which ternary feldspars and other minerals evolve in a satisfyingly regular way.

After I had given the Hallimond Lecture in 1977 I fell into conversation with Bill Brown, who was by then based in Nancy, France. This started intense collaboration which continues to the present. The first of our many shared papers was on two-feldspar geothermometry, but we then moved on to a TEM study of feldspars from Klokken. Since moving to Edinburgh in 1988 much of my work has centred on TEM, but I am a fraud, because most of the microscopy has been done by Bill and by a succession of splendid post-docs, Richard Worden, Kim Waldron, and currently Martin Lee. Bill is a far better crystallographer than I am, but somehow our interests and approaches are complementary and I have found our collaboration hugely rewarding. TEM can open a Pandora's box in minerals with complex microtextures; the secret is to study sets of samples from simple, well understood geological settings. In this respect Klokken has been a Rosetta stone, allowing the effects of cooling rate and composition to be disentangled, and showing how fluid–feldspar reactions can lead to pervasive recrystallization within 'single crystals'. Two research students, David Walker and Adrian Finch, have explored the geochemical implications, and Alex Halliday led me to consider the importance of microtexture in the $^{40}Ar/^{39}Ar$ field. Ray Burgess, Simon Kelley and I have collaborated on a study of the systematics of argon and halogens in alkali feldspars, using laser extraction and crushing, and we can relate the gases to the enclosing microtexture. I feel sure that many of the advances of the coming years will be at the interface between microtexture and geochemistry.

Mike, we have been good friends for many years, and it is a great pleasure to receive the Schlumberger Medal from you. We have had our feet in both petrology and mineralogy, and we have branched out into new techniques, in my case TEM, in your case synchrotron X-ray work. Last summer I directed a meeting of the feldspar mafia, in the form of a NATO Advanced Study Institute, in Edinburgh, and what is striking about these meetings is not how specialized but how wide ranging they are, in Earth environments from the mantle to soils, and in techniques from the hammer to EXAFS. Although our paymasters incessantly impose the most stupid distractions upon us, the science of mineralogy will forge robustly along, and I feel greatly honoured that the Society should signify, through this medal, that I have made a worthwhile contribution.

1993 Max Hey Medal

Presentation, by the President, Professor C. M. B. Henderson, to Dr R. J. Angel, 6 January 1994, at the University of Glasgow

In 1993, the Council of the Mineralogical Society approved a recommendation to establish a new medal, specifically for a 'young' scientist; 'young' being defined as less than 35 years. It was decided to name this medal after the late Max Hey, in recognition of his contributions to mineralogy in general and to our Mineralogical Society in particular. The citation for this new medal reads 'To recognize existing and ongoing research of excellence' and 'evidence of excellence should be in the form of work published in highly-regarded, international scientific journals'. Our nominee more than meets these requirements, and it will be my pleasant duty to present the first Max Hey Medal to Dr Ross John Angel for his crystallographic research on a variety of materials.

Dr Angel has the valuable pedigree of having graduated from Cambridge University with a first degree in Mineral Sciences, followed by a Ph.D. from the same 'stable'. His research topic was concerned with structural relations and phase transformations in pyroxenes and pyroxenoids, supervised by Dr Andrew Putnis. In the course of this work he gained experience in X-ray powder diffraction, high-resolution TEM, computer modelling, and piston-cylinder experimental techniques. He was then awarded a NATO Research Fellowship to go to the USA, the first year of which was held at the State University of New York at Stony Brook where he worked with Professor Charles Prewitt. During this time he embarked on the study of phases with incommen-

surate structures using single crystal X-ray and neutron diffraction methods: he also met and became engaged to Nancy Ross, who is, of course, now his wife. When Professor Prewitt moved to the Carnegie Institute of Washington Geophysical Laboratory as Director, Ross went with him and expanded his own research interests to include studies of high-pressure phase transitions of feldspars using diamond anvil cell techniques, and of the structures of high-temperature superconducting phases. Indeed, Ross was one of the team that published the first structure of a 90 Kelvin, 1-2-3 superconductor in 1987. In 1988, he moved to the Department of Geosciences at University College London as a Royal Society Fellow and thus joined the reverse 'brain drain' which occurred as part of the UGC Earth Sciences Review. Unfortunately for mineral physics research in the UK, he has very recently drained-away again to take up a new appointment at the Bayerisches Geoinstitut, Universität Bayreuth.

