Obituaries

Athelstan Laurence Johnson Beckwith

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Elected to Fellowship 1973

Athel Beckwith was born in Perth, Western Australia, on 20 February 1930 to Laurence Alfred Beckwith, a pharmacist, and Doris Grace née Johnson. He commenced primary school in Perth, but wartime precautionary measures saw the adult females of the Beckwith family together with Athel and his two brothers moved to Porongurup, some 400 km to the south, with the boys attending school at Mt Barker. Athel completed his schooling at Perth Modern School and enrolled at the University of Western Australia (UWA), completing a BSc with first class honours in chemistry in 1951.

Pausing before proceeding to a research higher degree, Beckwith spent two years as a graduate assistant at UWA. In January 1953 he married Phyllis Kaye Marshall and soon after the couple moved to Adelaide where Athel had accepted a junior lectureship at the university. They were to have three children, Paul, Catherine and Claire, all of whom, together with Kaye, survive him.

Athel's research career developed in Adelaide to the point where, after two years, he applied for and was awarded a CSIRO overseas scholarship which enabled him to follow a growing interest in free radical chemistry by working at the University of Oxford with world-leader William Waters. In September 1956 Athel's thesis *Free radical reactions of higher aromatic hydrocarbons* earned him his DPhil degree which was conferred the next month. The stay in England was prolonged because of shipping delays caused by the Suez conflict, but during the interregnum CSIRO supported his continued research with colleagues at Oxford and London. Finally arriving in Melbourne in early 1957, he was assigned to work with Harold Hatt, seeking chemical ways to utilise the waxes and steroids of lanoline.

In 1958 he returned to academe at the University of Adelaide where he was successively lecturer (1958–61), senior lecturer (1962–63) and reader (1964) in organic chemistry before being appointed to the chair in 1965, succeeding Geoffrey Badger in that position. His career flourished, as the 1960s and 1970s saw luxuriant growth in the field of organic chemistry where there was increased funding, a flow of talented graduate students, and important problems of structural and mechanistic chemistry to be attacked and solved. In 1973 Athel was elected to the Fellowship of the Australian Academy of Science. He was active in the Royal Australian Chemical Institute, first at state (South Australia) and later at national level. His research earned him the institute's early career Rennie Medal in 1959 and the HG Smith Award in 1980.

In 1981 Athel was appointed professor in the Research School of Chemistry, successor to Arthur Birch, at the Australian National University (ANU). This meant a major relocation for the research group, to a situation where resources, both equipment and technical assistance, were more abundant and undergraduate teaching was not required. Kaye had to leave behind a career in public service which had developed in Adelaide, in Aboriginal affairs then in local government as an elected councillor and alderman, and in the conservation movement. In Canberra she found the time to follow her interest in Indigenous culture as a collector and dealer in Aboriginal art.

In Canberra, Athel became more involved in the work of the Academy, being a member of Council in 1983–86, including vice-presidency in 1985–86, and again from 1997–2001 when he was treasurer. He was also active in the Royal Australian Chemical Institute, being vice-president in 1983–84 and president 1984–85, and receiving the Institute's Organic Chemistry Medal in 1992 and its highest award, the Leighton Medal, in 1997. The UK-based Royal Society of Chemistry awarded him a Centenary Medal in 1993 and in 2003 he received a Centenary of Federation Medal in Australia. Greater recognition of his achievements, however, came in his election to the fellowship of the Royal Society of London in 1989.

The molecules that make up the lexicon of organic chemistry consist of atoms linked together in various ways by pairs of electrons. In contrast, free radicals are species with unpaired electrons. They play important parts in many molecular transformations and reactions, being mostly short-lived and highly reactive, hence their designation as reactive intermediates. Beckwith entered the field as the nature of radicals was becoming better understood in the 1950s, and their – hitherto often unsuspected – roles in chemical reactions were being revealed. Beckwith was a leader among chemists who learned to generate free radicals at sites where intra and intermolecular reactions could take place, and to study reaction rates and stereochemical outcomes. His and his students' work at the laboratory bench was aided by spectroscopy, in particular electron spin resonance, and by calculations performed within his research group and in collaboration with theoretical chemists. In his field of specialisation he was a consultant to CSIRO and industry. Many academic researchers – I was one – also sought his advice on free radical chemistry.

Athel's reputation as a fine lecturer, which began in Perth, when coupled with his research achievements made him a popular speaker at national and international conferences, notably the Gordon conferences and the Burgenstock meetings. Despite the crippling effects of childhood osteomyelitis, which he bore throughout his life, Athel adored the stimulation of travel and shared this with his family during several periods abroad on study leave. These included time back in the UK at Imperial College, University of York and Oxford. There were in addition many side trips to continental Europe, a three-month lecture tour of the US as a Carnegie Fellow, and a senior von Humboldt award that supported periods of research in Freiburg, Germany.

As an administrator and academic leader, Athel was very much a man of his times, encouraging consultative decision-making and breaking down barriers of formality wherever he encountered them in organisations to which he belonged. At ANU he saw his special responsibility as maintaining the status of what is doubtless the leading school of organic chemistry in Australia, a major contribution to which was the appointment of young chemists who had proved themselves in Australia and at international level and who had much to give the institution as their careers developed further.

His academic 'children and grandchildren' paid him the compliment of a symposium of research results and reminiscences on his 80th birthday. His influence on day-to-day chemistry in Australia is perpetuated by the Centre of Excellence for Free Radical Chemistry. This dispersed organisation based in several Australian universities includes several Beckwith graduates – one of whom is the Centre Director, Professor Carl Schiesser of the University of Melbourne, and another, Chris Easton, a professor in the Research School of Chemistry at the ANU.

Like both of his parents, Athel was a more than competent musician, taking lessons in classical piano from age six, and in his mid teens turning to the clarinet as his love of jazz developed. One of the nicest tributes on his death came from the Canberra Jazz Club, who remembered him as 'the chemistry professor who took on free radicals – and won'. Athel was killed in a car accident in 2010. Kaye was seriously injured but made a full recovery.

Ian D Rae

Louis Charles Birch

Elected to Fellowship 1961

Louis Charles Birch was born in Melbourne on 8 February 1918, and died in Sydney on 19 December 2009. Charles, as he was always known, was educated at Scotch College, Melbourne, and at the University of Melbourne obtaining a BAgrSc in 1939. After graduating he moved to Adelaide to work as a research entomologist under the supervision of Herbert G Andrewartha at the Waite Agricultural Research Institute. He obtained an MSc from the University of Adelaide in 1941, and was later awarded a DSc in 1948.

Food security and production during the war years was a national service focus for agricultural scientists, and so Charles first worked on the problem of the plague grasshopper in the South Australian wheat belt, and then investigated insect pests in silos, such as the wheat weevil. It was known that weevils flourished in the outer layers of large mounds of grain, and finding that deep within the mound the temperature was higher and the relative humidity and moisture content was lower than that in the surface layers, Charles concluded it was simply too hot and dry for weevils to live any deeper than about 12 inches from the surface. Results of Charles's work were soon applied to prevent the deterioration in the quality of stored wheat resulting in millions of bushels being stored without infestation.

It was also during these war years in Adelaide that, together, Andrewartha and Birch made significant contributions to the study of population ecology. Until then the dominant view was that animal populations were controlled primarily through the competition for resources. They demonstrated that external forces and disturbances such as weather were very important as well for the control of population numbers and their distributions.

Their work was published as *The distribution and abundance of animals* by the University of Chicago Press in 1954, and soon became a most influential and enduring text in ecological studies. It is a classic volume for biologists everywhere. They were jointly awarded the David Syme Research Prize in 1954. Thirty years later they collaborated again to publish *The ecological web: more on the distribution and abundance of animals* (University of Chicago Press, 1984).

In Adelaide, too, Charles developed a particular world view that remained a strong constant for the rest of his life. Having been brought up in a strong religious environment in Melbourne he found that his basic beliefs were being rigorously challenged by the people he worked with at the Waite. But he also joined the Australian student Christian movement at the University of Adelaide – a more liberal-minded and ecumenical student group – and his thinking began to broaden and to change. He started to read more philosophy – particularly the works of Plato and of the contemporary Anglo-American philosopher, Alfred North Whitehead. He became very interested in the relation of science, religion and ethics, and the social responsibility of scientists.

In 1946 he went to the University of Chicago on a senior scholarship under the Commonwealth science and industry endowment fund to continue the research in insect ecology. The following year he studied animal population dynamics with Charles Elton at the University of Oxford. Returning from Britain in 1948, Charles joined the University of Sydney as a senior lecturer in zoology.

He began research on the Queensland fruit fly, finding that populations spreading south evolved in response to a changed environment. He then started investigating the important relationship between evolution and ecology – work he further pursued in Brazil with Theodosius Dobzhansky in 1955.

