

1992 Mineralogical Society–Schlumberger Award

**Presentation, by Professor C. M. B. Henderson, to Professor Ian S. E. Carmichael,
16 December 1992, at University of Manchester**

ON behalf of the Mineralogical Society of Great Britain and Ireland, it is my pleasant duty to present the Mineralogical Society–Schlumberger Medal to Professor Ian Carmichael of the Department of Geology and Geophysics, University of California at Berkeley. The citation includes the words ‘To recognise scientific excellence in mineralogy and its applications...’ and there can be no more worthy holder of the third medal to be presented. Ian currently defines his research interests as ‘Igneous petrology, thermodynamic properties of silicate liquids, analytical chemistry of silicates, volcanology, and geology of western Mexico’. His publication list shows that he has made major advances in all of these topics as well as in other areas as witnessed by the fact that he already holds the N. L. Bowen award from the American Geological Union and the Arthur L. Day medal from the Geological Society of America. It seems entirely appropriate that a learned society in the country of his birth should now recognise formally his contributions to science.

After graduating with his first degree from that distinguished academic stable at the Department of Mineralogy and Petrology, Cambridge University, he did field work for a year in arctic Canada before he returned to academia to do Ph.D. research at Imperial College, University of London, on the Thingmuli volcano, Iceland. Before he finished his thesis work he was appointed to a Lectureship at Imperial College where he stayed for 5 years before going to the U.S.A. on a National Science Foundation Senior Foreign Fellowship on leave of absence from Imperial College for 1 year. He was supposed to divide his visit between Chicago, Berkeley and Pennsylvania State but he must have liked California so much that he never got to State College. In fact, he never got back to Imperial College or the U.K., having stayed at Berkeley ever since (1964–present day), working his way to Chairman, Dean and now (Acting) Provost for research.

The list of Ian’s Ph.D. students and Fellowship collaborators includes many who are now emi-

nent in their own right, holding Professorships in Universities worldwide. His own Bibliography lists about 130 papers, including 6 in 1992 so far!!! Early papers were mainly based on meticulous analytical work on phenocryst phases laboriously separated from volcanic rocks—this was before the luxury of the electron microprobe. He was subsequently one of the first petrologists to make use of this invaluable new analytical tool. Throughout his research career he has continued to use his skills as a wet chemistry analyst, as well as playing major roles in work involving such novel techniques as double-axis spinning Nuclear Magnetic Resonance spectroscopy and ultrasonic studies of melt structure.

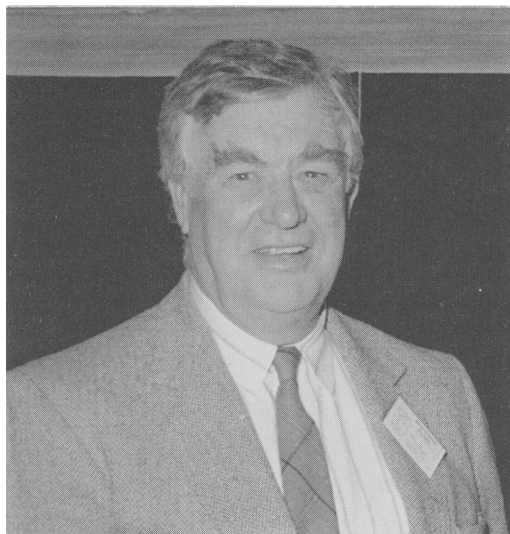
During this intensive research career he found time to front the excellent Carmichael, Turner and Verhoogen text on ‘Igneous Petrology’ and also served as Editor-in-Chief and then Executive Editor of Contributions to Mineralogy and Petrology for a total of 17 years.

On a more-personal note—I encountered Ian when I was a Ph.D. student at Imperial College, supervised by one of his colleagues. Ian eventually became a major source of advice and encouragement for my research and I will always be grateful to him. This advice usually took the form of two-way arguments—I quickly learned to try to give as good as received and I even won some of the arguments. One of my most embarrassing moments was when he asked me to take his crucibles off the hotplate when I finished late one night. The hotplate was fired by gas and I turned it off and then picked up one crucible. The burner blew-back and I spilled some of the crucible’s contents which contained one of his carefully separated iron oxide phenocryst phases. I owned up in fear and trepidation the next morning and was greeted by an amazingly calm and kind reaction. Needless to say he took it out of me later!

Ian, it gives me enormous pleasure to present you with the Schlumberger Medal. It is a handsome silver medal and I hope you will treasure it and keep it with your other well-deserved awards.

