

Acceptance of the Mineralogical Society of America Roebling Medal for 2007

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Thank you, Jerry and Mike, for your generous remarks and for nominating me for this prestigious award. I also wish to thank the 2007 Roebling Medal Committee for selecting me. Jerry and Mike, I am happy to count you among my close friends, both personal and professional. I also want to thank you for organizing the incredible symposium in my honor yesterday (October 29, 2007). The 31 talks presented an exciting retrospective and prospective of many areas of the mineral sciences and made a remarkably positive statement about the health of this field in its broadest definition. What a stroke of luck it was for me to choose to attend Penn State for graduate study in 1965 rather than go to graduate school in inorganic chemistry at the University of North Carolina with Jim Collman, who is now a colleague of mine at Stanford. I also made the correct decision to accompany you, Jerry, from Penn State to Virginia Tech in 1966. I have fond memories of the two of us discussing linear algebra and matrix theory at your home in State College, Pennsylvania, walking to get a milkshake at the local drugstore or a salad at The Greeks in Blacksburg, Virginia, laughing our heads off at the 1967 George C. Scott film *The Flim-Flam Man* at the only movie theater in Blacksburg at that time, and taking your graduate classes, which were models of clarity and the best classes I ever had. Mike, I remember meeting you for the first time when you came to visit me in the summer of 1976 and we collaborated on the high-temperature crystal structure and thermal expansion of cordierite, and the way you responded to the nickname “Rookie” from my more senior graduate students at Stanford when you joined my research group for Ph.D. work in 1977. You were a fantastic addition to my group and have become one of the superstars of mineralogy and geochemistry. I am so proud of both of you.

President Dutrow, Past President Valley, Vice President Heaney, MSA fellows, and members, ladies, and gentlemen, I am extremely grateful and humbled to have been chosen as the recipient of the 2007 Roebling Medal. I wish to sincerely thank the Mineralogical Society of America for bestowing this honor on me. When I received a telephone call from John Valley last October, I thought he was calling to tell me that Stanford should trade in our SHRIMP for a Cameca NanoSims. I was quite pleased to find out that he was calling me instead about the 2007 Roebling Medal. I am particularly humbled when I consider the past winners of the Roebling Medal, including William Lawrence Bragg in 1948, Norman L. Bowen in 1950, Martin J. Burger in 1958, Linus Pauling in 1967, Joseph V. Smith in 1982, Gerald V. Gibbs in 1987, William A. Bassett in 1994, Charles T. Prewitt in 2003, H-K. (David) Mao in 2005, and W. Gary Ernst in 2006.

This acceptance speech gives me a chance to publicly acknowledge many of the people who have helped me get to this point in my professional career. I must start by acknowledging



my third grade teacher, Janet Heredeen, in Jackson, Mississippi, who had a mineral collection in her room and often talked about her favorite minerals and how she collected them. I also must acknowledge the mentoring of chemistry professors Roy Berry and Richard Cain and geology professors Richard Priddy and Wendell Johnson at Millsaps College in Jackson, Mississippi. Another key event in my career path was taking a class in crystallography from a young mineralogist at Penn State named Jerry Gibbs. Jerry is the best teacher I ever had, and he inspired me to become a mineralogist. I followed Jerry to Virginia Tech where I completed my Ph.D. degree. This period was followed by a post-doc with Charlie Prewitt and Jim Papike at SUNY Stony Brook. There I worked with Charlie, Jim, Ted Bence, and others to help develop the emerging area referred to as petrologic crystal chemistry. We also worked on returned lunar samples and high-temperature structural studies of minerals. What an exciting time that was. These experiences served me very well as I have followed a somewhat circuitous career path that has most recently focused on molecular-scale studies of the speciation of heavy metal and metalloid pollutants such as lead, chromium, mercury, selenium, and arsenic in contaminated natural samples and their interactions with mineral surfaces and microbial organisms. This field is now often referred to as molecular environmental science, and I am proud to have played a small part in its creation. An example of the impact of heavy metals in the environment was in this morning's edition of USA Today. The cover story was on emission of mercury from about 500 coal-fired power plants in the U.S., which supply about half of the electricity in the U.S. and contribute about 40% of mercury emissions to the air in the

U.S. each year—about 9% of the world total. My group and I are currently working with Corning, Inc., to determine the speciation of mercury trapped by a new type of gas scrubber for coal-fired power plant gaseous emissions.