In 1954 he was the first to introduce the teaching of animal ecology in Australia. He was promoted to a readership in zoology from 1954 to 1960 when he became the Challis Professor of Biology holding

the chair until his retirement in 1984. He then took the title of professor emeritus. He was a Fulbright scholar at Columbia University in 1954, and in 1955 was visiting professor of biology at the University of Sao Paulo in Brazil. He was visiting professor of zoology at the University of Minnesota in 1957 and visiting professor of genetics at the University of California, Berkeley, in 1960.

A major administrative project for him at the University of Sydney was to combine the departments of zoology (founded in 1880) and botany (founded in 1913) to form the larger School of Biological Sciences in 1962. He was also instrumental in establishing the history and philosophy of science unit within the science faculty, and the Centre for Human Aspects of Science and Technology. He had a long connection with Wesley College at the University of Sydney and for several years was the vice-master. In 2000 he was awarded a DSc *honoris causa*.

In 1965 he published *Nature and God* – a short but very popular work on the history of the conflict between science and religion. It brought him fame beyond purely academic circles. He was involved for quite a number of years with the Wayside Chapel in Kings Cross and was publicly opposed to the Vietnam War, setting up the Committee for Conscience to assist students who were arrested for avoiding the draft. He promoted the 'zero population growth movement' in Australia and became a member of the Club of Rome.

Margaret Mead invited Charles to be part of a program on science, technology and the future, which she was setting up with the World Council of Churches. He played a leading role for them for some 20 years, 13 of which he was the vice-moderator. Most importantly in a major speech at the Council's Nairobi Assembly in 1975, he introduced the concept of the ecologically sustainable society. From that point on, sustainability quickly became part of the everyday vocabulary and discussion. He was awarded the Templeton Prize for progress in religion in 1990.

Charles was elected to the Australian Academy of Science in 1961, and served on the Academy Council from 1965 to 1967. In 1988 he won the Gold Medal of the Ecological Society of Australia, as well as the Ecological Society of America Eminent Ecologist Award. The Ecological Society of America later honoured him with an honorary life fellowship, as did the British Ecological Society and the Academy of Environmental Biology, India. In 2008 he was made a Member in the General Division of the Order of Australia.

Other publications include *Confronting the future: Australia and the world – the next 100 years* (1975, 1993), *The liberation of life: from cell to community* (1981), *On purpose* (1990), *Regaining compassion for humanity and nature* (1993), *Feelings* (1995) and *Science and soul* (2007).

Charles never married and is survived by his twin brother Sid, sister-in-law Jenny, and their family. His older brother Hugh died in 1996.

Peter Farleigh

Keith David Cole

Elected to Fellowship 1983

Keith Cole passed away in Melbourne, Australia, on 13 December 2010. He was born in Cairns in Queensland on 2 March 1929 and grew up there. He received BSc (Hons) (1952); DipEd (1953); MSc (1954) and DSc (1967) from the University of Queensland. After a short time as a secondary school teacher, Keith was appointed auroral physicist on the Australian National Antarctic Research Expedition to Macquarie Island in 1956, and so began his lifelong research into the aurora and other solar-terrestrial phenomena. After the year-long expedition he took up a position as a theoretical physicist with the Australian Antarctic Division (AAD) where he remained until 1962 when he was seconded to the CSIRO upper atmosphere section, headed by David Martyn.

After periods at the University of Chicago and University of Colorado as a research associate, in

1966 Keith took up his appointment as a foundation professor of physics at La Trobe University in Melbourne. By this time he had established himself as a leading theorist in solar-terrestrial physics having shown that red arcs and the pre-dawn enhancement are produced by thermal conduction from above, and having made significant advances in our understanding of geomagnetic storms and particularly the ring current. In 1962 he proposed that the ionosphere is heated via Joule heating, a phenomenon now known to be a major energy source for the ionosphere and thermosphere at high latitudes.

Keith formed the theoretical and space physics group at La Trobe which he headed until his retirement. Under Keith's leadership the group built the Beveridge field station north of Melbourne and developed radio, optical and magnetic instruments for use at Beveridge and at Australian Antarctic stations. These instruments were used to study a wide range of phenomena in the ionosphere, thermosphere and magnetosphere. Keith also continued his theoretical research into geomagnetic storms, ionospheric irregularities and other phenomena in the magnetosphere-ionosphere system.

Keith did not confine himself to his own research interests and those of his many postgraduate students. He also made major contributions to the organisation of science both nationally and internationally. He served the International Association of Geomagnetism and Aeronomy (IAGA) as vice-president (1976–79) and president (1980–83) and was president of the Scientific Committee on Solar-terrestrial Physics (SCOSTEP) (1977–86). In these roles he was a vigorous promoter of international scientific programs, so essential for the study of global scale phenomena.

At La Trobe Keith served terms as head of physics and dean of the school of physical sciences. Nationally, he was a very active Fellow of the Academy, serving as foreign secretary, Council member and chair of various committees including the National Committee for Solar-Terrestrial Physics. These roles also provided avenues to promote participation by Australian scientists in international programs including the important ICSU International Geosphere-Biosphere Program.

Keith was an outstanding colleague and mentor for many people around the world. He was a person of ideas and was popular as an invited speaker as he would provide a fresh view on topics and challenge people with new ideas.

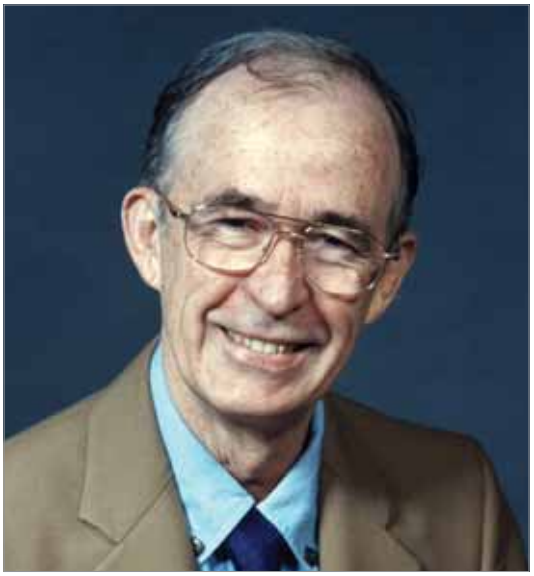
He received many honours recognising his contributions to science, including the International Union of Radio Science (URSI) Appleton Prize for contributions to the understanding of the basic processes taking place in the magnetosphere and the ionosphere, life membership of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP), honorary membership of IAGA, fellowships of the Australian Academy of Science, the Australian Institute of Physics, the Institute of Physics (UK), the Indian Institute of Geomagnetism, the Explorers Club of New York, and associate of the Royal Astronomical Society, London.

Keith's scientific legacy will live on through his contributions to the basic science of solar-terrestrial physics phenomena and through the many colleagues and students he influenced throughout his career.

Keith married Ailsa Moore in 1956. The marriage ended in divorce in 1981. In 1989 he married Valery Troitskaya (died 2010) who had also been president of IAGA. They settled in Melbourne near La Trobe University where Keith was professor of physics. Keith is survived by his son David.

Peter Dyson

Rossiter Henry (Ross) Crozier



Elected to Fellowship 2003

Ross Crozier was born on 4 January 1943 in Jodhpur, India, the son of Sheila Sybil Goss and Laurence Arlington Crozier, and died on

12 November 2009 in Townsville. On 2 March 1968 he married Yuen Ching Kok and is survived by his wife Ching and sons Michael and Ken.

Ross Crozier was educated at Geelong Grammar School and received both BSc (1965) and MSc (1966) degrees from the University of Melbourne. He studied for his PhD at Cornell University under the supervision of William Brown, entomologist and ant specialist, graduating in 1969.

Crozier held the following academic posts: professor, School of Tropical Biology, James Cook University (2000–09); professor, Department of Genetics and Human Variation, La Trobe University (1990–2000); professor (personal chair) (1989–90), associate professor (1982–90), senior lecturer (1977–81), lecturer, (1975–76) all at the University of New South Wales; assistant professor, Department of Entomology, University of Georgia (1970–74).

He served on numerous editorial boards including *Molecular Biology and Evolution*, *Genetique*, *Selection*, *Evolution*, *Annual Review of Ecology and Systematics*, *Journal of Molecular Evolution*, *Australian Biologist* and *Insectes Sociaux*. He served as associate editor for the journals *Evolution*, *Behavioral Ecology and Sociobiology*, *Molecular Biology and Evolution* and *Ecology Letters*.

He served on the Australian Research Council (ARC) biology panel 1993–95, chairing an ARC committee on access to Australia's genetic resources. From 1995–2002 he served on the board of the Australian Genome Information Centre as ARC representative. He was a member of the scientific advisory committee to the Zoological Parks and Gardens Board of Victoria. He held two successive special investigator awards from the ARC.

Crozier authored two books, *Animal cytogenetics 3 Insecta* (1975) and *Evolution of social insect colonies: sex allocation and kin selection* (1996), and published over 200 papers which were collectively cited more than 5,000 times at the time of his death.