Over a 10 year period, about 40 of his papers have been published in major international journals. The range of research spans topics from mineralogy to solid state physics and encompasses both experimental and theoretical methods. Materials studied have included single-chain silicates, feldspars, cordierite, mullite, new minerals and, of course, superconductors. It seems to me that such a range of research is quite exceptional for someone of such a tender age.

In 1990 Dr Angel was presented with a Research Award from the American Mineralogical Society, and in 1991, with the Philip's Crystallography Award of the British Crystallographic Association. Ross, on behalf of the Mineralogical Society of Great Britain and Ireland, I am delighted to present you now with the first Max Hey Medal. I hope that this handsome silver medal will help to stimulate further excellent work in your future career.

Acceptance by R. J. Angel

Mr President, Members of the Society, the citation for this award uses the words 'young scientist', so as such I will not be so presumptuous as to make statements on the state of mineralogy, or where I think research in Universities is headed over the next decade. I would, however, like to take this opportunity to thank many of the people who have influenced me and helped me over my first decade in research, and those who, when I was an undergraduate, encouraged me to start this career.

Unlike many mineralogists, and others whom I meet in the geological world, my interest in mineralogy did not come from collecting rocks, minerals, or even fossils at a tender age. Instead, my career in mineralogy started when I went to Cambridge as an undergraduate with an intention to specialize in chemistry within the Natural Sciences Tripos. I was fortunate enough to be a member of Clare College where Mike Bown was the tutor and supervisor for Crystallography. I immediately found crystallography a much more rewarding study, partly because it required only the learning of principles instead of endless lists of arbitrary facts, but mostly as a result of the inspirational teaching of Mike Bown, who I know has also inspired several generations of Natural Scientists as well as many of my immediate colleagues in crystallography and mineralogy. I was also very fortunate to have as my teachers, as I progressively specialized in crystallography, a series of people who not only taught very well but also persevered with me when I the student could not see the purpose of learning the subject in hand. Needless to say, I have subsequently had to return, 'cap-in-hand', to the likes of Tim Holland, Mike Bown, Christine McKie and Mike Carpenter to ask about the areas of our broad subject where I did not pay sufficient attention as an undergraduate. It goes witout saying that they have always been very helpful, but my experience does show that students are not the best qualified, despite assertions of current bureaucracies to the contrary, to decide what they wish to be taught.

Following my undergraduate degree, Andrew Putnis showed great faith in me by applying not once, but twice, to NERC for a research studentship on appeal, and then letting me alone for three years to pursue several areas of research on chain silicates, much of which concerned bustamite and rhodonite, the subject of one of Max Hey's earliest studies at the Natural History Museum. It was at this point, sharing offices at various times with a great range of field geologists, petrologists and geochemists that I started to learn about the possible applications of mineralogical studies to solving large scale problems in Earth sciences.

On completion of my research studentship I joined Prof. C. T. Prewitt's group at SUNY StonyBrook, on a fellowship to determine the structures of incommensurate minerals such as mullite and plagioclase feldspars. This move brought me two major pieces of good fortune that have shaped my subsequent life. First, Charlie Prewitt had also hired a young post-doctoral worker, Nancy Ross whom, through Gretchen Prewitt's hosting of excellent dinner parties, I met in a social as well as professional setting. Charlie and Gretchen became almost surrogate parents to us as we rapidly became engaged, and like all mothers Gretchen spread word of what we thought was a well-kept secret to all who passed through StonyBrook on their way to the International Mineralogical Association in Stanford in 1985. Nancy and I were most surprised, therefore, when we arrived at IMA after a quiet holiday in Yosemite to find ourselves the centre of attention, but it was most enjoyable! Subsequently Nancy has been the greatest help to me both as an outstanding scientific colleague and partner in marriage, although these two aspects of our life together often become confused. For example, as an archetypal husband, I often fail to listen to Nancy, but subsequently decide that what she has suggested is an extremely good idea. Most of my more productive research projects, including the current one on pyroxenes, started this way.

