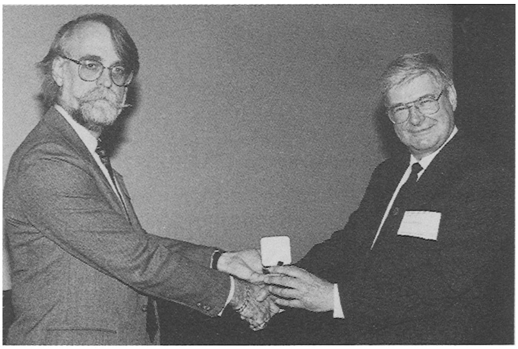
1994 Mineralogical Society–Schlumberger Award

Presentation, by the President, Professor Ian Parsons, to Professor F. C. Hawthorne, 5 January 1995, at the University of Sheffield

I first met Frank Hawthorne some years ago in Joe Smith's country home on the shores of Lake Michigan. I can remember Joe's exact words of introduction. He said: "This is Frank Hawthorne, *mineralogist extraordinaire*". Quite why Joe felt obliged to resort to French for his superlative I do not know, but the description certainly fits the subject perfectly. It is a great pleasure to introduce Frank Hawthorne as this year's recipient of the Mineralogical Society's premier award, the Schlumberger Medal, and I can do so secure in the knowledge that he is a quite outstanding figure at the forefront of world activity in mineralogy.



Frank Hawthorne (*left*) receiving the Mineralogical Society–Schlumberger Medal from Ian Parsons.

Frank is currently Professor of Crystallography in the Department of Geological Sciences at the University of Manitoba in Winnipeg, where he went as a post-doc in 1973 to what was then called (in contrast to the changes made in many UK Departments) the Department of Earth Sciences. He was born in Bristol, England (retaining, miraculously, a trace of a west-country accent) and graduated in Geology from Imperial College in 1968. His PhD, obtained at McMaster in 1973, was on *The Crystal Chemistry of Amphiboles*, and it is for his work on amphiboles that he is probably best known, although in fact they make only a relatively small fraction of his output (so far!) of some 200 papers. A 300 page review paper, with the same title as his PhD thesis, was published in Canadian Mineralogist in 1983, and is particularly well-known.

The range of minerals Frank has studied is extraordinary, including the important rock-formers, amphiboles, pyroxenes, staurolite, vesuvianite and beryl. He seems to have given feldspars a miss — perhaps he finds their simple chemistry too dull! Others that have gone to satisfy his amazing appetite for mineralogical challenges include an extraordinary range of rare minerals, many of which, unless I am much mistaken, will be as unfamiliar to Mineralogical Society members as they are to me: pinchite, preobrazhenskite, inderborite, wickenburgite, spangolite, meyerhofferite, dietzite, stillwellite .... these crop up in 1993–94 alone! Linking all this together is a profound desire to understand the fundamentals and underlying principles of crystal structure, the factors which link the enormous diversity of crystal chemistries and structures. This has led to the development of a framework for the understanding of crystal structures based on the energy content of the chemical bonds in structures treated as topological networks. His approach has been recognized in crystallographic circles as an important development in solid state chemistry. Notwithstanding these contributions to chemistry and physics, Frank has not lost sight of his geological roots, and has made substantial contributions to the study of granitic pegmatites, gossans and sabkha deposits. His work on many mineral species has been directed at understanding crystal-chemical principles which can be applied in a petrological context, to understand conditions of formation of a particular deposit.

A tremendous range of physical techniques has been applied to these problems, many of them novel, or substantially advanced by his development, and Frank is an acknowledged leader in these techniques in their own right. They include Mössbauer, infrared and Magic Angle NMR spectroscopies, and he edited the Mineralogical Society of America volume on Spectroscopic Methods in Earth Sciences. He is involved in Proton-Induced X-ray and Gamma-ray

Emission Analysis, and as well as producing many papers involving conventional structure refinement, has been a major force in developing the Rietveld method of structure determination which is especially useful for very fine-grained synthetic or natural assemblages. His work has also included *ab initio* molecular orbital calculations, and band-structure methods applied to minerals.

It is impossible to think of any other mineralogist with such a broad range of skills and interests. It is good to know that although much of your work has been done in Canada you began this outstanding career as a British graduate. You have maintained many links with the British mineralogical community including naming an amphibole after our own amphibole-man, Bernard Leake.

Frank Hawthorne, it is a real pleasure and an honour to be able to hand you the Schlumberger Medal to add to your existing array of honours and awards.

Acceptance by Frank C. Hawthorne

When Ian called me and said that I had been awarded the Schlumberger medal, I felt an initial thrill of elation. Experience then asserted itself and I asked him "What do I have to do?". He answered "It's very simple; you shake my hand, take the medal, and then bare your soul to the audience".

So tradition dictates that I should say something about my scientific history. As a boy, I was always interested in the natural world: flowers, trees, birds; this developed into an interest in the landscape and physical geography. In turn, this kindled my interest in Geology, and I attended the Royal School of Mines, Imperial College. I must confess that an addiction to sport and social activities led to a very undistinguished career as an undergraduate. However, I have never ceased to be amazed at how much Geology I was taught, even though I wasn't paying attention for much of the time. In fact, this period has had a major influence on my career, as I have always considered myself as a geologist first and a crystallographer second. It was here that I also realized the importance of minerals. From the start, we were told "If you can't identify minerals, you won't find mines!".