Crozier was elected Fellow of the Academy in 2003, serving on the Council from 2007 until his death. He was also a Fellow of the American Association for the Advancement of Science since 2002. In 2006 he was awarded the inaugural Hamilton Award by the International Union for the Study of Social Insects for 'lifetime achievement in the biology of social insects'.

Crozier made outstanding contributions to phylogenetic inference, cytogenetics, population genetics, sociobiology and conservation genetics. Crozier's overriding interest, applied in all these areas of biology, was the evolution and diversity of social insects, particularly ants.

In early years he used cytogenetic techniques to investigate diversity (in its broadest sense) of Australian and American ants. He published a widely adopted protocol for preparing ant chromosomes for study. Modifications of this protocol are used to this day for a variety of insects. One of Crozier's more curious cytogenetic discoveries was an ant species with only one chromosome.

He was one of the first to appreciate the significance of William Hamilton's ideas about inclusive fitness and the importance of genetic relatedness to the evolution of sociality in insects. He was the first to use allozyme data for estimating the relatedness of individuals within and between colonies. This required development of new statistical procedures that are still used.

Multiple mating by social insect queens is unexpected because it lowers intra-colonial relatedness, and yet multiple mating is widespread, especially in the advanced bees and ants. In 1985 (with Robert Page) Crozier evaluated 13 hypotheses for their ability to explain the evolution of multiple mating. This paper had an extraordinary impact. Crozier's front running hypotheses have been tested in dozens of species by dozens of labs. He also formalised the theory of kin recognition, the idea that if an individual is to direct care towards a relative, it would need to be able to recognise it first. Crozier explored the possibility that genetic cues are used as a basis for kin recognition, leading to what has become known as Crozier's paradox. Imagine a species that relies on genetically based cues to distinguish kin from non-kin. The more two individuals differ at the recognition loci the less likely they are to recognise each other as being related. Such a system will work better if there is great alleleic diversity, for when there is limited genetic variance, the chance of costly mistakes rises. However, a bearer of a new allele in the population is likely to bear the brunt of antagonism from kin and non-kin alike, reducing the chance of the new allele spreading, and the workability of a genetic basis to kin recognition system.

Crozier's group later pioneered the application of microsatellites (a kind of molecular genetic marker) for pedigree reconstruction in honeybee colonies.

This work revealed unexpected reproduction by workers, and sparked a new field searching for reproductive cheats in insect colonies and in other group-living animals.

In 1993 Ross and Ching published the complete sequence of the honeybee mitochondria. This was only the second complete sequence to be obtained from an insect after Drosophila. Crozier found numerous changes in gene order between bee and fly, which remain unexplained, and a remarkably high AT content in the honeybee DNA sequence.

Phylogeny reconstruction techniques of the day assumed that mutations are random across the lineages being studied. Crozier's insight, based on the comparison of the bee mitochondria with that of a fly, was to show that directional mutation pressure towards A and T in certain lineages can lead to significant errors in phylogeny reconstruction. He pioneered the application of maximum likelihood consensus trees to phylogeny reconstruction, for this is the only technique that can take account of directional mutation pressure.

Crozier's expertise in phylogeny reconstruction led to an interest in setting conservation priorities – how best to spend scarce conservation dollars to maximise biodiversity. Crozier pointed out that a species that is phylogenetically novel, like a tuatara, should perhaps be more valued than a species like *Drosophila simulans*, which has numerous sister taxa. This view is controversial, but we think it is a sensible one.

Ross Crozier was an extraordinary mentor of students and postdoctoral researchers, whose influence now spans the globe. During his career he supervised 33 honours students, 26 postgraduate students and 18 postdoctoral fellows.

Ben Oldroyd
Oliver Mayo

Hans Charles Freeman

Elected to Fellowship 1984

Hans Charles Freeman was a true pioneer and gained national and international recognition in a range of research areas, as well as being an inspirational teacher, and ceaseless campaigner for science in Australia.

Hans was born in Breslau, Germany on 26 May 1929 and moved to Australia at age nine with his father Karl, mother Lotte, and sister Eva, after Karl received

a tip-off from a member of the Nazi Party on the impending persecution of Jews. Hans quickly adapted to his new life and the following year was dux of Double Bay Public School. He was then dux of Sydney Boys High before commencing his studies at the University of Sydney where he graduated with a BSc (Hons) first class, and the University Medal in Chemistry (1949), then completed an MSc (1952), both under the supervision of Professor Raymond Le Fèvre FRS. He subsequently spent a year at the California Institute of Technology as a Rotary Foundation Fellow under the supervision of Dr Edward W Hughes after Nobel Laureate, Linus Pauling, sparked his enthusiasm for crystallography. Hans returned to the University of Sydney to complete a PhD in 1957 and held academic positions at the University of Sydney from 1950 until he passed away. These included: teaching fellow (1950–51); temporary lecturer (1952); lecturer (1954–57); senior lecturer (1959–64); reader (1964–71); foundation professor of inorganic chemistry (1971–95); head, School of Chemistry (1975–76); professor of chemistry (1995–97); professor emeritus (chemistry and molecular and microbial biosciences) (1998–2008).

Hans held the following visiting appointments: George Ellery Hale research fellow, California Institute of Technology (1958–59); visiting lecturer, inorganic chemistry, University of Basel (1966); visiting professor, biochemistry, University of Göteborg (1966); visiting professor, molecular biophysics, Yale University (1968); guest professor, inorganic chemistry, University of Copenhagen (1977); and visiting scholar, Chemistry and Stanford Synchrotron Radiation Laboratory, Stanford University (1983). He was elected as a Fellow of the Royal Australian Chemical Institute (RACI) in 1968;

the Royal Society of Chemistry in 1984 and the Australian Academy of Science in 1984 and was honoured with the award of Member of the Order of Australia in 2005 for his contributions to science, particularly inorganic chemistry. He also received the Australian Academy of Science Craig Medal for Chemistry (2007); the Royal Society of New South Wales' Liversidge lecturer (1979); the Inorganic Chemistry Award and Burrows Medal (1980); the Leighton Medal (1999), and distinguished fellowship of RACI.

Hans was active in the Academy and served as chair of its National Committee for Crystallography from 1984–93 during which time he headed an inquiry on access to 'big science' facilities (1988–89). This led on to his involvement as a committee member on the Australian Department of Industry, Technology and Commerce, International Science and Technology advisory committee (1989–92); the Australian Science and Technology Council working party on Australian participation in major accelerator and beam facilities, *Small country, big science* (1989–90); and Australian Science and Technology Council working party on major national research facilities *Major research facilities – a national program* (1991–92). As such, he was instrumental in establishing the Access to major facilities program, the Australian Synchrotron research program and, ultimately, provided the basis for the development of the Australian Synchrotron.

Hans made other major contributions to the development of a vibrant and internationally recognised community in crystallography and synchrotron science. As the foundation president of the Society of Crystallographers in Australia (1976–77) and his memberships of the Australian National Beamline Facility (Management and Program Committees, 1991–95); Australian Synchrotron Research program (Policy and Review Board, 1996–2008); and Advanced Photon Source, Argonne, USA (Consortium for Advanced Radiation Sources, Board of Governors, 1998 until 2008), he was pivotal in paving the way for groundbreaking research in these areas.

Other noteworthy contributions included being the chair of the Coordination and Metal Organic Chemistry division of RACI (1971–73), a member of the international program committee for the 13th (1984) and 15th (1990) International Congresses of Crystallography and chair of the program committee for the highly successful 14th Congress held in Perth in 1987.

With Alex Boden FAA he founded the Foundation for Inorganic Chemistry at the University of Sydney in 1972. This foundation continues to bring high profile international researchers to Australia and has been instrumental in providing many opportunities for international collaborations and for students and other researchers to join prominent overseas research groups. The first of these visitors was Nobel Prize winner, Linus Pauling, whose visit led directly to the establishment of the Human Nutrition Department at the University of Sydney.

For over 40 years, Hans was one of Australia's most highly regarded chemists, both locally and internationally. He was a pioneer in the development of crystallography in Australia, and was responsible for the construction of Australia's first diffractometer and the purchase of the first 4-circle diffractometer. He pioneered the use of computers in crystal structure analysis, including using Australia's second computer, SILLIAC. His leadership resulted in Australian crystallography making an impact far beyond what might otherwise be expected.

Soon after becoming chair of inorganic chemistry, Hans established the first protein crystallography laboratory in Australia and together with important contributions from Peter Colman – later, a Fellow of the Academy – and Mitchell Guss amongst others, Australia's first protein crystal structures were determined. Professor Guss became a long-time collaborator and subsequently headed the protein crystallography laboratory in the School of Molecular Bioscience within the University of Sydney, where Hans upon retirement continued his interest in protein crystallography until his death.

