as a mineral".

Nickel made clear that substances previously recognized as minerals, but not within the new definition, would not be denied continued status as minerals. For example, he went on to specify that "chemical compounds formed by the action of geological processes on anthropogenic substances cannot be considered as minerals," but he had to concede that the CNMMN had accepted such substances as minerals in the past. With that in mind, a skeptic could have rightfully argued for this seemingly **never-published** definition:

**"A mineral is a substance that has been formally recognized as a mineral by the International Mineralogical Association's Committee on New Minerals and Mineral Names"**

Nickel (1995) maintained the exclusion of solids generated by organisms, using "the shells of marine molluscs" as an example of materials that "are not regarded as minerals", even though by the late 1900s geologists conceded that those shells consisted of calcite or aragonite. As we'll see in Part III, the exclusion of substances made by organisms persisted into the 2000s.