The second piece of good fortune for us at StonyBrook was Charlie Prewitt's appointment as Director of the Geophysical Laboratory, and his request that we move with him to Washington. Having seen the developments in experimental petrology at upper mantle pressures at StonyBrook under Bob Liebermann and Tibor Gasparik, the move to the Geophysical Laboratory brought us to work with Larry Finger and Bob Hazen, the foremost developers of single crystal diffraction at high pressures. But that was an area that I did not initially pursue as soon after our arrival the first of the two liquid-nitrogen temperature superconductor 'events' took place. Bob Hazen received a telephone call from Paul Chu whose group had synthesized a two-phase mixture of which one component was a 90 K superconductor. Our job, over one very hectic week, was to determine the structures of the two phases by X-ray diffraction, as well as their compositions to allow Chu's group to synthesize the pure phases. The whole story was subsequently published, to our mild embarrassment, by Bob Hazen in a book sub-titled *The Race for the Superconductor*. A race it certainly was, and gave us both our first taste of working (and writing papers) under extreme time deadlines—I well remember writing portions of the first Physical Review paper with both Bob and Paul Chu grouped around the computer about five minutes before the postal courier was due to arrive to collect the manuscript. After the initial excitement the crystallography group then settled back to other work, occasionally interrupted by various research groups around the US asking us to help in the characterization of various side-products of attempts to synthesize other superconductors. Amongst other things in that extremely productive year Bob Hazen told me that since I was from Cambridge I should be studying feldspars. So we embarked on what we thought was to be a straight-forward introduction for me to diamond-anvil cell work with a compressibility study of end-member feldspars. As we should have guessed from their extremely complex low-pressure behaviour, it transpired that feldspars are similarly complex in their compressional behaviour and we are still characterizing their various high-pressure phase transitions some six years later! Charlie Prewitt's appointment to the Geophysical Laboratory had also involved funding for a rotating anode generator, and one of the more amusing incidents of that year was hanging out a first storey window (of the old laboratory building in Upton St.) removing components from the $150,000 generator perched on a fork lift truck (which was in turn manoeuvring upon a flat-bed truck) because the generator was just too big to fit through the window frame.

And then, almost exactly a year later, the crystallography group received two more phone calls from physics departments. Each had synthesized new superconductors, both members of what turned out to be polytypic series of structures, and we were off again into a couple of weeks of very hectic crystallographic characterizations. While not in the end being particularly satisfying, as structural studies of the initial

synthesis products are always severely limited by the usually poor quality of the crystals, this sort of work has the same appeal as that of, for example, exploring a new land. In fact, it is almost better, because as the crystal structure emerges from the data, one knows one is looking at something never previously seen by man.

The life of post-docs is short, as many readers of this either know, or are about to find out! Nancy and I had to leave Upton St. with its Friday beer hours (termed liquidus) on the front lawn with views across Washington to the Capitol. We took positions at University College London, my wife as a lecturer and myself as a Royal Society research fellow, where we set up and developed our own laboratories to carry out high-pressure diffraction. The now head of department at UCL, David Price, has encouraged us to apply our research to mantle problems, and this has led us to explore the technical limits of both the precision and maximum pressures of our experiments. We believe we have made some progress to improving both areas. In particular, we have continued our stimulating collaboration on the development of diffractometer software with Larry Finger of the Geophysical Laboratory, mostly by means of that essential modern research tool, E-mail. On the practical side we are now looking to develop the ability to carry out high-quality diffraction studies at simultaneous high pressures and temperatures that will allow us to study mantle minerals at conditions directly relevant to the Earth's interior, thereby avoiding the current dangerous necessity of extrapolating their behaviour.

Working in London has, like the other places in which I have worked, brought its own particular lessons and incidents. Of the former, it has given me an opportunity to learn under David Price's guidance, how to run a laboratory, not necessarily in a practical sense but in terms of operating within the political environment of a university department. The latter mostly involves the excellent variety of real ales now to be found in London pubs, and should, perhaps, not be alluded to further! I hope to take all of the lessons with me as I take up a new position as crystallographer at the Bayerisches Geoinstitut in Bayreuth, which will provide me with many new opportunities to interact with petrologists and geophysicists.

Mr President, members of the Mineralogical Society, it gives me great pleasure to accept this award, which marks the completion of my first decade in mineralogical research. Ian Carmichael said in his acceptance of the 1992 Schlumberger Medal that such an award is a tribute to one's students. In my case, I would like also to add my thanks to all of the people who have helped me over the years. I have tried to acknowledge some of them, but there are many more colleagues and friends who have provided advice and friendship over the ten years. My thanks to you all, and I look forward to the next ten years which I aim make at least as productive as the decade just past.