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Acceptance of the 2013 Roebling Medal of the Mineralogical Society of America

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Mr. President, Colleagues, and Guests:

Thank you, Norman, for those kind words; I am not used to being so politely addressed by a Dean. I thank MSA for awarding me the Roebling Medal, and for being a major focus of all aspects of mineralogical research during my professional career. I have derived much enjoyment and satisfaction from my participation in MSA and its activities.

I decided to become a geologist when I was 15. At grammar school, I specialized in Pure Maths, Applied Maths, Physics, and Geography, and the latter provided me with a way into Geology. I was told that the Royal School of Mines (Imperial College) was the place to go to become a geologist, and as I always do what I'm told, this is what I did. I'm afraid I wasn't a very good student, spending too much time on rugby and beer and not enough time in lectures. However, I managed to get through and also developed an interest in Mineralogy. Jack Nolan advised me to go to McMaster University and work with Doug Grundy, so that's what I did. For me, it was an incredible piece of luck. I was idealistic and interested in theory, and Doug, a very pragmatic person, impressed upon me the importance of accuracy and precision, and the necessity of understanding and mastering the equipment one uses. The key thing about McMaster was that the Geology Department was part of the Materials Research Institute, and it was there that I learned X-ray and neutron diffraction and Mössbauer spectroscopy. There was also a large and comfortable coffee room for faculty and students, and this provided the best education one could ever have. Different groups of about a dozen people each, faculty and students, would talk about various aspects of geology, chemistry, and physics every day. It was here that I met David Brown and Bob Shannon in 1971. At our first meeting, Bob took me to his office, showed me what he and David were doing with bond-valence theory, and I was an instant convert. Needless to say, this had an immense influence on my way of thinking about minerals, and I am pleased that Bob and David remain friends and colleagues to this day.

I went to the University of Manitoba for a post-doc with Bob Ferguson, and working with Bob and Petr Černý turned me into a mineralogist. I was exposed first to Ta-Nb oxides and alumino-fluoride minerals, and then to the diverse world of pegmatite minerals. For 10 years, I travelled to McMaster University to collect X-ray data on amphiboles and a variety of pegmatite minerals. Chris Calvo was in charge of the laboratory, and he let me collect data for free (as I had no money). At this time, I was working hard on amphibole crystal chemistry, but I was also looking around for something else to do. I read extensively, and while admiring much of the crystal-chemical work that was being done at the time, I was inspired by the work of Paul Moore on topological and combinatorial aspects of crystal structures. With the publication of a paper on the crystal structure of morinite in 1979, I started on my bond topological journey. I wish I could say that, having identified my goal, I worked toward it at a great rate. However, this was not true. I spent much of the following 30 years fumbling around wondering what was going on with atomic arrangements. I have since rationalized this to myself as follows: if I know what's happening, I shouldn't be working on it; if I'm doing science properly, I *should* be fumbling around in the dark, wondering what's going on.

After my post-doc at Manitoba, I became a Research Associate with the job of renovating an old electron microprobe, getting it working and analyzing minerals (and also replacement teaching a variety of undergrad and grad courses). This was a struggle for a theorist, but things worked out, and in 1980, I was awarded a University Research Fellowship (for 10 years) by the Federal Government of Canada. In the late 1970s, there were no jobs in science and engineering at universities in Canada. The Feds recognized that this might lead to problems in recruitment 10–15 years down the road and hence set up the URF program. Fifty fellowships were awarded each year across science and engineering, and so I became employed.

In 1981, Fred Wicks persuaded me to go to the Tucson Gem and Mineral Show. I immediately became a mineral junky, and also found a source of crystals for experimental crystallography. I have since made innumerable friends in the mineral collector and dealer communities, and they have contributed immensely to my experimental work.

In 1983, I acquired both a single-crystal diffractometer and my first graduate student, Lee Groat. Poor Lee….the electronics of the electron microprobe would only function below 50 degrees F, and he spent countless hours in the probe lab, freezing in a parka, gloves, and woolly hat. So began my adventure with graduate students and post-docs, the people who actually did all the work. When I look back and see what I gave them to work on: Lee Groat—vesuvianite, Mark Cooper—kornerupine, Yulia Uvarova—amphiboles, Julie Selway, Christine Clark, Aaron

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Lussier—tourmaline, I now wonder if I should have given them something more tractable. However, I have never ceased to be amazed at their imagination and capacity for science, from Peter Burns and crystal Hartree-Fock calculations on copper minerals, to Jian-jie Liang and coupled Rietveld and structure-energy modeling, to Oliver Gagne and the analysis of bond-length variations in crystals for the complete periodic-table bonded to oxygen. For many years, I worked on bond-topological aspects of structures by myself, while my students worked on their own topics. This changed when Michael Schindler came to work with me as a post-doc. He insisted on working with me on bond topology and bond-valence theory, and he was right. We had an inspiring (at least for me) collaboration that greatly advanced our ideas on complex minerals, and on what controls their chemical compositions and structural arrangements. I must confess that, in some ways, I was sad to see him get a proper faculty job at another university.

In 1983, I received an invitation from Pep Rossi to visit Pavia, Italy, an event that initiated a lifelong collaboration with Roberta Oberti, Luciano Ungaretti, and their colleagues. In total, I have spent about four years in Italy, a time that has greatly enhanced my cultural and scientific life. In particular, it has given me the opportunity to work with Roberta Oberti on the crystal chemistry of the amphiboles, the longest and most extensive collaboration of my scientific life. This work has led to a greatly increased understanding of the behavior of this fascinating group (or I should say "supergroup") of minerals, and detailed examination of synthetic amphiboles by the "Amphibole Consortium" (Giancarlo Della Ventura, Mati Raudsepp, Mark Welch, Gianni Iezzi, Jean-Louis Robert, and myself) led to the extensive characterization of short-range order in amphiboles.

The Canadian system of research funding gave me the opportunity to build an extensive instrumental facility that has enabled me to collaborate with a large number of people worldwide. This has contributed in a major way to my scientific life, and I thank my comrade-in-arms Norman Halden for cooperating with me in this endeavor over the last 30 years, Joel Grice for the right advice at the right time, Donna Danyluk for taking care of the many details of scientific life that seem to be beyond my capabilities, and most of all, Mark Cooper and Neil Ball for maintaining the instruments and for doing nearly all of the work.

Finally, and most importantly, I wish to thank my wife, Dr. Elena Sokolova, for her love and support, for being so interesting, and for putting up with my argumentative nature. She has greatly expanded my horizons, introduced me to many interesting scientific collaborations in Russia, and has greatly augmented my personal and cultural life.

When I look back on my professional life as a mineralogist, I see that mineralogy is a very special occupation for me. The science provides unending intellectual entertainment, the people that I meet—other scientists, mineral collectors, mineral and gem dealers, museum curators—provide unusual social diversity, and my daily activities provide a level of interest and engagement that is the best reward I could ever receive.