

## Acceptance of the 2018 Roebling Medal of the Mineralogical Society of America

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Thank you, Frank, for your generous words on this occasion, and also for the friendship, encouragement, and scientific vision you have shared with me during our decades-long collaboration.

I'm especially pleased and honored to be the recipient of this year's Roebling Medal in part because of Washington Roebling's strong connection to the institution where I've spent nearly my entire 43-year post-Ph.D. career. For those of you who don't know Roebling's story, he was born in 1837 and was an 1857 civil engineering graduate of Rensselaer Polytechnic Institute (RPI). He went on to serve with distinction in the Civil War and later (more famously) to oversee construction of the Brooklyn Bridge, which was completed in 1883. More important to the MSA is the fact that Roebling was an avid and accomplished amateur mineralogist whose interest in minerals was kindled at RPI, as Frank just noted. (In the early- to mid-19th century, RPI was a hotbed of geological research and exploration where several pioneering geologists studied and/or taught, including Amos Eaton, Ebenezer Emmons, James Hall, and Douglass Houghton.) Later in his life, Roebling's personal wealth enabled him to amass a collection of 16,000 mineral specimens, which were donated to the Smithsonian Institution by his son John A. Roebling II upon Washington's death in 1926. In 1924 (like myself in 1997!), Washington Roebling served as Vice President of the MSA, and shortly before his death he made a substantial gift to the MSA that served as a founding endowment of our Society. I wish it were otherwise, but I will not be able to match his financial impact on MSA!

On an occasion such as this, it is customary (perhaps expected?) that a senior award recipient look back on his or her career and speculate why it might be judged as having been successful, and what factors or individuals helped guide it. This is a difficult and risky thing to do, of course—but I suppose my perspective is unique and therefore possibly of interest to some. I've worked on a variety of topics over the decades that might seem bewilderingly random to many observers (and certainly not always very mineralogical)—but which all fit together seamlessly in my own mind. Most of the projects I've pursued stemmed from the optimistic belief that any chemical phenomenon hypothesized to occur in the Earth can be illuminated and understood through experimentation if we can just figure out the right experiment to do and how to do it. This belief has produced useful new results in many cases, but there's no question it has also led me into some blind alleys and dead ends—which, in general, the scientific community does not know about, for obvious reasons! I don't regret the unproductive risks I've taken, because I've learned something useful from every experiment (even just knowing what *not* to do in the future has obvious value), and I think risk avoidance can be a prescription for ordinary science. I realize, of course, that this philosophy is easy for a senior scientist to en-



dorse, but understandably impractical for many young researchers to fully embrace.

One of the connecting threads in my decades of experimentation relates to the systematic nature of science. At the risk of dwelling on the obvious, I'm fascinated by the idea that natural physical and chemical phenomena and properties are inherently systematic—partition coefficients, diffusion coefficients, mineral solubilities, wetting properties, effects of temperature and pressure on reactions, for example—and that if I do my job (figure out the systematics) I can create tools to understand the Earth's complex systems and delve into Earth's past. I've also realized only later in my career that I enjoy the role of being *useful* in my profession by providing tools to other researchers—although some would say that in certain cases the systematic behaviors I offer as tools are unwanted constraints! The research that I've conducted personally can be broken down into two rough categories: (1) new types of experiments that previous researchers were wise enough to avoid attempting and (2) implementation of established principles of chemistry and materials science to describe and understand uniquely geological systems and behaviors. Interestingly, the papers of which I'm proudest are not in all cases ones that have been particularly popular with readers.

Speaking of old papers, recently I had reason to go back and read publications that I wrote nearly 40 years ago (these were about apatite saturation in magmatic liquids, which I talked about earlier in the present GSA meeting). Sometimes I've been impressed by this old work “Wow—that was insightful!” and sometimes I have to ask “What possessed me to say *that*?”. I realize in reading these old papers that I know a lot more now than I did then (thank goodness!), and I'm a better scientist in

the sense of having a broader view—but I’m not entirely sure I’m a better writer now.