Acceptance by I. S. E. Carmichael

FLYING between San Francisco and Chicago, en route to London, I wondered what was said last year on this occasion when Bernie Wood received the Schlumberger medal. Reading Bernie's acceptance I felt a surge of pleasure at returning, after almost 30 years in Berkeley, to the society that gave me the opportunity to make my first professional friends. At an event like this, one should not bore an audience with a contentious view of the future of experimental geochemistry, so instead I would like to tell you of the 1950s when I was a student and a young staff (faculty) member. In those days the floor of the Geological Society of London, either at its meetings, or at those of this Society, was the stalking ground of four giants of the times: Professors Holmes (Edinburgh), Read (Imperial College), Tilley (Cambridge) and Wager (Oxford; superfluous affiliations perhaps but informative to my younger colleagues in the U.S.A.).



My geological story starts with Stuart Agrell of Cambridge, who on my first meeting with him as my tutor, warned me of the evils of religion and women, particularly in combination; he inclined towards moderation in all things, including moderation. He is unrivalled in his skill with a microscope, and demonstrated enormous stamina for field work in NW Scotland in the most appalling weather, now considered even more so after my sojourn in California. In my senior year

he nominated me for membership of this Society, with annual dues of about 7/6d. In later years I was often a guest at his home, partly built in Tudor times for contemporary tall men of 5'3" but with a magnificent garden to salve repeated head injuries. On one of my visits to Cambridge, as a London research student, he introduced me to Osborn (Penn State), who was golfing in Cambridge on sabbatical, but who took the time to explain the mysteries of oxygen fugacity and its effect on liquid differentiation.

After graduating from Cambridge, I wintered in the Canadian arctic, and returned to England anxious to become a research student. I had an idea of the problem I wanted to investigate, and at Stuart's suggestion, I obtained an appointment with Professor Tilley. He was a daunting character, whom I only came to know later in the sixties in the U.S.A., where he shed his gruff and stern exterior to become a convivial and generous host with an infectious zest for professional gossip. Tilley left me in no doubt of his low opinion about my proposed problem, the relationship of phenocrysts to the congealed liquid of obsidians and pitchstones. He saw the absence of a thermocouple to measure obsidian quench temperatures as being insurmountable (useful mineral geothermometers were still some time away); instead he proposed that I should work in the Moines on a metamorphic problem. I found this so unappealing that I visited the Imperial College of Science. Here I met Professor Read, who I suspect was intrigued by the prospect of a Cambridge graduate (therefore a magmatist) wanting to work with him, for he reassured me that the volcanic world of obsidians and the like had nothing to do with the immense affairs of granitic plutons.

So I came to meet George Walker; his interests in Iceland were dominantly geological and zeolitic, mine became petrological and chemical. He was a phenomenal observer, even mapping the habits of individual mineral species while I was struggling to identify any two of them. George was not yet a licenced teacher in the University of London, so I handed my thesis draft to John Sutton. As I remember he read it overnight, and then the next day offered me a job at Imperial College. Thereafter I had five glorious years as a staff member at IC, sharing an office with that consummate structural geologist and musician, John Ramsay. Soon a rudimentary

group of research students (Gloria Borley, Wally Johnson, Ian Gibson, David Blake, Tony Beswick, Ian Baker and peripherally Mike Henderson), as devoted to lunch in the Ennismore Arms as to volcanic petrology, came into being.

Travelling daily forth and back from the housing that one could afford to Imperial College provided two or three hours of unfettered opportunity to read the literature; the ploy of on-upmanship of those days was to cite literature in quaint obscure journals. Nowadays memoirs and treatises lie undisturbed on most desks, and only the shortest of papers in the essential journals are read; to my dismay my students often do not cite papers more than five years old, so we are doomed to continually rediscover the wheel.

In those days, Oxford controlled the editorial management of the two prestigious journals, *Geochimica Acta* and the *Journal of Petrology*; Wager of the former and Malcolm Brown of the latter. An Imperial College pedigree, normally gaining instant access to the annals of structural geology, did not do so to those journals. However a hastily prepared manuscript on pyroxenes, laboriously separated and analysed by wet chemistry (with the advice of the maestro, David Vincent), developed into a friendship of many years with the then supremo of pyroxenes, Malcolm Brown.

My unsurpressed interest in the vagaries of feldspar crystallisation in obsidians took me to a meeting of this Society, and after a nervous delivery in the Geological Society, I waited for questions. A tall bearded red-headed man rose to say with a Scots lilt 'Mr. President, I would like to congratulate Mr. Carmichael on his presentation'. (My relief at surviving the ordeal was overwhelming, so that I did not immediately appreciate the significance of the word 'presentation'.) 'However I cannot agree at all with his conclusions. I think that he is in error.' So started an enduring and valued relationship with Mac (W. S. MacKenzie, Professor of Geology in the University of Manchester) who is surely one of the great mentors of his era. I, one of his several minions, look back on the years when we collaborated on experimental phase equilibria in Manchester as the most stimulating and satisfying of all. We once attracted the ire of Professor Read, who in a brilliant and witty speech, sermonical in style and delivered to an excited conference, poured scorn on the idea that the shrowded majesty of his vast granitic plutons could be revealed in those scruffy little gold capsules that experimentalists used.

