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Presentation of the Roebling Medal of the Mineralogical Society of America for 1984 Paul Booth Barton, Jr.

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President Prewitt, members and friends of the Society:

Some years ago Paul Barton and I were taking a group of visiting geologists on a tour of the Creede mining district in Colorado, where Paul and I have worked together for a number of years. As we drove along Paul described to our visitors his concept of some aspect or other of the volcanic history of the area. Since I was in considerably less than full agreement with Paul's interpretation, I proceeded to list five or six reasons why I considered Paul's ideas totally devoid of merit. (The gravity of this occasion dictates some delicacy of wording.) One of our visitors volunteered, "Gee, Paul, I don't think Phil liked your idea." To which Paul responded, "That's OK, if Phil ever gets an idea, I won't like it either." Paul, I wish I could say that your selection as the Roebling Medalist was my idea, and then ask you how you like it; but, of course, I had nothing to do with it—and all I can do is applaud the Society's judgment and document, to some extent, the basis on which it was made.

Few would dispute the designation of Paul Barton as the Father of Modern Ore Petrology. Our progress over the past quarter century in understanding the chemistry and physics of ore-forming processes and in relating them to the major processes of crustal evolution has been nothing short of phenomenal. There have been many contributors; but it has been Paul, more than any other person, who has shown us how to read the record written in the mineral assemblages of ore deposits. His instruction has been, like Paul himself, straightforward and elegant: "Look carefully at the rocks, write the reactions describing the relations between phases, and, if the data to quantify the reactions are not available, invent some experiment to determine them."

A selective sampling of Paul's writings shows how he has woven these three threads—careful observation, rigorous theoretical analysis, and ingenious experimentation—into the fabric of ore petrology. His early paper, "Some Limitations on the Possible Composition of the Ore-forming Fluid" set the stage. From this came an appreciation of the importance of the chemical potential of sulfur in determining the mineral assemblage and a deep concern as to how well the minerals of ore deposits recorded, and preserved, the record of the chemical and physical evolution of the ore fluid. The first inspired an experimental attack, in Gunnar Kullerud's lab at the Geophysical Laboratory, by examining the role of sulfur in determining the iron content of sphalerite. These experiments were continued in the laboratory Paul built at the U.S. Geological Survey. Together with Pete Toulmin he devised the electrum-tarnish method of measuring the fugacity of sulfur and then applied the method in a definitive study of the thermodynamics of pyrite and pyrrhotite. The resulting knowledge of the variation of pyrrhotite composition as a function of temperature and sulfur fugacity allowed the use of the iron sulfides as both buffers and indicators of sulfur fugacity in working out the thermodynamics and phase relations of a number of sulfide systems; most importantly Fe–Zn–S and Cu–Fe–S, the systems that have formed the backbone of the petrologic interpretation of ore deposits—particularly those of hydrothermal origin. The sheer elegance and simplicity of this set of experiments make it one of the classics of experimental petrology.

Paul attacked the problem of reading the record written in the mineral assemblage by selecting, along with Ed Roedder, the OH vein in the Creede mining district as a natural laboratory wherein the results of laboratory experiments and theoretical analyses could be tested against a real ore deposit, and where methods of reading the mineral assemblage could be developed and refined. One of the first results to come out of this natural laboratory was a consideration, along with Pete Toulmin and myself, of the problems of the attainment and recognition of equilibrium in ore deposits, based in large part on observations of the textural relations of the Creede ores as revealed in doubly polished thin sections. The methods developed and the lessons learned in the studies of the Creede ores have been applied to an uncounted number of ore deposits by a generation of ore petrologists, of particular note is Paul's own recent textural interpretation of the Kuroko ores of Japan, shared, in part, with Stu Eldridge and Hiroshi Ohmoto. Paul's mastery of the art of ore petrology is exceptionally well documented in his brilliant analysis, modestly entitled, "Progress Toward the Interpretation of the Chemistry of the Ore-forming Fluid for the OH Vein," a paper on which Ed Roedder and I are credited as coauthors for reasons of what can most appropriately be described as generosity.

Paul's other experimental studies range from an imaginative method for determining single-ion activity coefficients in aqueous systems to the determination of the phase relations in Fe–S systems containing Bi, As, or Sb to the distribution of minor elements between sulfide phases. His theoretical analyses have extended to the role of organic matter in ore genesis, the possible role of nitrogen as an oxidant in

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hydrothermal fluids, and to mechanisms of cooling of hydrothermal fluids. Many of these studies were done in cooperation with other workers, because Paul is extremely generous in sharing his ideas, anxious to get the job done, and especially effective in motivating his colleagues.

One would expect a career like Paul's to produce a number of syntheses, and such is, indeed, the case. Of the ten or so I count, perhaps those most illustrative of his career are: his article on Sulfide Petrology which was published in the Society's Special Paper Number 3 and reprinted in Volume 1 of the Society's Short Course Notes (now Reviews in Mineralogy) the outstanding compilation and evaluation of the thermochemistry of sulfide minerals published with Brian Skinner in the "Barnes volume" on the Geochemistry of Hydrothermal Ore Deposits, and his recent contributions to the Short Course Notes on Fluid-Mineral Equilibria in Hydrothermal Systems published by the Society of Economic Geologists.

Paul's horizons extend well beyond pure science. His Presidential Address to the Society of Economic Geologists was entitled: "Public Perspectives of Mineral Resources". That address, and his service to the National Academy of Sciences—to which he was elected in 1978—in pulling together the volume "Mineral Resources: Genetic Understanding for Practical Purposes" reveal his concern about the role of science, and of scientists, in the betterment of the human condition.

To focus on the fruits of Paul's scientific efforts, as I have done, is to ignore what is, perhaps, the most essential ingredient in his makeup: his nearly complete lack, as far as I can tell, of selfish motive. One of Paul's best friends remarked to me the other week that Paul is the kind of accomplished individual, capable of meeting all challenges with apparent ease, that the rest of us would love to hate. It is remarkable, indeed, that Paul's enormous generosity of self has engendered just the opposite reaction.

Mr. President, I hope that my remarks have betrayed my profound admiration for the Society's judgment in selecting, and my extreme pleasure in introducing, Paul Booth Barton as the Society's Roebling medalist for 1984.