If I can presume to offer advice to young scientists, I would start with this: Try to discover, through honest introspection and exploration (trial and error?), what you as an individual enjoy doing and perhaps do better than most other individual scientists. The knowledge and confidence gained by this exercise will free you to pursue your ideas and let your own style emerge. At the same time, be open to developing contacts and collaborating with people who have different skill sets and perspectives from your own (my 25 years of working with Frank Richter taught me this). If you’re an experimentalist, don’t be afraid to try new things that are not based on old recipes or standardized methodologies.

I’ll close by saying that I—like all successful scientists at my career stage—I wouldn’t be where I am without a lot of help and enabling along the way, and I am indebted to many individuals. I would like, first, to say thank you to the students who have ventured to upstate New York to pursue their Ph.D. degrees under my guidance. Some readers know that RPI Geoscience has always been very small (six to seven faculty members), which has meant that my department has never had a big pool of applicants to our graduate program. We’ve lacked the collective draw of big departments, and we have not been blessed with fellowships or more than a handful of teaching assistantships to support our graduate program. In spite of these challenges, I’ve had my share of extraordinary Ph.D. students, some of whom are in this room today.

I also extend my sincere thanks to those who showed me the way during the formative years of my undergraduate and graduate education. Wally Bothner at the University of New Hampshire challenged me to work hard and not simply to learn but also to learn how to learn; John Dickey, Fred Frey, and Stan Hart at the Massachusetts Institute of Technology planted the seeds of ideas and the basis for critical thinking, and also allowed me an exceptional degree of freedom to succeed or fail—the significance of which I did not appreciate until much later.

My sincere thanks are also due to those individuals who have helped sustain me as a scientist over the decades. This group includes my RPI faculty colleagues, who are and have been extraordinarily good at what they do, and who have kept our department visible and respected on our technology-dominated campus and well beyond. This group also includes my long-term collaborators—first and foremost Daniele Cherniak, whose knowledge and skill in ion beam analysis is unparalleled and who has been a constant reminder to me of the value of focus, discipline, and determination (Daniele is a champion ultramarathon runner). My long-term collaborators also include Frank Richter,

Mark Harrison, Rick Ryerson, Dave Wark, and Calvin Miller, all of whom have contributed in essential ways to my world view.

I am grateful to the Roebling Medal committee for seeing value in what I do even though I’m not a competent mineralogist. My case must have been presented very effectively by the nominating team, and I’m honored by the fact that this group was not made up entirely of the usual suspects—that is to say, old friends and collaborators who are obligated to write good things. The contributions made by all members of the nominating team are greatly appreciated, but special thanks go to Sumit Chakraborty, Jiba Ganguly, and Julia Hammer.

Last and by far the most important, I’m grateful more than I have the words to express to my wife Susan, who for almost three decades has done the lion’s share of running the Watson household and raising a son (Jonah, now 25 years old) of whom we’re very proud. In this selfless pursuit, she has made it possible for me to focus on doing and teaching science to an extent that many in my position do not have the opportunity to do. She has put up with the times I’ve been physically away at meetings (occasionally during very challenging weather: it snows sometimes in upstate New York, and we have a 1700-foot driveway)—and also the not infrequent times when I’ve been physically present but mentally absent, subconsciously pondering some scientific problem of marginal consequence in the grand scheme of things. My son Jonah has been a joy and inspiration to me, too, and he doesn’t seem to have judged me too harshly for being so focused.

I’ll finish with a brief story. When my son was weighing his options for college, he told me that “...science is interesting, Dad—and I know you like it and are good at it—but I need to do something meaningful in my life.” Having come of age myself during a tumultuous time in our nation’s history (Vietnam war; civil rights unrest; assassinations of prominent figures), I knew exactly where he was coming from and was not in the least dismayed by his words. I went off to college myself thinking I would major in political science, become a politician, and solve the world’s problems. However, political science and I did not get along very well, so—excited by the idea of doing science outdoors—I switched to geology (I became a laboratory geologist in graduate school). Looking back now from my scientifically mature vantage point, I’m amazed by what we now know about the Earth that we did not know when I was a Ph.D. student. That collective knowledge bears on crucial societal challenges and imperatives relating to the environment, global climate, mineral and energy resources, natural disasters (e.g., volcanoes and earthquakes), and the origins of life. If my career effort has contributed in a small way to addressing any of these issues, perhaps I’ve done something meaningful without having to become a politician.