Hans's initial interests focused on the successful determination of the structure of the electron transfer protein, plastocyanin, which had a dramatic effect on the field of bioinorganic chemistry. This achievement was celebrated on its 25th anniversary in a special session at the 11th International Conference on Biological Inorganic Chemistry. Hans made many other important contributions to crystallography (protein and metal complexes) and active-site determinations of metalloproteins by X-ray absorption spectroscopy.

Hans died on 9 November 2008. He is survived by his wife, Edith, his children, Maeva and Philip, and sister, Eva.

Peter Lay

Anton Linder Hales

Elected to Fellowship 1976

Anton Linder Hales was a geophysicist whose career spanned three continents – South Africa, North America and Australia. His connections with Australia went back to the 1950s but his most important period occurred from 1973 to 1978 when he was the first director of the Research School of Earth Sciences (RSES) at the ANU. He came as a widely respected scientist and with very considerable experience in the administration of universities and research laboratories, having previously led similar institutions in South Africa and in Dallas, Texas. This experience, together with his broad research experience in Earth sciences and worldwide contacts, made him an ideal founding director of RSES. During this period RSES became one of the leading geoscience institutions in the world.

Professor Hales was born on 1 March 1911 in Mossel Bay, Cape Province, South Africa. He showed an early brilliance for science, entering the University of Cape Town and studying physics and mathematics. He graduated with a BSc degree, awarded with distinction, at age 18, and received an MSc degree the following year. At age 20 he was appointed a junior lecturer in applied mathematics at the University of the Witwatersrand in Johannesburg. The following year he went to the University of Cambridge, where he studied with the famous mathematician and geophysicist Harold Jeffreys. This influence can be seen in the geophysical pursuits he followed for the rest of his life.

He finished the maths tripos at Cambridge in 1933, and returned to the Applied Mathematics Department at Witwatersrand, where he advanced to senior lecturer, at the same time developing geophysical research in a number of topics, notably seismology. He gained a PhD from the University of Cape Town, for geophysical studies. World War II interrupted his scientific career, and he served as an engineering officer in the North African Campaign, exploring for sources of fresh water.

After the war, Hales spent time at the Bernard Price Institute of Geophysical Research at Witwatersrand, involved with seismic equipment development, and gravity measurements using pendulums, and then returned to Cape Town as professor and head of the Applied Mathematics Department. In 1954 he was appointed director of the Bernard Price Institute, and put great energy into advancing a number of geophysical methods, including paleomagnetism. This latter was particularly important in that it anticipated the demonstration of continental drift from measurements of the Earth's past magnetic field. He recognised that it was important to obtain paleomagnetic data from different continents and he played an advisory role in establishing this research activity at ANU that led to the demonstration by Ted Irving that continental drift had occurred in the geological past.

In 1962 Hales moved to the USA where he became first head of a new geoscience program at the Southwest Center for Advanced Studies (later the University of Texas) at Dallas. This decade was one of great activity in geophysics and geochemistry, and Hales made his laboratory a front-runner in a number of key areas. This included seismology, in which he conducted experiments in North and South America designed to understand the structure of the crust and upper mantle, an interest that he developed further at ANU. The American experiments involved the use of explosives as energy sources for the seismic waves recorded at variable distances from the source. When he left Texas his students presented him with a photographic record of his field experiments, including made-up newspaper headlines about running explosives across the US-Mexico border. Later in Canberra this record was lost, having been left on his car roof, and was only returned after it had been handed in to the Canberra Times!

After 11 years building a new department and a new university in Texas, Hales, at the age when most people are contemplating retirement, was convinced by Professor Ted Ringwood that ANU represented a new challenge for him. He

established the RSES and created new chairs in economic geology (Lew Gustafson) and geophysicial fluid dynamics (Stewart Turner) and was also able to fill the geophysics chair (Kurt Lambeck) vacated earlier by John Jaeger. He was a strong supporter of a non-departmental structure for the school such that the science would not be contained within the traditional boundaries. He encouraged instrumental developments, most notably in mass spectrometry, and made it possible for Bill Compston to develop the ion microprobe SHRIMP, which has become one of the great success stories of RSES.

Hales also actively pursued science that was focused on the Australian continent and its setting, both in field studies and in laboratory analyses, and much of today's seismology research at ANU has its origins in the projects set up by him then. At the same time he advocated the global nature of Earth science. He encouraged his staff to become globally engaged and led by example, serving as president of the Inter-Union Commission on Geodynamics and being active in the International Union of Geodesy and Geophysics.

For some years after his retirement from ANU in 1978, Hales resumed his research activities in Dallas as a professor of geosciences, at the same time maintaining his home in Canberra, where his family had settled, and his two younger sons were at school. He retired from Dallas in 1982, and back in Australia his energies then went into establishing a new family house and garden on a bush block in Wamboin, New South Wales. This was not without its own excitement, including removal of ladders when his wife was on the roof cleaning gutters, but it provided him with an outlet for his tremendous energy that remained with him and an interest in plants and animals. His geophysics interests continued with him contributing in a visiting position at RSES in which he provided guidance to young staff and new directors alike, notably in the latter case only when asked.

Hales's career spanned much of the 20th century, and he was active in a major and remarkable scientific advance, which saw the demonstration and recognition of the mobility of the Earth over long times, exemplified in the, now accepted, theory of plate tectonics. His scientific honours include fellowship of the Royal Society of South Africa, the American Geophysical Union, and the Australian Academy of Science. They indicate the esteem in which he was held in these three continents, where he had developed three distinguished careers.

Anton Hales died on 11 December 2006. He is survived by his second wife Denise, three sons, and seven grandchildren. Denise was strongly supportive throughout this marriage and at Wamboin she provided the environment, love and care that permitted him to enjoy his retirement up to the end.

Kurt Lambeck
Ted Lilley

Sefton Davidson Hamann

Elected to Fellowship 1966

On 13 January 2003, at the age of 82, Dr Sefton Hamann fired off a missive to his friend Bill le Noble in Stony Brook New York,

> A habit of Firestone's that annoys me intensely is the way in which he gaily dismisses, or bends to his ends, or just ignores, anything that seems to trouble his arguments. And he gets away with it!

But he didn't get away with it this time! After months of careful analysis of all the available experimental results, Sefton and le Noble were able to show that the phantom activation volumes claimed by Firestone did not exist. Their paper was published in *The Journal of Physical Chemistry A* in 2004. This was the last of Sefton's scientific publications.

Dr Sefton Davidson Hamann was born in Christchurch, New Zealand on 8 January 1921, the youngest by 18 and 20 years of three children. He studied for a BSc in chemistry and physics at

Canterbury College. His studies were interrupted when he volunteered for service in the Royal NZ Navy in August 1941. He served until February 1946. For about 18 months during the war he was seconded to New Zealand's Department of Scientific and Industrial Research (DSIR) to carry out research on microwave radar. During this secondment he spent six weeks at the Council for Scientific and Industrial Research (CSIR) Radiophysics Laboratory in Sydney. During his time in the Navy he was under the command of Lieutenant Commander EJ Marklew who wrote,

> ...He was responsible for independent development and scientific investigation and contributed in no small manner to the success of Radar sets developed in New Zealand… he served in the Solomon Islands and carried out important duties in the fitting of sets in cruisers and small ships at the Devonport Naval Base.

Dr Hamann gained an MSc with first class honours from the University of New Zealand in 1947 and worked at the Dominion Laboratory in Wellington. During this time he revisited the CSIR Radiophysics Division in Sydney. At this stage in his career he chose to develop his interest in solution chemistry and went to the University of Manchester to pursue a PhD, which he gained in 1949.

He must have enjoyed his experiences in Sydney because in 1948 he wrote to Dr Ian Wark, the Chief of the CSIR Division of Industrial Chemistry, asking if there were going to be positions available at the end of 1949. Wark got Dr Keith Sutherland to interview him in London and he was duly appointed to a position in Sydney commencing 5 January 1950.

He was rapidly promoted within the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and was invited to take the position of chief of the Division of Physical Chemistry in 1960. The divisions of physical and organic chemistry merged to form the applied chemistry division in 1966 and he retained the position of chief until 1974 when that new division was separated into the divisions of applied organic chemistry and chemical technology. He was the chairman of the Applied Chemistry Laboratories until 1978 and retired from the organisation in July 1983. All his post PhD papers had a CSIRO address except the one above published in 2004.

He was elected a Fellow of the Royal Australian Chemical Institute (RACI) in 1964, awarded RACI's highest medal for science, the HG Smith Memorial Medal in 1969 and elected a Fellow of the Australian Academy of Science in 1966. An indication of his international standing was the invitation to present a paper on *Properties of electrolyte solutions at high temperatures and pressures* at the 1979 Nobel symposium.