I was fortunate to have been at Stanford University when the world's first synchrotron radiation user facility known as the Stanford Synchrotron Radiation Project opened in 1974 at the Stanford Linear Accelerator Center. Now known as the Stanford Synchrotron Radiation Laboratory or SSRL, this DOE facility enabled me and my graduate students and post-docs to carry out some of the first X-ray spectroscopy studies of cation environments in minerals and melts and adsorbates on mineral surfaces. The extremely intense X-rays from SSRL, the National Synchrotron Light Source, the Advanced Photon Source, and the Advanced Light Source also allowed us to determine the molecular-level speciation and phase association of environmental contaminants, including mercury, at very low concentrations in natural samples such as soils and sediments.

My Stanford colleague George Parks played an important role in introducing me to the field of mineral surface chemistry and being a research partner for a 15-year period (1986–2001). The late Werner Stumm was my scientific hero during this period. My 50+ graduate students and post-docs during my 34 years at Stanford have been research partners with whom I have explored structure-property relationships of silicate glasses and liquids, trace element environments in silicate melts, the two-dimensional world of mineral surfaces, and the complexities of environmental geochemistry at the molecular level. Without them, I would not be standing here today. I don't have space to publicly acknowledge all of my past and present students and post-docs, but I do wish to publicly acknowledge and thank those who are here today, including John Bargar, Karim Benzerara, Jeff Catalano, Andrea Foster, Mike Hochella, Chris Kim, Peggy O'Day, John Ostergren, Aaron Slowey, Alexis Templeton, and Tom Trainor. I am so proud of you and all my other graduate students and post-docs. I share this award with you. My Stanford colleagues

Anders Nilsson and Alfred Spormann have also been valuable research partners over the past seven years and are key members of the Stanford Environmental Molecular Science Institute. I also wish to acknowledge the many research collaborators I have had from other institutions. This list includes Georges Calas, Guillaume Morin, and Farid Juillot at the University of Paris VI and VII; Francois Farges, a former post-doc who is now at the Muséum National d'Histoire Naturelle, Paris, France; Glenn Waychunas, a long-time Stanford colleague who is now at Lawrence Berkeley National Lab; Tetsu Tokunaga at LBNL; John Rehr at the University of Washington; Scott Chambers and John Zachara at PNNL; Satish Myneni at Princeton University; Anne Chaka at NIST; Jim Rytuba at the USGS; Sam Traina at U.C. Merced; and Peter Eng, Steve Sutton, Matt Newville, and Mark Rivers at GSECARS (University of Chicago).

I would be remiss if I did not acknowledge the long-term financial support of my research at Stanford University by NSF-Earth Sciences, NSF-Chemistry, DOE-BES Chemical Sciences, Geosciences, and Energy Biosciences, DOE-BER Environmental Remediation Science Program, and the EPA. In addition, I wish to acknowledge DOE Basic Energy Sciences for building the four major synchrotron radiation user facilities in the US, where much of my research over the past 30 years has been done, and for the support provided by the DOE Geosciences program, now headed by Nick Woodward, to GSECARS, which is the premier earth and environmental sciences synchrotron program in the world. Finally, I wish to thank my wife Nancy, my main cheerleader and life partner, and our two children Michael and Tracey, who have put up with my late nights, innumerable weekends at synchrotrons, and weeks away at meetings for many years. Without you I could not have achieved what I have in science or in my life. I look forward to many years of sharing memorable experiences with my five grandchildren (Sam, Sarafina, Ian, Chloe, and Evelyn). In closing, once again, I wish to thank the Mineralogical Society of America for bestowing this honor on me. I am proud to be a mineralogist.