

Sir Alan Howard Cottrell, FRS, FEng – a Tribute

Friends, colleagues and, especially, members of the Cottrell family - it is a singular privilege to speak to you today and present this tribute to the life and work of Sir Alan Howard Cottrell - metallurgist, scientist, academic leader and administrator, Government officer and administrator, author, musician, humanitarian and, above all, family man.

It is 50 years, almost to the day, when, as a raw New Zealander, I first went into the Department of Metallurgy, as it then was, in Pembroke Street to meet with Sir Alan. I had recently completed a PhD in Auckland on aspects of work hardening and work softening and, as a consequence, and not at all surprisingly, he was something of a legend to me. I approached that first meeting with a mixture of awe and trepidation but it will not surprise you at all to learn that, in his own quiet and unassuming way, he put me immediately at ease. We discussed the research work in the very new field of composite materials, sponsored by Harwell, which I was to take on working with John Chilton and Tony Kelly. But, and this to me is very much the mark of a great and considerate man, he showed equal concern that I and my young family were settling into Cambridge. He launched me on an academic career which leads directly to me standing here in front of you today. He was a model of thoughtfulness, integrity, commitment and sensitive awareness.

His roots are well documented not least through the many tributes that were published in the weeks that followed his death. Born in Moseley in July 1919, aged only 17 he entered Birmingham University from Moseley Grammar School, with a scholarship from the Birmingham City Council, graduating with a BSc in 1939 and a PhD in 1942. His early years are commented on by him in the delightful interview he recorded in March 2011 as part of the British Library series 'An Oral History of British Science' - it is available on the British Library website and I would strongly recommend it since he deals in his own words with a great many aspects of his life and work.

But I digress - his research work in the early 1940s was concerned with the serious problem of the cracking of alloy steel tank armour during welding. He attacked this problem with deep insight and experimental acumen and came up with an effective solution. He has said that in the process he became an expert welder 'because I had to' which was an early indication of the breadth of skills that he was to marshal throughout his career in dealing with issues both scientific and non-scientific. His outstanding promise was clearly recognised by the then Head of Department in Birmingham, Professor Daniel Hanson, who appointed him to a lectureship in 1943. It is interesting to note at this stage that Alan attributes his taking up the study of metallurgy to Hanson's 'persuasive voice' - the world owes a lot to that voice.

By this time Alan's research interests were moving to the atomic science of metals - he focused on seeking to understand the structure and properties of metals in terms of the behaviour of the constituent atoms and electrons. This led in 1948 to the publication of his classic book *Theoretical Structural Metallurgy*. The book was groundbreaking not only in its

content but also in its approach - Alan started down the road of turning a largely qualitative discipline into a strongly quantitative discipline, a route he followed resolutely over the ensuing years. He also began to develop his interest in the mechanical properties of metals and, in particular, the exploration of the role that the crystal defects known as dislocations played in influencing the plastic behaviour of metals and alloys. This was the basis of his second classic book *Dislocations and Plastic Flow in Crystals* published in 1953. In his British Library interview he acknowledges the part that Robert Cahn played in firing his interest in the role of dislocations.

In the meantime, he had been awarded a Personal Professorship in 1949 at the unusually young age, for that time, of 30. His talents were further recognised in 1955 when he was elected a Fellow of the Royal Society aged only 35. It is not surprising that he was, in 1955, persuaded by Monty Finnieston to move to Harwell as Deputy Head of the Metallurgy Division. These were exciting times at Harwell as the embryonic nuclear power industry was developing. A number of critically important problems emerged which fell under Alan's scrutiny among which were shape changes in fuel elements under irradiation, the integrity of steel pressure vessels and the behaviour of graphite reactor cores during annealing. This latter issue assumed national importance in October 1957 when a reactor at Windscale caught fire when being annealed. His response was immediate and effective - he set up a completely new laboratory facility with special equipment so that within six weeks he and his team were deeply involved in unravelling the cause. Within a year they were able to give the confident assurance that the new generation of Magnox reactors could be designed quite safely.

His reputation had grown by then both nationally and internationally such that he was invited by the Vice-Chancellor of the University of Cambridge in January 1958 to take up the prestigious Goldsmiths' Professorship of Metallurgy. It was clear that he was pleased to return to academic life and he set about developing a new strategic vision for the Department with vigour and determination. He recruited a group of young and talented staff, a number of whom I am very pleased to see are here with us today, and he identified new areas of scientific endeavour which he wished to see pursued in the Department. In this context, the Department and Jesus College have prepared a short document of Tributes which you will all be given today which includes reminiscences from many of those who were closely involved in those exciting developments.

So far in this address I have focused quite naturally on Alan Cottrell's academic and scientific achievements to the detriment of the important things in his personal life. This I must now correct. In 1944 he had married Jean Harber whom, by his own admission, he had met at a local meeting of the Iron and Steel Institute - she was working at the time in a small corrosion laboratory near the University run by the Institute. The marriage was to last for 55 happy years. In 1951 their son Geoffrey was born - he went on to follow in his father's scientific footsteps having a long term involvement in the Plasma Physics Laboratory at Culham. Later Ioana, whose parents, close friends of the Cottrells, died when she was a girl, came into the family as their adopted daughter. Here it is also important to put into the record that Alan had many interests outside his professional life. He admits his involvement

in his younger days in tennis, swimming, fly fishing for trout, music and bridge. He and Jean were enthusiastic hillwalkers spending many of their vacations together in the Lake District and the Alps.