Sefton made outstanding contributions to our understanding of the effects of pressure on chemical reactions. His book, *Physico-chemical effects of pressure* was published in 1957 and is still being cited 50 years later. This book was a comprehensive survey and analysis of the effects of pressure on volume, phase changes, viscosity and diffusion, dielectric and optical properties and chemical kinetics. His view at the time was that all the theory behind the physico-chemical effects of pressure had not been developed. He spent much of his scientific career developing and testing that theory.

A meeting was held on Monday 9 April 1968 at the Reserve Bank of Australia's Melbourne office that would change the course of Sefton's career as well as the careers of many other CSIRO scientists.

The then governor of the Bank, Dr HC (Nugget) Coombs called the meeting of his top note printing staff and seven of Australia's top scientists to discuss ways of devising techniques to produce notes which would be difficult to counterfeit. Sefton Hamann was invited to attend the meeting, and of those present, he was the only one who stayed with the project to its conclusion. Dr David Solomon was invited to the second meeting which was held in Thredbo on 15 to 16 June 1968 and so commenced a long and exciting collaboration that resulted in the release of the $10 commemorative note in 1988 and the conversion of all our banknotes to a polymer substrate by the mid 90s. Sefton concentrated his work on diffraction gratings and moiré patterns, not for the purpose mentioned at the first meeting, but as security devices in their own right. A Captain Cook diffraction grating was incorporated in the 1988 banknote.

Sefton's legacy is his science. Keith Sutherland summarised Sefton's contribution succinctly in writing a promotion case in 1957,

> Hamann has the ability to strip problems to a few essential features which, when investigated, clearly illuminate a wide group of phenomena.

Sefton died on 12 January 2009. He is survived by his son Conrad, daughter-in-law Christine and two grandchildren.

Tom Spurling
David Solomon

Phillip Garth Law

PHOTO: PAT QUILTY

Elected to Fellowship 1978

Law was born on 21 April 1912 in Tallangatta, Victoria, near the family home in Mitta Mitta, the second of six children. He died on 28 February 2010 at Balwyn, a Melbourne suburb, eight weeks before his 98th birthday. He was the son of Arthur James and Lillie Lena (née Chapman), both teachers by profession.

Throughout his growing years, Phil was haunted by his small stature and within the family was always 'little Phil', later 'Squib'. This small size meant that he was excluded from some of the activities of the 'big' boys even of the same age and in the same class at school. Probably because of the treatment, he developed some of the 'small man syndrome' and had to perform in some areas, both physically and academically, at a higher level than those around him, a practice that never left him.

Throughout life, Law tackled every new challenge, be it sport, music or administration, with enthusiasm, dedication and ability. In every area, Law strove to excel, often at considerable cost. Like so many of his generation, he completed high school in time for the Depression and thus took up teaching as an employment option.

He was introduced to the world of natural sciences on an excursion with Dr Charles Fenner, father of Professor Frank Fenner, but eventually chose physics as his field.

After qualifying at the University of Melbourne, Law recognised that he could be little more than a 'competent, well organised routine scientist' within the University system and began to apply for administrative positions. This led to his attraction to the newly established Antarctic Division (AD) of the Department of External Affairs, which he joined in 1947 as chief scientist, soon to be promoted to director.

Under Law's guidance, a diverse scientific program evolved with the AD fulfilling two roles – as both logistic support, and as an institution with its own scientific program. Law believed strongly that the director of the AD should be a scientist who was actively involved in the program. He saw the link between Australia and Antarctica in many disciplines and, in some way, may have been influenced by that other dominant Australian Antarctican – Douglas Mawson. Like Mawson, Law was not interested in science entirely for its own sake; it had to have a practical side including the use of Antarctica as a source of wealth (geological resources, fishing) or of other practical uses such as storing nuclear waste or excess agricultural production.

Law was a man of grand vision and he pursued it with enthusiasm but was frustrated with the inability of the government service to react to urgent needs. He thus took many shortcuts to achieve his aims. It is unlikely that he would be able to get away with this approach in the modern public service.

Law oversaw the establishment of stations on Macquarie and Heard Islands (1947; the latter closed in 1954) and on the Antarctic mainland at Mawson (1954) and Davis (1957). The mainland stations placed Australia in very good stead for the International Geophysical Year (1957–58). Wilkes was taken over from the USA and became the site of Casey.

Law's contribution to science stems from two facets. When he was establishing Antarctic facilities, geographic exploration, including delineating coastline and near coastal features (glaciers, mountains) was to the fore and his dedication to accurate astrofixes was critical.

Once stations were in place, diverse scientific programs developed, taking advantage of local opportunities under the umbrella of the Australian National Antarctic Research Expeditions (ANARE). He believed in cooperation between members of small communities and resultant papers often had authors with apparently widely different specialties.

Thus, while Law published few scientific papers under his own name, he can be regarded as the source of all.

Law is without peer the outstanding Australian in the modern Antarctic period, best known for his role in establishing the reputation and traditions for the Australian program. Even several decades after his retirement, Law was the most widely recognised face of the program, widely called on to speak on the topic, and to contribute to Antarctic conferences and workshops. The list of his awards, and their international character, attest to his standing.

He was a prolific diarist and keeper of records and thus comprehensive reviews of his life and impacts are readily available. He also published several books. He enjoyed a good red wine and his legendary cigars.

Perhaps through family and his own teaching experience he had a long interest in education at all levels, and in his later days at the AD much of his time was spent on education committees. He applied for higher university positions, leading ultimately to his resignation and move to the Victorian Institute of Colleges (VIC). Law's role in the VIC has been overshadowed by his Antarctic persona and deserves to be better known.

As he aged, he became very stooped and appeared frail, but if a microphone was placed within reach, the voice and mental acuity of the past were very obvious.

His many awards include the following: Founder's Gold Medal, Royal Geographical Society of London (1960); Commander of the Order of the British Empire (CBE) New Year's Honours (1961); Doctor of AppSc *honoris causa*, University of Melbourne (1962); Officer of the Order of Australia (AO) (1975); Foundation Fellow, Australian Academy of Technological Sciences and Engineering (1975); Fellow, Australian Academy of Science (1978); Companion of the Order of Australia (AC) (1995).

In typical Law fashion, prior to his death he organised a post-expiration dinner for some 160 of his 'friends' at the headquarters of the Melbourne Cricket Club, on what would have been his 98th birthday. It is believed that he chose the wines, speakers, menu and the list of invitees. This event was followed two days later by a memorial afternoon hosted by the ANARE Club of which he had been patron for so long.

Because of his wife Nel's heart condition, the Laws agreed not to have children so there are no direct descendants.

At a ceremony in Hobart, the ashes of both Phil and Nel were handed to the Australian Antarctic Division to be taken to Antarctica and placed on West Arm at Mawson, Law's first station established on mainland Antarctica.

Patrick Quilty

Arthur Melville (Mel) Thompson

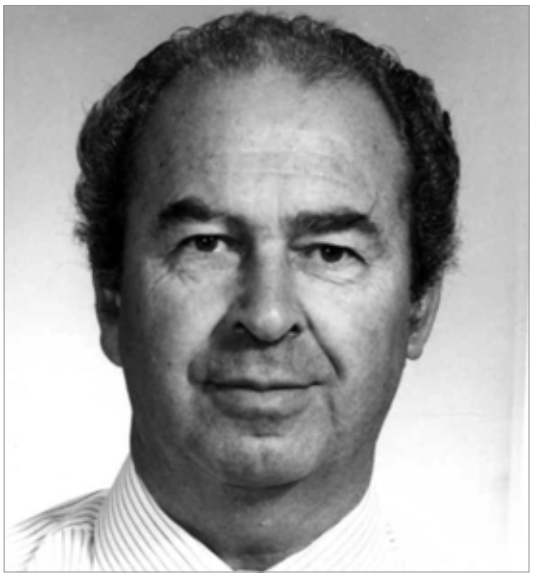


PHOTO: BARRY INGLIS

Elected to Fellowship 1972

Mel Thompson was born in Adelaide on 4 January 1917 and died in Sydney on 8 August 2009. Mel was educated in Adelaide and received a BSc Honours degree with first class honours in physics, from the University of Adelaide in 1938. Following graduation he worked for a year as a demonstrator in the physics department at the University of Adelaide on a CSIR grant before taking up a CSIR studentship in 1940. Under the studentship he received training in electrical measurements at the National Physical Laboratory in the UK and the National Bureau of Standards in the USA, now the National Institute of Standards and Technology. Mel returned to Australia in 1941 and was appointed to the research staff in the electrotechnology section of the National Standards Laboratory (NSL). He rose through the research scientist ranks to be appointed chief research officer in 1962 and chief research scientist 2 in 1971. After retiring in 1982

he continued his research for a further year as an honorary senior research fellow.