Visiting Manchester frequently from Imperial College, alas not on the Manchester Pullman, I

became friends with Bob Howie, who not only searched for willing recruits for his beloved and essential *Mineralogical Abstracts*, but also had an unremitting gusto for the politics and rumours of geologic affairs, and like many moderate men, drove his mini-Minor like a fiend. Jack Zussman, a more sedate driver, coached me through the intricacies of powder diffractometry, whereas Jack Nolan resisted sharing his precious bombs, until the last.

Mac and I decided to approach DSIR (succeeded by NERC) for a joint Manchester-Imperial College experimental project on feldspar liquid-solid relations, for which there was a subsequent hearing chaired by Professor Wager. Doubtless seeking escape from awarding such a large sum to a geology project, Wager proclaimed that Mac and I were not geologists, but chemists, and duly gave us what we asked for. Then Mac and Joe Smith of Chicago, the twin monarchs of feldspars, conspired to get me a National Science Foundation (U.S.A.) fellowship to visit Chicago for a few months, and I was granted a nine-month sabbatical leave from IC. The Head of the Geology Department there was David Williams, who celebrated my departure with a pre-prandial sherry in his office, in quite the smallest vessel that I had ever seen; in later years his identical twin brother in Berkeley had no such qualms about my sobriety, and proffered gargantuan glasses filled to the brim.

Nightly sessions on the Chicago electron microprobe illustrated the enormous potential power of this machine, forever allowing us to abandon the desperately arduous separation of minerals for chemical analysis that everyone had been forced to do until then. Then came the chance to visit Berkeley, for there were dominant and influential characters there too, and a short visit turned into a permanent translation. Howell Williams held sway, an ardent field geologist with an exhaustive experience of all things volcanic, and great pride in his Liverpool degree in archaeology. He reigned in partnership with John Verhoogen, the most analytic and far-sighted of Earth scientists, Bill Fyfe, a chemist with an enormous enthusiasm for all matters geological, Adolf Pabst, a meticulous crystallographer, and Frank Turner, who introduced every visitor to the great love of his life, Californian wine, and sought coauthors for textbooks amongst his colleagues, in which he was ultimately successful with me.

I arrived in Berkeley woefully ignorant of thermodynamics and the techniques that were used to measure thermodynamic properties, although metamorphic petrology was fast incorporating the mineral thermodynamic data that

were becoming available. In those days the properties of silicate liquids were taken to be no different to those of glasses, and as little was known about either that was useful to a petrologist, natural liquids were endowed with whatever property was required to achieve the desired effect. Courses in the Chemistry and Materials Science departments at Berkeley, into which I was impelled on the grounds that as a graduate adviser in the department, I should know something of the courses I was recommending to students, led to my meeting K. K. Kelley, W. Giaque and Leo Brewer. So started my involvement with the thermodynamic properties of multicomponent silicate liquids, which for those corresponding to natural compositions, I now believe to be well established. Based on these, a nine-component solution model of the liquid state, constrained by experimental liquid-solid equilibria, is available, but made more uncertain by the mixing properties of the solid solutions than by uncertainties of the liquid. We are (or at least Mark Ghioros is) on the brink of having a comprehensive model with which we can calculate the cooling history of any anhydrous natural liquid under any stipulated conditions, the one remaining problem being the mixing properties of the calcium-rich pyroxenes. So also will inverse processes, such as partial fusion during adiabatic ascent, be amenable to calculation and display on a computer.

Less certain are some of the transport proper-

ties of silicate liquids, and our recent attempts to measure the thermal conductivity of diopside liquid shows that this could be an order of magnitude less than currently accepted values. But these are not easy measurements to make, and the prospective experimenter should appreciate that most experiments seem to go wrong, more often and calamitously at high temperatures. Only an interest in rocks and how they occur can moderate the pessimism of an experiment prepared for weeks, and failing in minutes. Success in fieldwork seems so much more easily won, and twenty years in the volcanic belt of western Mexico is a wonderful panacea.

Mike, President Michael Henderson, I was thrilled to receive your telephone call and I am delighted to be given the Schlumberger medal by you. I am sure that those interests of thirty years ago, and the friends that one makes in the early stages of a career, had much to do with my being here today. I am grateful to you and to the Society for the Schlumberger award, which as every academic will realise, is more a tribute to ones students than it is to the professor. And I have been blessed by a phenomenal group of young colleagues in Berkeley. The generosity of the Schlumberger company is also appreciated, not only in giving me the opportunity to visit Manchester again, but in their care for my elder son, who as one of the company's employees in Chicago, never ceases to arouse an academic's envy at his salary.