I decided to go to Canada for graduate work. Jack Nolan told me to go to McMaster University, and I'll always be grateful to him for this advice. I went to McMaster and began my grad work with Doug Grundy. At our first meeting, he asked me what I wanted to work on, and I said "Feldspars". He replied "Take my advice; never work on feldspars"; I've followed this advice to the letter ever since. Doug suggested that I work on a curious blue amphibole that Jim Crockett had found in the Frood mine at Sudbury. I began work on the crystal chemistry of the amphiboles at a time when the chain silicates were becoming very fashionable. However, at this juncture, I was extremely fortunate. The success of the Apollo program induced most crystal chemists to focus on the pyroxenes, with the result that I was left to putter about with the amphiboles by myself.

McMaster was a very interesting place to be a graduate student. Geology, Physics, Chemistry and Materials Science occupied the same building and had joint coffee facilities: perhaps a dozen or so large tables, each surrounded by a mixture of faculty and grad students from all four disciplines. I learnt an enormous amount of science in this environment, and scrounged time on a neutron diffractometer, Mössbauer spectrometer and infrared spectrometer through contacts at 'coffee time'. Doug Grundy supported all my sorties into other areas of science, never baulked at the associated problems or costs, and also taught me to have a healthy scepticism about the numbers that come out of instruments and computers. While I was at McMaster, Bob Shannon came from Dupont to work with Chris Calvo on vanadate structures. He developed a very strong pairwise interaction with David Brown, an interaction that resulted in the derivation of bond-valence curves for inorganic materials. As a grad student, it was a very exciting experience for me to be in on this, and the subsequent development of these ideas has greatly influenced my own thinking on structure and bonding in solids.

I went to the University of Manitoba to do a post-doc with Bob Ferguson, another feldspathologist. Bob encouraged me to follow my own interests, and although we cooperated on many things, they all involved transition metals. I also became exposed to Petr Černý, who showed me that there are many more minerals in the world than I had hitherto suspected, and I began to learn mineralogy. I read extensively in mineralogy and crystallography, and came across the work of Paul Moore. This was a seminal experience for me, and changed my principal interest to bond topology in mineral structures and its relationship to mineral paragenesis. An interest in the combinatorial aspects of nets led to an invitation to spend some time in Chicago working on nets with Joe Smith. At this time, I got to know Jeremy Burdett who significantly influenced my thinking on the relation between bond topology and energetics in crystal structures.

In 1983, I was invited to speak at a meeting on pyroxenes and amphiboles at Tivoli in Italy, and also visit the CNR centre in Pavia. This began a (for me) very important cooperation with Roberta Oberti, Luciano Ungaretti, Elio Cannillo and the late Giuseppe Rossi, and later with Luisa Ottolini and her colleagues. We have worked together extensively on amphiboles and staurolite, and I have been fortunate to spend a significant amount of time with them in Pavia; it has been an inspiring experience.

Sometimes I can't believe that someone actually pays me to work on minerals; they don't pay me enough, but I'm amazed that they actually pay me at all! Considering the serendipity involved in how one's early education develops, I feel that I have been really lucky to become a mineralogist, particularly at the present time. The science of the Earth is currently going through a major transition: Geology, Oceanography and Atmospheric Sciences have developed to the extent that they are no longer able to ignore one another. Flux exchange across boundaries between the solid Earth, oceans and atmosphere can no longer be ignored as our science becomes more integrated and more quantitative, and the three disciplines are now melding to form Earth Sciences. This process has been accelerated by environmental concerns that are now reaching global proportions. However, we cannot lose sight of the fact that minerals are the fundamental materials of many of these global processes, and we must understand the properties and behaviour of minerals if we are to understand Earth processes at a fundamental level. The problems to be solved are fascinating; I hope you all have as much fun working on them as I have had in the past, and intend to have in the future.

1994 Max Hey Medal

Presentation, by the President, Professor Ian Parsons to Dr S. A. T. Redfern, 5 January 1995, at the University of Sheffield

The Max Hey medal goes to 'young' scientists, that is, 35 years old, or younger, who have shown 'evidence of excellence [which] should be in the form of work published in highly-regarded, international scientific journals'. Simon Redfern, our second recipient of this medal fulfils both these criteria, the first with a few years to spare, the second with a splendid output of over 30 papers both in the condensed matter physics and in the mineralogical literature.

Simon Redfern (*left*) receiving the Max Hey medal from Ian Parsons.

Simon has actually sprung from the same stable as Ross Angel, last year's recipient, with both a first degree and a PhD from Cambridge, the latter on *Thermodynamics of displacive phase transitions in framework silicates* under the supervision of Ekhard Salje. He has been one of the leading lights in the group which has shown that the Landau model of phase transitions works extremely well for many mineral species, including feldspars. After a year as a temporary lecturer at Cambridge he moved to Manchester, in the aftermath of the Earth Science Review, but in early 1994 returned to a University lectureship in Cambridge.

Simon's work has been mostly concerned with phase transitions, in silicates, carbonates and oxides. Phase transitions have been studied using synthetic materials using *in situ* methods at high T and P. Thus he has used the high-resolution X-ray diffraction facilities at the Daresbury Laboratory synchrotron. He is an expert experimentalist, including the use of diamond-anvil cells. Words like 'spontaneous strain' and 'coupling' and 'ferroelastic' appear frequently in the titles of his papers, and there is no doubt that very real insights into the behaviour of a wide range of complex materials have come through the unifying Landau theory, to which he has made major contributions. No mineralogist working on phase