During his early days at the NSL he was engaged in defence work related to magnetic mines on behalf of the Australian Navy. However, the main focus of his illustrious career was on precision electrical measurements and electrical standards. In particular, he developed new bridge measurement techniques and impedance design techniques that advanced the state of the art by several orders of magnitude and continue to be the basis of precision impedance measurement technique to this day. Perhaps his greatest contribution, and the one for which he gained greatest recognition, came in the early to mid 1950s with his conception of a calculable capacitor design requiring measurement of only a single linear dimension. While working with DG Lampard on the calculation of capacitance of this design they realised that the design could be generalised. This gave rise to a new theorem in electrostatics, known as the Thompson-Lampard theorem that was published in *Nature* in 1956. The interest in developing new calculable capacitance standards at NSL was part of a larger program to realise absolute values for the units of capacitance (farad) and electrical resistance (ohm). The Thompson-Lampard capacitor put Australia in advance of the rest of the world in this field and really put NSL on the international map. The Thompson-Lampard capacitor and Thompson's novel bridge techniques were rapidly taken up by other national measurement institutes around the world and continue to be used as the basis for capacitance measurement. There is currently a new generation of these capacitors being developed at the National Measurement Institute, Australia in collaboration with the International Bureau of Weights and Measures (BIPM).

Mel was one of eight founding father appointees at the NSL. He was an outstanding scientist who made major contributions of international significance in electrical metrology. Indeed, the high international standing that NSL – and later the CSIRO Division of Applied Physics, the National Measurement Laboratory and currently the National Measurement Institute – enjoys is in no small measure due to his work.

Mel was elected to the Fellowship of the Academy in 1972. He received many other honours and awards, including the Instrument Society of America's Albert F Sperry Medal (with DG Lampard) in recognition of their contributions to the improvement of fundamental international standards of capacitance and resistance resulting from their development of a new theorem in electrostatics, and its application to the design of a calculable standard of capacitance (1965); an honorary *doktor-ingenieur* conferred by the Technical University of Hanover for outstanding contributions to electrical measurements (1968); the IEEE Morris E Leeds Award for outstanding advances in absolute electrical measurements, particularly capacitance and resistance (1977); and a Centenary of Federation Medal (2003).

Mel is survived by his wife, Joan, and his children, Marc and Haydn.

Barry Inglis

Donald Eric Weiss

Elected to Fellowship 1971

Don Weiss was born in St Kilda, Melbourne on 4 October 1924. He was the only child of Herbert Vernon Weiss, a librarian, and Lillian (Lill) Kate née Le Lievre, a school teacher. After his parents separated when Don was three, Don and his mother moved to Adelaide to live in a house owned by his mother's older, widowed sister, Nellie Moyes. Nellie's son Owen and Lill's younger sister Florence, who like her two sisters was a school teacher, also lived in the house.

Don attended the Mitcham Primary School where he played the fife in the school band. He commenced his secondary education at Scotch College, Adelaide, in 1937 and completed

his leaving certificate in 1941. He graduated from playing the fife to the flute and in 1941 was the first flautist in the school orchestra. He maintained a lifelong interest in the flute. He was not very interested in studying until introduced to chemistry by two first class teachers, John E Smith and John Dow. In his last year at Scotch College he won the science prize, and shared the mathematics prize and the special English prize.

Don decided at an early age that he was going to be an industrial chemist and so enrolled in the Diploma of Industrial Chemistry at the South Australian School of Mines and Industry (now part of the University of South Australia). He transferred to a BSc course at the University of Adelaide in 1944 and graduated in 1945. He was awarded a DSc from the University of Adelaide in 1960.

Don was employed as a shift chemist at the Australian Pulp and Paper Manufacturers mill at Burnie, Tasmania from 1945 to 1946, and then as a development chemist at the Commonwealth Serum Laboratories in Melbourne. He was engaged in experimental laboratory and pilot plant investigations of penicillin production. Don met Richard Thomas, a CSIR scientist, at a RACI meeting and they discussed Don's design for a device to carry out continuous fractional precipitations. Thomas talked about this to his chief, IW Wark and soon after Don was recruited to the CSIR Division of Industrial Chemistry to commence on 2 January 1948. He remained with CSIR/CSIRO for the rest of his career.

Don achieved rapid promotion in CSIR/CSIRO. In 1971 he was appointed assistant chief of the Division of Applied Chemistry, and then in 1974 was appointed chief of the newly created Division of Chemical Technology. He remained in that position until 1979 when he was invited to become the director of CSIRO's planning and evaluation advisory unit. He retired from CSIRO in 1984.

Don was a very active member of RACI. He was the president in 1983 and is the only person to have won all four flagship medals of RACI. He won the Rennie Memorial Medal in 1950, the HG Smith Memorial Medal in 1966, the Leighton Memorial Medal in 1977 and the Applied Research Medal in 1980. He was also active in the Society of Chemical Industry of Victoria and the UK-based Society of Chemical Industry (SCI). In 1992 the SCI gave him a special award for 'innovative contributions to ion-exchange technology and its application in practice'. Don was involved in the Australian Water and Waste Water Association and the International Association for Water Quality Pollution Research, being the Australian branch president in 1979. He was a foundation Fellow of the Australian Academy of Technological Sciences and Engineering.

Don devoted his entire scientific career to separation science. He was trying either to recover a valuable component from a dilute solution or mixture or to separate impurities from a valuable solvent. His work was always user driven and he never thought that his work was complete until it was embodied in a plant operating on a commercial basis. This was often frustrating because the companies with which he worked often changed their direction before Don's technology could be implemented. Setbacks were only ever temporary; Don's natural enthusiasm drove him to the next problem.

Delegates at the Fifth Empire Mining and Metallurgical Congress which was held in Australia in 1953 were shown Don's continuous water softening system and some of them saw that the system had potential for the direct recovery of uranium from a slurry of leached minerals ores. After some negotiations, Don obtained a security clearance to visit plants in the Colorado desert where he gained a better understanding of the needs. In collaboration with the Australian Atomic Energy Commission (now ANSTO) and Consolidated Zinc Pty Ltd (now Rio Tinto Ltd) Don developed a counter current ion exchange plant which extracted uranium ions. The technology was licensed to the Permutit Company but was never implemented by Consolidated Zinc. The work begun by Don was continued in Russia and Japan, where Asahi developed from it the first commercially successful continuous ion-exchange process for boiler feed and industrial water treatment. The Newport power station in Melbourne contains this equipment.

In the early 1960s Don turned his attention to municipal water treatment. He studied the needs and markets carefully, visiting water authorities in Melbourne, Adelaide, Perth, Sydney and Brisbane. He decided to concentrate on developing technologies to treat the predicted rise in salinity of water supplies in Perth and Adelaide. This became his main scientific interest for the rest of his career.

Don and his collaborators developed many processes for water and waste water treatment.

The first was Sirotherm, whereby salt is extracted from brackish water by a mixture of weak acid and certain weak base resins which are then rinsed with hot water. Heating the weak base changes its basicity causing the adsorbed ions to be released as a more concentrated effluent. Two types of resin were used in separate pilot plants: 'plum pudding resins' had the micron sized active resins dispersed within a porous matrix bead of standard size, and 'magnetic resins' where micro-beads of resins contained a proportion of gamma iron oxide. Unmagnetised these resins dispersed but when passed through a magnetic field they flocculated and settled rapidly. The Sirotherm process was not a commercial success.

In the mid 1970s he realised that the removal of colour and turbidity from ground and surface waters was a problem. He and his collaborators discovered that magnetite particles themselves could absorb colour and turbidity and the 'Sirofloc' process was developed. Commercial plants were constructed in Tasmania, New Zealand, England and Ireland. The Esk Valley Water Authority in northern Tasmania is still operating a 'Sirofloc' plant.

The concept of magnetic ion exchange resins was further developed by the CSIRO Division of Chemical Technology (and its successors, the Divisions of Chemical and Wood Technology, Chemicals and Polymers and Molecular Science) and is now licensed to Orica. MIEX technology, as it is now called, has been successfully applied for the removal of dissolved organic carbon from potable water sources. More than 20 plants have been installed around the world.

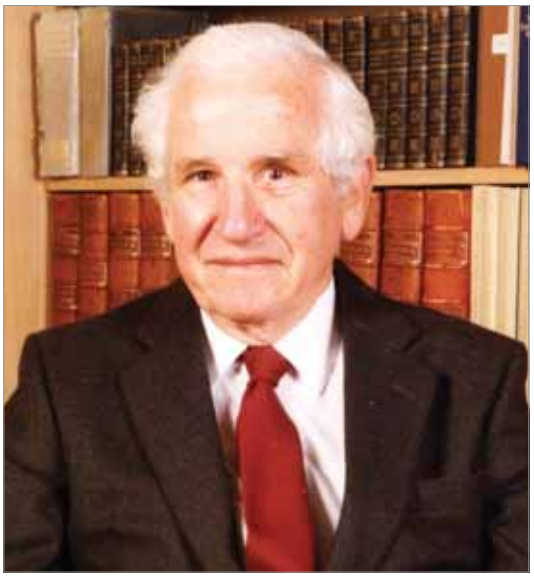
Don initially tried an electrochemical approach to the regeneration of ion-exchange resins using activated carbon electrodes. In pursuing this goal, Don and his collaborators reported a substituted polypyridine with a remarkable resistivity of 0.03 ohm cm. These polymers could not be applied to desalination so Don abandoned this line of enquiry. This was unfortunate because conducting polymers were rediscovered in 1977 by Heeger, MacDiarmid and Shirakawa, who won the 2000 Nobel Prize in Chemistry.

