American Mineralogist, Volume 97, pages 1011–1012, 2012

Acceptance of the Dana Medal of the Mineralogical Society of America for 2011

ROSS ANGEL*

Crystallography Laboratory, Department of Geosciences, Virginia Tech, Blacksburg, Virginia 24060, U.S.A.

Any award for scientific achievement, at any level, recognizes just one person without naming the teachers, colleagues, collaborators, co-authors, and the scientific community as a whole that have contributed to the success of the individual. Were I to simply name just those who have formally collaborated with me, for example as co-authors, the list would far exceed the space available for this response. So, rather than list my major collaborators and so risk offending especially those who fall immediately below the cut-off (rather like getting 6 "excellent" reviews on a grant proposal only to be told the money was not sufficient to fund it), I would like to take this opportunity to instead thank some people whose influence on my career may not be so obvious to the casual reader of my scientific publications.

I now realize that the foundations of much of my success in crystallography and mineral physics predate not only university, but even my formal schooling. Both my father, being a quality control engineer, and my mother as a tracer and later a drawing office supervisor, had to develop a precision in work and attention to detail far beyond that required in most peoples' lives. And their influence clearly gave me a head start in a field where precision, and understanding both its significance and its difference from accuracy, is a fundamental requirement for success. While both my parents also gave me the practical engineering background that makes me equally happy (perhaps happier) underneath the instrument to repair it as to use it to produce precise data, I see in retrospect that my grandfather was perhaps an even greater, but nonetheless complementary, influence on me. He spent many, many days in every one of my school holidays taking me around London, showing me not only the well-known major museums and places of history that all tourists visit, but also the lesser-known back streets and alleyways, bomb sites, and obscure fragments of buildings that have marked unwittingly the histories of the cities of Westminster and London and provide the texture and social context for their history. Further, as a journalist, for many years of some stature as the senior journalist in the U.K., he insisted that I write reports of our outings together. So it was he who first taught me to observe and record the critical details and then report them in the context of the larger picture—an essential skill that was later reinforced by a very rigorous secondary education, much of which I hated at the time. But in retrospect I can now see my schooling as having developed my skills as a reporter of experimental science. Not only in the science classes, but especially in the endless and painful years of classes in English grammar and précis, the latter a process for which English has not yet developed a word adequate to describe the full horror faced by a schoolboy having to reduce a novel to a paragraph of precisely (yes, precisely) 100 words.

My schooling, and the teachers there, provided me with an excellent basis in theoretical and experimental science in classes that emphasized the integrated nature of the physics and chemistry of the solid state. That was continued at University under the guidance of many excellent teachers, Michael included. I remember the excitement of understanding the spinodal microstructures in feldspars and pyroxenes in terms of the free energy curves of the minerals, and was even more excited when I learned that what Michael had just described to us undergraduates was current cutting-edge research. Of all of the many excellent teachers in "Min-Pet" in Cambridge I do want to especially thank my undergraduate advisor Mike Bown. Many will know him as the creator (with the late and wonderful Peter Gay) of the "a", "b", "c", and "d" notation for the diffraction maxima of feldspars and, more importantly, for recognizing the structural significance of these classes. But I know Mike as a man of great insight into human nature who guided me through many years with wit, much well-aimed criticism and raised eyebrows, great parties, and endless encouragement to do better. I still often quote his comment on one answer sheet of mine: "grade α-: you have merely reproduced the material of the lectures perfectly." The standards implied by this evaluation remain beyond my ability to reach, although I still strive to do so.

In his citation, Michael Carpenter has emphasized the broad range of materials on which I have worked, from high-temperature ceramics to low-temperature metamorphic minerals and including some very obscure (but technologically important) perovskite compositions as well as the mineral group to which most mineralogists from Cambridge devote a substantial portion

* Current address: Department of Geological Sciences, University of Padova, Via G. Gradenigo 6, I-35131 Padova, Italy.

0003-004X/12/0506–1011$05.00/DOI: http://dx.doi.org/10.2138/am.2012.589

of their career—the feldspars. This eclectic mixture of materials I have chosen to study derives from my fundamental belief that the physics and chemistry of the solid state at the crystal-chemical level is the same, whatever the material. And that the crystal-chemical level is the correct one to use to develop an understanding of the complex behavior of minerals because it provides an intellectual framework (pardon the pun) that can link causes in structures with effects in properties. Thus, insights into the crystal chemistry of feldspars can be gained from understanding how the frameworks of perovskites respond to changes in pressure and temperature, because while the principles of behavior are the same the balances of forces are changed. Some have criticized this approach as being "reductionist," but I want to understand "why?''. Why are some of the elastic tensor components of coesite and feldspar of anomalous signs? And why are their magnitudes the ones they are? And why is the three-dimensional framework of a feldspar as elastically anisotropic as a mica? If it does not develop an understanding of the systematics of the behavior of the material world that can answer the "why?" questions, all science becomes merely politics, hearsay, and stamp-collecting.

The other side of my professional life is the development of methods, because without the tools to test the ideas precisely, our science cannot progress. I was very fortunate to be taken to the Geophysical Lab by Charlie Prewitt and to be introduced to Larry Finger, the consummate crystallographer, programmer, and clear thinker. I have also been trying to live up to Larry's standards for 30 years and also have yet to achieve them. Nonetheless I have been fortunate to not only inherit Larry's crystallographic software but especially to have the opportunity to subsequently develop the Single software over more than two decades to support the exciting research programs of a lot of younger colleagues around the world. They often have much better ideas than me for measurements (and much more nimble fingers with which to carry them out), so continuing this support and development for the renaissance of single-crystal diffraction will be one of the major joys of my future career.

Michael has noted that the Dana medal is a mid-career award (I once called it the middle-aged award) and that more is expected—in the words of Churchill in a more serious and important context "It is not even the beginning of the end. But it is, perhaps, the end of the beginning". Perhaps I have almost completed the end of the beginning, my training in basic physics and chemistry of the solid state. And now, through my interactions with the community of scholars of the solid state, including mineralogists and petrologists, I hope that I can continue to make contributions to our understanding of minerals and mineral behavior. Indeed, those who read my Dana lecture will see that the tools now available to us today to both model structures at the crystal-chemical level and to measure their elastic properties appear to make it possible to develop over the next decade the structure-function relationship that is central to modern biology but has so far eluded us in mineralogy and petrology. And that will be the beginning of the end.