To return to his professional career - in 1964, to the surprise and disappointment of many in the Department, Alan accepted an invitation pressed on him by Lord Mountbatten and Sir Solly Zuckerman, then Chief Scientific Adviser in the Ministry of Defence, to become Deputy Chief Scientific Adviser. He saw the move to Whitehall as a natural development of his growing concern with issues outside the academic domain, not least the decline of traditional manufacturing industry. In the Ministry he was immediately plunged into studies of defence policy in support of Dennis Healey's defence review. Working with senior military officers, scientists and Government officials, he brought his formidable intellect to bear on the analysis of costs and benefits associated with many of the then contemporary defence activities. There is little doubt that he had a significant influence on many Government decisions. Zuckerman moved in 1966 to become Chief Scientific Adviser in the Cabinet Office and Alan succeeded him in his role in the Ministry of Defence. In 1968 he followed Zuckerman to the Cabinet Office again as his Deputy. He became Chief Scientific Adviser in 1971 being knighted in the same year.

As Chief Scientific Adviser he initiated studies and advised on a wide range of issues - among which were space and aircraft policy, civil nuclear policy, environmental pollution, arrangements for Government research and development, national priorities in science and technology, the Advanced Passenger Train, the "brain drain" and scientific relations with other countries. He was also responsible for the very important development which led many Whitehall Departments to appoint their own Chief Scientists. There is clear evidence that at all times he argued his case powerfully however unpopular it might be.

In 1974, with some sense of relief from the tensions of Whitehall, he returned to Cambridge by accepting the invitation to become Master of Jesus College. He not only worked tirelessly within the College, which was much preoccupied with the issue of the admission of women Fellows and students and the associated revision of its Statutes, but also used the independence of his position to participate in important matters of public debate. A series of books flowed from his pen which encapsulated much of that debate - *Portrait of Nature (the World as seen by Modern Science)* in 1975, *Environmental Economics* in 1978 and *How Safe is Nuclear Energy?* in 1981. Further, in 1979, he was elected to Fellowship of the Royal Academy of Engineering (then the Fellowship of Engineering). This was delightfully appropriate since, at a much earlier stage of his career, he had chaired for The Royal Society a committee which examined the place of engineering and technology in the Society at the time when the nascent Fellowship of Engineering was been established.

He was Vice-Chancellor of the University from 1977 to 1979 an office he discharged with his usual flair notwithstanding the amount of administrative work involved not all of which was to his taste not least the number of disputes and complaints that ended up on his desk. There was also much official entertaining and here Jean was an unflagging support.

Previously they had engaged very effectively with their social responsibilities in College life but as Vice Chancellor matters moved to a higher level particularly since the Chancellor, Prince Philip, was a regular visitor to Cambridge and guest in the Master's Lodge. Jean managed it all consummately and with much apparent pleasure. This was also the time when Prince Edward came in to residence in the College as an undergraduate an experience which, by all accounts, he both valued and enjoyed.

But it was not only in these official roles that Alan showed his colours - he also took on many other responsibilities both within and outwith Cambridge. One of these was his Chairmanship of the Trustees of Lucy Cavendish before it was taken into the University fold as a recognised College. He was also able to indulge his talent as a skilled pianist additionally, as it is reported, through his frequent encounters with the spinet in the Prioress's Room in the College.

He retired from the Mastership in 1986 and returned to the Department to pursue a renewed scientific life. He turned his attention to a new topic, the application of the modern electron theory of metals to metallurgical problems. To this topic he applied his vigour and rigour and both papers and books followed including *Introduction to the Modern Theory of Metals* in 1988, *Chemical Bonding in Transition Metal Carbides* in 1995 and *Concepts of the Electron Theory of Alloys* in 1998. Such an output would have been admirable in a much younger man - it was masterly in one approaching his 90s.

But tragedy was just around the corner. In early 1996 Jean had fallen ill with Parkinson's disease. She was looked after by Alan with great care and commitment but she died in 1999. There was no doubt that this was a devastating blow to him which he handled with the very strong support of his family.

Alan's many achievements were recognised by an astonishing array of honours and awards - 16 Honorary degrees; a substantial number of Gold Medals amongst which was, in 1996, The Royal Society Copley Medal where uniquely he was the first metallurgist to receive the award since it was first instituted in 1731; many Honorary Memberships of Learned Societies across the world. Perhaps his stature is best recognised by the praise given to him in the many published tributes

- "the very father of modern materials science"
- "the most outstanding and influential physical metallurgist of the 20th century"
- "a scientific Colossus in the field of materials science and metallurgy".

His intellectual curiosity took many turns. The extent of that curiosity is perhaps well illustrated by a Sermon he preached in this very Church on 21 October 1979 entitled 'Where Science meets Religion' when he was the University Vice-Chancellor. He begins by asking a number of questions among which are "What are we to make of this strange world in which we find ourselves?" and "Why is the universe as it is? Why does it exist at all? Is there a great purpose behind it all?" An elegant discourse follows which leads him to ask the last

question “What, if anything, can science say about the moral and ethical aspects of religion?” To this he gives the simple answer “... very little indeed, since there is very little in science, up to the present, that takes us beyond the purely material world”. But he does not stop there. He moves on to consider the idea of love and concludes with a wonderful juxtaposition

“It took the superhuman efforts of our greatest geniuses to produce the scientific general principles such as Newton's law of gravitation and Darwin's law of evolution. Yet these are not greater, as general principles, than the law of Love, which is the brilliant Christian principle - and I use the word ‘brilliant’ in just the way that any scientist would, for describing an idea which is breathtaking in its simplicity and power - the brilliant Christian principle for how we should all behave towards one another”.

This is very much the measure of a great man described by others as kind, gentle, sensitive, and with a sense of humour. I can do no better than close with the words of Sir Peter Hirsch “His lifetime achievement in impact has been immense, of which his family can be justly proud, and for which the rest of us can be grateful”.

Graeme Davies/9.6.12