Don was a creative and enthusiastic scientist. He was a tall man and a towering presence in more ways than one. He never seemed to join in ordinary conversations; his brain was always employed elsewhere. He was fortunate in having many loyal and talented collaborators to assist in bringing his ideas into practice. He was infallibly courteous towards his colleagues and assistants. The many MIEX plants operating around the world are a testament to the strength of his ideas and to the value of perseverance.

Don married Betty Axford Evan in 1951. They had two sons – Robert Andrew, born in 1952, a chemical engineer and Peter William, born in 1956, an architect. Don had three grand-daughters and a grandson. Don died on 30 July 2008. Betty died in 2010.

Tom Spurling

Wesley Kingston Whitten



Elected to Fellowship 1982

Wes Whitten was born at Macksville, New South Wales on 1 August 1918. He was educated at the East Maitland Boys High School and later the University of Sydney where he graduated with a BVSc with honours in 1939 and BSc in 1941. After four years (1941–45) in the Australian Army, first as a captain in the Veterinary Corps and then as officer-in-charge, Land Headquarters Food Laboratory, he joined CSIRO in 1946 to work on infertility in sheep particularly the infertility associated with grazing clover dominant pastures. In 1949 he was appointed to supervise the breeding of laboratory animals in the John Curtin School of Medical Research at the ANU and to carry out cognate research. In this position Wes made significant contributions to understanding the metabolism of embryos and designed a completely synthetic medium (Whitten's medium) for the world-first culture of mammalian embryos. Wes's

contributions in this area have proved seminal in the development of assisted reproductive technologies in Australia and worldwide. He also made major findings in the endocrine control of embryonic implantation and the role of pheromones in reproduction (Whitten effect) via the vomeronasal organ. For these studies he was awarded a DSc by the University of Sydney in 1962.

His research interests also included possum and seal reproduction and in 1958 he spent three months studying elephant seals on Macquarie Island. In 1961 Wes resigned from the ANU to become assistant director (endocrine products) at the National Biological Standards Laboratory in Canberra. In 1966 Wes moved to Bar Harbor, Maine, USA to work at the Jackson Laboratory, famous for its work on genetics and physiology of mice. This work has greatly enhanced the role of laboratory mice as models in the study of human genetics, physiology, immunology and disease processes. He was senior staff scientist and associate director of research and with colleagues published numerous papers on the breeding and physiology of mice, much of which has been applied in the field of fertility and assisted reproductive technology in humans. With Dr David Whittingham he pioneered the freezing and international transport of embryos. In collaboration with colleagues at Dalhousie University in Canada he continued to pursue his interest in pheromones and their significance in animal reproduction and behaviour. The Memorial University of Newfoundland awarded him an honorary DSc in 2001. Wes published over 100 papers in major scientific journals and was assistant editor of *Biology of Reproduction* and *Journal of Experimental Zoology*.

Wes retired in 1979 and returned to Australia. First he lived in Hobart where he played a major part in setting up a successful IVF laboratory and then in 1980 moved to Canberra where he continued an active interest in research at laboratories of the ANU and CSIRO. He held honorary appointments in the Department of Zoology, University of Tasmania; the John Curtin School of Medical Research at ANU; the Cooperative Research Centre for Biological Control of Vertebrate Pest Populations; and the Medical School at Memorial University, Newfoundland, Canada.

Wes was elected to the Australian Academy of Science in 1982. In 1993 the Society for the Study of Fertility awarded Dr Whitten the Marshall Medal, the society's premier award, which was established in 1963 to be awarded 'from time to time by the society to outstanding contributors to the study of fertility and reproduction'. The International Embryo Transfer Society awarded him the society's Pioneer Award in 1996. In 2009 the ANU named its new world-class animal breeding facility the Wes Whitten Building in honour of his outstanding contributions to biomedical science.

Wes was an enthusiastic swimmer and surfer, and a keen bushwalker and canoeist. He married Enid Elsbeth Cay Meredith in 1941 and had two sons (Greg and Mark) and two daughters (Jane and Penny). After Beth passed away in 1999 he married Jocelyn Mary Taylor, a long-standing friend and colleague, in 2001 and lived in Oregon, USA until failing health compelled him to return to Canberra in 2008 to be nearer his family.

Wes died on 24 May 2010. He is survived by Greg, Mark, Jane and Penny, five grandchildren and two great-grandchildren.

Jim Shelton

(John) Paul Wild

PHOTO: PENNY WILD

Elected to Fellowship 1964

Paul Wild was born on 17 May 1923 in Sheffield, England, the son of a cutlery manufacturer who lost everything in the Depression. As Paul described it, the family went from riches to rags. Paul's father went to the US to sell his patents but never returned, although he was able to provide support once his financial dealings were done. An early gift of a Hornby train from his mother started Paul on his lifelong love of trains. Paul described three early

ambitions – to be a train driver on a King Class locomotive, to be an opening batsman for Yorkshire and to become a Fellow of the Royal Society and as he said, 'I only achieved the third'.

Paul had an early love of mathematics and attributes much to his school mathematics teachers. When he went to Cambridge in 1942, he took mathematics and then, 'to do something useful for war service' went straight into part two physics, which he greatly enjoyed, and at the end of the year joined the Navy. He was proud of having only ever spent five terms at university. After a year away he was given a BA and later paid £5 to convert it to an MA.

Paul became a radar officer on the flagship HMS *King George V* in the British Pacific fleet and spoke of making his name by explaining to his captain (the Admiral) at a critical moment that 'normal' meant 'at right angles to' and then watched on radar as the whole fleet turned through 90 degrees.

It was during visits to Sydney that Paul met Elaine Hull and became engaged to marry her – a good reason to come to Australia. After the war he returned to England and taught radar to naval officers until, in 1947, he obtained a job at the Radiophysics Laboratory of CSIR in Sydney, to maintain and develop test equipment. After a year in this role, he was able to get into radioastronomy research with Joe Pawsey's group. Paul was a great admirer of Pawsey, 'He just provided ideal conditions, an ideal environment to allow everyone to use their own initiative'.

In his then role as an assistant research officer, Paul was able to start his work in solar radioastronomy. He worked with Lindsay McCready and, at Pawsey's suggestion, built a spectrograph to study solar bursts. This instrument would allow a display of frequency versus time covering a swept frequency range from 40 to 70 MHz. With this instrument, they identified and named three types of bursts – types I, II and III, distinguished by the way the frequency drifted with time and published a series of papers in 1950. They deduced that the type II bursts were associated with shock waves coming out through the solar atmosphere at 1000 km/sec and were associated, 30 hours later, with aurora in the Earth night sky. They associated type III bursts with streams of electrons being ejected at a third the speed of light and taking only an hour to reach the Earth. The mechanisms proved to be correct and their naming of the phenomena became the standard. Paul likened this research to the study of taxonomy that preceded Darwin's 'Origin of species'. His analysis of the anatomy of the solar flares and his development of the physical interpretation culminated in a unified model which integrated the apparently complex radio flare phenomena in the solar chromosphere, solar corona, and in the interplanetary space.

In the course of this solar work, Paul became interested in the radio spectrum of hydrogen and wrote up an internal report related to the potential for spectral lines in the solar bursts. When Ewen and Purcell in the USA first observed the 1420 MHz transition in 1951, Paul went back to his report, generalised it to include the interstellar medium, and six months later published the first detailed theoretical paper on the hydrogen lines – a classic in the field. The assistant research officer had come a long way in the brief period since 1947. After 10 years of research, Paul's collected papers gained him a DSc degree from Cambridge University. The group was the pre-eminent group in the world for solar radioastronomy and would continue their work for three decades.

All the results had been inferred from the spectral observations and there was a growing desire to be able to image the sun at the same range of frequencies with angular resolution comparable to the human eye. This dictated the need for an instrument more than a million times the size of the aperture of the human eye – three kilometres across. With Pawsey's help, £630,000 was raised from the Ford Foundation to build a radioheliograph at Narrabri in northern New South Wales. Paul acknowledged his friend Kevin Sheridan, chief electronics engineer, as the key figure in this development. The heliograph stayed in operation for 17 years from 1967, providing a tremendous amount of data and insight into the way the solar corona works and the relationship between solar and terrestrial phenomena. Paul published more than 70 papers in this area, and was elected a Fellow of the Royal Society of London in 1970.

