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Acceptance of Distinguished Public Service Award of the Mineralogical Society of America for 2019

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Mr. President, Colleagues, and Friends:

My thanks to Kevin for his kind words and the exaggerated description of my accomplishments. I have long admired Kevin's skill as an Academy Board Director and as a Committee Study Director—so it is very special for me to have Kevin as my citationist.

I am deeply grateful to the Mineralogical Society of America for the recognition and presentation of the Distinguished Public Service Medal. This honor is all the more meaningful for the list of previous recipients, particularly Konrad Krauskopf, Pierrette Tremblay, and Alex Speer—about all of whom I will say more in a moment. I want to use this brief address to touch on three issues related to this award.

The first is *Elements*. I must admit that when I receive each new issue of *Elements*, I am rather proud of this "baby" that is now fully-grown and in its 15th year. I never anticipated the level of success or longevity of *Elements*. I knew that *Elements* was a good idea because I had witnessed the extraordinary success of the *Materials Research Society Bulletin*, which served as a model for *Elements*. Today, let me confess that as a member of the MRS Council, I voted against the creation of the *MRS Bulletin* because I thought that the business plan was not sound. I was humbled by the subsequent success of the *MRS Bulletin*. I now realize that a good idea can prevail over a critical analysis of the business plan. A good idea transcends practical limitations. I also learned that a good idea needs the dedicated attention of those who believe. In this case, two people were of exceptional importance. Pierrette Tremblay brought *Elements* to life by attending to each detail with a patience and skill that I have never had. Alex Speer, the Executive Director of MSA, provided an administrative and financial umbrella for this fledgling magazine. Without Pierrette or Alex, *Elements* would not exist. Importantly, both have received the Distinguished Public Service Award, hence I am honored to be in their company.

My second activity, really a hobby, has been my work on the management and disposal of nuclear waste. Very early in my career, in the 1970s, I became aware of the nuclear waste problem. I was surprised that highly radioactive waste would be immobilized in a borosilicate glass. I had the idea that with an effort of some five to ten years, I could contribute to the development of better nuclear waste forms. I and others, such as Ted Ringwood with his titanate Synroc and Rustum Roy with his silicate supercalcine, made substantial scientific progress. After a decade of scientific advances, I was puzzled that none of the new science was being used. The harder we worked on new science, the more the plans remained the same. Thus,

I have spent the last decades trying to understand why scientific advances have had so little effect on strategies for handling and disposing of highly radioactive waste—hence, my drift into regulatory and policy issues.

I think that there are two important revelations. First, performance and safety assessments, as valuable as they can be, often squeeze the science out of the regulatory process. Second, nuclear waste management and disposal has two important aspects: technical and social. Without full attention to social issues, the science cannot prevail.

This brings me to Konrad Krauskoph who received the Distinguished Service Medal in 1994 for his work on nuclear waste. I quote from his acceptance:

"This problem, unhappily, is as far from solution today as it was when I first looked at it 25 years ago."

"It seems curious to me that public service should be rewarded when it has produced so little."

Sadly, after another 25 years, I can make the same statements. In truth, the passage of 50 years has made the nuclear waste problem even more complicated

Two of the important issues fall within the purview of the geoscience community. We lack experts who have mastered both the geologic and nuclear basics that are required to conceptualize the framework of possible solutions. Second, the application of advanced modeling techniques to simulate the behavior of geologic systems remains speculative. Probabilistic risk analyses out to hundreds of thousands of years, which are used to demonstrate

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regulatory compliance, have squeezed the science out of safety assessments and obscured public understanding. Today, we have proposals that would use deep borehole disposal for radionuclides, ^{137}Cs and ^{90}Sr, which have half-lives of only some 30 years and the disposal of long-lived, highly mobile fission products, such as ^{129}I, in near surface disposal sites. Plutonium (mainly ^{239}Pu) would be placed in the highly soluble salt beds of the Permian Basin. We have strategies that use Ti-drip shields in "dry" environments and hundreds of tons of MgO stacked on top of barrels of transuranic waste in salt beds. These *Alice in Wonderland* strategies can only happen in a world that ignores the scientific challenges and limitations in modeling long-term performance. I believe that we have to make a fundamental change in the approach used to evaluate the safety of proposed "solutions". In the few years I have left, I plan to work in this direction.

Finally, I do not think that we as a discipline, particularly in academia, emphasize the importance of public service enough. Last year, a distinguished economist gave a lecture at Stanford on the economic impact of global warming, but he ended his lecture by warning an audience of young academics not to do this type of work until *after they had tenure*. The ivory tower should be more than a safe haven for academics—there should be a public benefit.

Let me make a modest proposal, we should all spend at least 10% of our time working on subjects that have a social impact—tenured or not. Whatever the topic, we should work to ensure that new data and understanding have an impact on the regulatory and policy framework. I think our role is not only to create new knowledge, but to push that new knowledge into areas that improve the public good. A 10% contribution from each of us could have a huge impact on the quality of life for all of us.

Thank you for this recognition, but there is still so much more to do.