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Acceptance of the Roebling Medal for 2009 of the Mineralogical Society of America

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Ladies and Gentlemen, Colleagues and Friends:

It is an honor, both humbling and delighting, to receive the Roebling Medal, and indeed to have it bestowed by Nancy Ross in her multiple roles as citationist, MSA President, my Ph.D. student at ASU, colleague, and friend. It is equally wonderful to be surrounded by colleagues and friends of many generations. I thank you all for your support, stimulation, and companionship.

Rather than dwell on highlights of my career, I wish to consider our field, mineralogy, the study of inorganic natural products and their synthetic analogues. Guided by chemistry and physics and empowered by modern technology, mineralogy has evolved from descriptive to the edge of predictive. I entered the field just as plate tectonics, amidst much resistance, did, and I started my faculty career as man set foot on the Moon. I saw the ability to access conditions of the deep interior of planets grow from a dream to reality. Electron microprobes, electron microscopes, mass spectrometers, computers, and yes, even calorimeters, have become standard tools. In recent years, extrasolar planets and the core and deep mantle have greatly expanded the *P-T-X* space we think about. Critical societal issues for the application of mineralogy have evolved from finding oil and ore deposits to sequestering carbon dioxide and radioactive waste. Mineralogy continues to be exciting and relevant.

Yet there are a number of recurring cautions, not just for mineralogy but for science as a whole, and, inasmuch as science offers a rational organizing principle for dealing with the world, for us all. I observe that I could not have built my career in mineralogy with education and funding only from the Earth sciences. Nor can a young faculty member do so today. My training as a physical chemist and my pursuit of problems in materials science and solid state chemistry in parallel with those in mineralogy have enriched my thinking and my funding. Indeed we must all be interdisciplinary, relevant, and nimble. Relevant to what? For the coming decades, relevant to energy, resources, and the stewardship of the planet.

I am dismayed, have been concerned all my life, at the "us vs. them" mentality, the creeping tribalism that may be part of our nature, but must be mitigated by nurture. In Earth sciences it manifests itself in conflicts like hard rock vs. soft rock, simple systems vs. "real rocks", theory vs. experiment, the critical zone vs. the core-mantle boundary, processes in the present vs. those in deep time, mineralogy vs. mineral physics, NSF vs. NASA, etc., etc., etc. In the bigger world, it is the "us vs. them" of religion, culture, race, and gender. Please ladies and gentlemen, be inclusive, intellectually omnivorous, and generous of spirit. For a small society like MSA in a field the outside world perceives, alas, as old fashioned or dying, this flexibility is crucial.

We all struggle with attracting the right sort of students to our research groups. So many of the must illustrious contributors to mineralogy in the broadest sense have come with undergraduate backgrounds and often also Ph.D.s in other fields—physics, chemistry, geophysics. We must continue to recruit and welcome them as students, postdocs, and faculty. We must show them our field is both intellectually stimulating and societally relevant. Fortunately that is not hard.

Returning to my own odyssey, I came from physical chemistry into Earth science first through an interest in spinels; I was delighted to find they existed in the Earth, and that even stranger ones formed at high pressure. I then sought commonality between mineralogy and materials science in silicate melts and glasses and in perovskites. I gradually moved toward more complex and lower temperature materials. Are zeolites and iron oxides more relevant as minerals or as technological materials? The answer is yes. Now, despite the vagaries of NSF, I am exploring complexities, inspired by materials science, of non-oxide analogue materials, as models for behavior of minor constituents in the mantle and core. Do they form a wealth of accessory minerals we have not yet considered? What is the mineralogy of Super-Earths or of carbon planets? I am head over heels in surface and interface energies, and their effects on polymorphism, dehydration, and redox equlibria, as I will discuss in my lecture later this afternoon. I am excited to be a major participant in two DOE Energy Frontier Research Centers, one on the Materials Science of Actinides (another MSA), led by Rod Ewing, and the other on Nanoscale Controls on Geologic CO2, led by Don DePaolo. I expect strong, but less formal, interactions with other evolving initiatives. Yes there is wonderful new science to pursue with the same existential and intense joy as my happy dogs pursue squirrels. I wish that joy to all mineralogists and all people.

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