In 1971, Paul took over from EG (Taffy) Bowen as chief of the Division of Radiophysics. While continuing his interest in the solar area, he now looked around for opportunities to use the skills gained from the radioastronomy work and to provide a balance of pure and applied work in the Division. Discussions with Egon Stern from the Department of Civil Aviation identified a replacement for the ILS (Instrument Landing

System) as a key opportunity, which was taken up with great enthusiasm by Paul. This work led to the Interscan System, ultimately accepted as the new global standard in 1978.

Paul was appointed chairman and chief executive of CSIRO in 1978, the last person to hold both titles. As chairman of CSIRO from 1978 to 1985, Dr Wild was a national science leader. He led the organisation through the restructure designed in 1978 to modernise it and bring it closer to the industries and community which it serves. He recognised that CSIRO needed to adapt and provide scientific and technological leadership in a changing world. And, as he wrote in 1984,

> Yet, whatever the changes, one characteristic must remain inviolate: a high standard of excellence and originality. Without excellence and originality, research achieves nothing.

During this period he was instrumental in securing funding for major national research facilities including the Oceanographic Research Vessel, the Australian Animal Health Laboratory and the Australia Telescope, and he established a new division of information technology. The Australia Telescope was, in fact, built on the site of Paul's radioheliograph and the observatory was named the Paul Wild Observatory.

Another project that started in this era was his Very Fast Train (VFT) project following a train trip from Sydney to Canberra. He envisaged a fast train linking Sydney, Canberra and Melbourne. He became chairman of the VFT consortium, which comprised TNT, Elders IXL, BHP and Kumagai Gumi but the project collapsed in the early 1990s when the government rejected proposals for tax benefits for infrastructure projects.

A longstanding interest of Paul's was gravitational theory. In his later years Paul published a modified Newtonian theory of gravity which is simpler than the general theory of relativity but makes equivalent predictions. Although this is acknowledged as a valid and complementary approach it has had limited impact. Paul's deep understanding of gravity theory and general relativity led him to an insight which could provide a link between the inertial and gravitational mass and a prediction of the mass density of the universe. This work was incomplete when he died.

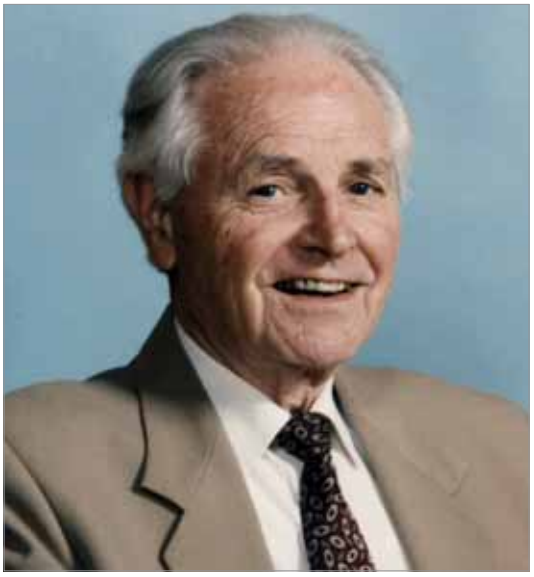
The 'big-picture' people in science, the 'system thinkers' who can see their way through the complexity to set the path are the ones who take the world forward. In this arena, Paul was in the absolute top drawer. On any technical issue – he got it! This shows through from Paul's earliest work. He clearly had an exceptional intellect, wide knowledge and a continuing and unstoppable interest in 'the new'.

Paul gained many honours. These include the Hale Prize in 1980. He was a Fellow of the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering and the Royal Society, a foreign member of the American Philosophical Society and a Fellow of the American Academy of Arts and Sciences. He was made a Commander of the Order of the British Empire (CBE) in 1978 and a Companion of the Order of Australia in 1986.

Paul died on 10 May 2008. He is survived by his son Peter, daughter Penny, son Tim and Tim's children Arnold and Victor.

Bob Frater
Ron Ekers

Howard Knox Worner



Elected to Fellowship 1973

Howard Worner was born at Swan Hill in Victoria, Australia on 3 August 1913 into a farming family. He received his early education at the local school and appeared to be destined for a farming career. However after a prolonged drought and the Depression the family moved to Bendigo where he attended a technical college with his two brothers, Hill and Neil. They all showed academic promise and continued on to the School of Mines where

Howard studied industrial chemistry and graduated with a gold medal in 1932. He then went to the University of Melbourne to study metallurgy and graduated with a BSc with first class honours in 1934. Appointed to the staff of the metallurgy department in 1935 he commenced research on creep of lead and was awarded an MSc with first class honours in 1936. His work led to lighter plates in lead-acid batteries and was the basis for development of delayed timing devices in World War II. After four years he moved to the Department of Health on a National Health and Medical Research fellowship to work on a wide range of dental materials. He was awarded a DSc in 1942 on the basis of his pioneering research in the area which was recognised internationally. The results laid the foundation for the Australian Dental Standards Bureau. Between 1944 and 1945 he carried out work with the services tropical scientific unit directed to improved storage of dental and surgical stores in tropical areas for the Australian Army.

In 1946 Howard was appointed as professor of metallurgy at the University of Melbourne and later became dean of engineering in 1953. He carried out research on new methods of casting high strength alloys and on electrolytic production of titanium and seemed destined for a distinguished academic career. However his strong desire to see practical application of research led him in 1955 to accept an offer from The Broken Hill Pty Co Ltd (BHP) to become director of research and establish BHP's central research laboratories in Newcastle, New South Wales. He encouraged researchers to explore new ways of processing coal and iron ore for steelmaking which led in 1960 to the concept of continuous steelmaking to replace the batch processing used at that time. He envisaged the combination of injection of reactants through pipes into a flowing stream of hot metal and slag. This concept became his personal commitment for many years. He demonstrated the concept on a trial basis at Newcastle Steelworks but failed to convince senior management of its potential since at that time there was no driving commercial urgency for such a process. Howard determined to take it further and left BHP in 1962.

After discussions with several international companies he took up the post of director of new process development for the newly formed Conzinc Riotinto Australia (CRA) Group at Cockle Creek near Newcastle in 1963. CRA's main interest was in mining copper and nickel which were more amenable to continuous processing than steel and Howard developed a range of technologies under the name of WOCRA (after WOrner and CRA Ltd). However CRA did not have smelters in Australia and the processes were exploited overseas in Europe for copper and lead, and in Japan and China for steel. He was later awarded the Metallgesellschaft Medal in Germany and the Shanghai Society of Metals Medal in recognition of his pioneering research. The concepts developed by Howard have come to fruition in Australia several decades later in the developments of SIROsmelt (after CSIRO) and ISAsmelt (after Mt Isa).

While in industry Howard recognised the need to build bridges between university researchers and industry and he fostered the formation of the Australian Industry Research Group (AIRG) linking research managers of the major Australian companies. He was elected as a Fellow of the Australian Academy of Science in 1973 at a time of considerable debate about the recognition of technologists by the Academy. Howard strongly believed in the need for a body to recognise achievements of applied scientists and engineers as existed in Europe and the United States. With an initial base from the AIRG, the Australian Academy of Technological Sciences (later, 'and Engineering' was added) was formed in 1975 with Howard as a foundation Fellow and honorary secretary, a position which he held for 10 years.

He retired from CRA in 1975 and took up a new challenge in the energy area in 1976 as chair of the Victorian Brown Coal Council where he stimulated research on low rank lignite including use as char and in production of oil from coal for a period of five years. During this period he was also chair of the Victorian Solar Energy Council and stimulated research on low energy housing and solar heating and cooling in industry. At the national level, he was chair of the National Energy Advisory Committee from 1976–77 and oversaw the production of a number of influential studies on energy issues. As a result the Australian Government established the National Energy Research Development and Demonstration Council with a substantial funding base. Howard was appointed chair from 1976 to 1977 and succeeded in effectively linking university researchers and industry. His achievements over this period were recognised by the award of a CBE in 1978.

In 1983 he moved to Wollongong for family reasons but continued links to both academies, serving as a

member of the Academy Council from 1983–85. He looked for new challenges and in 1987 he joined the University of Wollongong as an honorary professor and took up the position of director of the newly formed Microwave Applications Centre. Here he developed the EnvIRONment technique using microwaves to process sewage sludge and steelworks dust to make iron and zinc pigment. He was able to prove the concept on a small scale but it proved difficult to scale up for industrial production. A significant legacy at the university is his bequest of his minerals collection which he commenced at Broken Hill in 1932. It is one of the finest collections in Australia and he worked on cataloguing it until his death on 17 November 2006.

In 1937 he married Rilda Muller and had two sons and a daughter, namely, John, Ruth and Colin. Both Rilda and John predeceased him.

Howard received many other medals and awards during his long and productive life. He is remembered as an excellent communicator who worked naturally and easily between academic and industrial research and made lasting contributions in metallurgy, materials and geology.

Greg Tegart