ACCEPTANCE OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA

ARTHUR F. BUDDINGTON, *Princeton University, Princeton, New Jersey*

Mr. President, Professor Hess, Fellows and Members of The Mineralogical Society of America and Guests:

I was unaware of who was to introduce me until our President announced it. The Society has been very kind indeed to me in having one of my best friends act as my sponsor.

The award of the Roebling Medal by a group of scientists in one's own special field of endeavor makes the recipient have a warm feeling for all his fellows and a deep seated, though humble, appreciation of the very distinguished honor.

I am also grateful for the medal in that it gives me an opportunity to publicly express thanks for the analytical data of the many chemists whose work has been so essential to my studies. I am pleased that this is occurring in Minneapolis, as I am peculiarly indebted to the chemists of the local Rock Analysis Laboratory of the University of Minnesota for their cooperation and accurate work over a period of many years.

My professional lifetime has seen such an extraordinary growth of laboratory and theoretical researches in geochemistry and the development of new instruments for the furthering of the interpretation of the nature and origin of minerals and rocks that the *relative* importance of field studies in which I have taken such pleasure has diminished.

We have but to mention the following to realize the importance of new instrumentation; the universal stage and micropetro fabrics, the mineralographic microscope and mineragraphy, the *x*-ray and crystal structure, *x*-ray diffraction, the differential thermal analysis instrument, and electron microscope in clay mineralogy; the emission spectrograph and spectrophotometer in trace element geochemistry, the mass spectrometer and isotope geology, the geochemistry or geophysics of age determination, chromographic methods in geochemical prospecting, high temperature bombs for silicate or sulphide chemistry with volatiles, and instrumentation suitable for both high temperature and high pressure for experimental metamorphism.

One has difficulty in matching this array with new ideas based primarily on field work. During the past two score years we have had the major development of the theory of secondary enrichment, zoning of metalliferous deposits and of pegmatites, metasomatism and the migration of elements, qualitative geologic thermometry, the systematic sequence of rocks within stratiform sheets and their correlation with

mineral sequence, and the systematic variation of regional mineral assemblages with metamorphic intensity of zoning, all based largely on field geology and the use of the petrographic microscope. However, our real understanding of the origin of the diversification and principles of fractional crystallization within stratiform sheets is based on the experimental chemical studies of the silicate systems, and the development of the metamorphic facies concept on theoretical physicochemical principles. With the aid of physical chemistry we are just beginning to get real *quantitative* controls for geologic thermometry, and the necessary physical chemistry for the adequate interpretation of zoning in mineral deposits is still to come.

I believe that the advances in our knowledge and understanding of the sciences of mineralogy, petrology and mineral deposits during the present century has been equal to that of all previous time and that at least half of the material in our present graduate curricula dealing with the mineralogical sciences has been developed during my professional lifetime and is in large part based on geochemistry, geophysics, mathematics and new instrumentation. One may also note that in the current mineralogical literature about half the references are to publications of the immediately preceding 10 years and 80 per cent to the preceding 25 years.

What does this mean for the *geological* mineralogist of the future?

There is no question but that researches in geochemistry will advance the mineralogical sciences at an accelerated rate for many years to come. However, I believe it is also true that every advance in geochemistry requires ever greater knowledge and refinement of our knowledge based on field relationships and the two must go forward together, each reacting on the other. A specimen of rock *can* be treated in the laboratory as an entity in itself. But the significance for geology of the data obtained from it can only be as good as the thoroughness of the knowledge of the nature of the immediate surroundings of the specimen where in place and of its physical and chemical history as read by a field geologist with the appropriate background.

A glance through the recent university catalogues reveals courses in geology departments in the following subjects, the bases for which have been developed during the normal professional life-time of one man; Crystal structure or x-ray crystallography; Mineragraphy, Crystal chemistry, Chemistry of silicate systems, Geochemistry of ore solutions, Spectrochemical analysis, Isotope geology, Thermodynamics of rock making minerals, Geochemistry, Quantitative Sedimentology, Universal Stage studies. This suggests that the present day student of the mineralogical sciences may look forward to the development of at least one

new field of research in the mineralogical sciences every decade. Since it takes only 10–25 years to develop a new field to the routine working stage where a textbook or university course in the subject is available, the student must be prepared to acquire a working knowledge of several new fields in his lifetime. If interested in creative research he must have the background and maintain a flexibility such that he can be a participant in the development of two or three quite new fields of endeavor. He must furthermore be familiar with the foreign literature for at least three fifths of our major new ideas in the mineralogic sciences have in the past been developed outside of North America.

In looking over the acceptance remarks of former Roebling medalists I found a statement of Professor Paul Niggli which I feel can bear repeating; "the work of the mineralogist and petrologist starts from the study of Nature and is an attempt to apply the teachings of all fundamental sciences to his own very special problems."

What wonderful opportunities the mineralogic sciences afford. One may enjoy oneself in so many ways; there are the deep satisfactions of new insights resulting from laboratory or library studies; the joy of wandering in the high mountains or the pastured lowlands; the pleasure of talk and friendly fellowship with other mineralogists and finally in addition to and beyond all this one may receive the respected and honored Roebling Medal. I thank you.