ANU REPORTER 24/5/85

Neutron expert joins research school

Professor John White, a chemist of high acclaim who has been in the forefront of the development of neutron-scattering techniques, has joined the University as Professor of Physical and Theoretical Chemistry in the Research School of Chemistry.

He succeeds Professor David Craig, under whom he studied at Sydney University in the 1950s.

Professor White comes to the ANU with top credentials in his field, including the directorship of the prestigious Institut Laue-Langevin, which operates the joint French-German-British High-Flux Reactor at Grenoble, France.

Australian-born, Professor White went to Oxford to do his PhD after winning a Royal Commissioners for the Exhibition of 1851 Scholarship, and studied under Professor (now Sir) Rex Richards. In 1959, when he began his work at Oxford on nuclear magnetic resonance (NMR) spectroscopy, it was then a very new field. 'My aim was to learn about it and put it into action', he told the *ANU Reporter*.

Before he had completed his doctorate he was given a fellowship at Lincoln College in conjunction with an Imperial Chemical Industries Fellowship to study NMR.

'We were given a large grant by the Paul Instrument Fund of the Royal Society of London to develop a new instrument — the High Resolution Electron Nuclear Double Resonance Spectrometer. That worked very well and was used by a lot of people,' he said.

In the years that followed, Dr White began to develop the use of neutron inelastic scattering for the study of chemical problems.

'That was a technique beginning to be rather important in solid state physics and liquid state physics, as well as magnetism. Looking from the point of view of my background in nuclear magnetic resonance I thought it might have some potential for physical chemistry,' he said.

But using the new techniques to investigate molecular systems had its problems, and the first few years proved disappointing. It was not until Dr White and his colleagues built a new spectrometer with much higher resolution than had been available, that the new application yielded worthwhile results. He was awarded the Marlow Medal in 1968 by the Faraday Society for the development of chemical aspects of neutron inelastic scattering.

'Subsequently we found that the neutron method could be applied to a wide variety of physico-chemical systems and indeed even in biology. It could be used to study liquids, ionic solutions, polymers and in surface and colloid chemistry.'

Professor White . . . public should be accurately informed.

By the mid-1970s, the use of neutron scattering methods had begun to spread through the sciences and many researchers began to use the method to tackle problems which had not been resolved by more traditional methods.

In 1974 Dr White was invited to become Assistant Director of the Institut Laue-Langevin on secondment from Oxford, and in 1977 he became director, succeeding Nobel prize-winner in physics, Professor Rudolph Mössbauer.

During the late 70s in the Institut there was much scientific excitement and a ferment of ideas as a new period in science was opening up. This period embraced new scientific areas and new technique development — a mix of activity at the Institut which remains, perhaps, the best of its kind in the world.

'My own scientific activity was concerned with seeing how far properties of adsorbed molecules and the nature of interfaces could be probed using a combination of neutron scattering and nuclear magnetic resonance methods. We found the first examples of quantum mechanical tunnelling of adsorbed species, and on the whole the work proved fruitful and opened up a wide range of applications. One of our major interests was the nature of interfacial phenomena. It still is, and this is an area we will continue to study in Canberra,' he said.

Professor White expects that research conducted under him will continue to make use of the facility at Grenoble.

He also wants to see a powerful local facility using X-rays made available for doing complimentary work, although he says it would be unlikely that a neutron source could be established in Canberra in the near future.

It was hoped to have access to the Lucas Heights reactor, and overseas facilities.

'I think one of the exciting things about coming to Canberra is that the School already has a strong basis in the study of molecular crystals and liquids, but there is scope to add some new areas,' Professor White said.

Work to be done in the School would be concerned with X-ray scattering, with a particular aim of studying interfacial phenomena and low-dimensional phenomena. It has been found that the properties of materials, in the one or two-dimensional forms, can be quite different to their normal three-dimensional properties; for instance, with molecular polymers it is possible to make plastics that conduct electricity. These conducting polymers have other unusual physical properties and under suitable conditions exhibit battery action. One of Professor White's students is studying this with the object of trying to improve the conventional battery.

'We are concerned particularly with fundamental aspects but we are not blind to commercially interesting spin-offs, and when possible we will exploit them,' he said.

'I think it is essential for us to focus on the highest possible scientific goals but, be ready to pass on anything useful to industry.'

Practical spin-offs from some of the lines of research Professor White is following could have a long gestation period of more than 50 years, but are no less important for that.

Much of the 'pure science' of the 1930s looking into the fundamental nature of matter has led to the present revolution in techniques and equipment used to carry out the study of matter at the atomic level.

Professor White, having spent much of his professional life in the development and refinement of techniques using neutrons, is concerned that the public be accurately and impartially informed of progress and developments in the peaceful nuclear area. The great distinction from non-pacific ends should be clear, he says.

'I think that in a democracy, the public has a right to choose the way it wants to live; it is essential that the issues be put very clearly.

'I think that with the question of nuclear materials there is a lot of fear. Not just in Australia but everywhere. It is the duty of people who are concerned with experiments involving nuclear phenomena to be as clear as they can be about what they are doing; about what dangers, if any, there are; or, as is usual, about the lack of dangers.'

For example, present and foreseen uses for neutron beams ranged from radiation therapy to non-destructive metallurgical testing, and these could become indispensible to society. These methods, if introduced, needed to be conducted with respect for public concerns, he said.

'I think it is difficult to go backwards in knowledge; for example the knowledge of nuclear weapons exists and I think the use of such knowledge has to be contained by political constraints. But I also believe that these constraints should allow progress in valuable directions.'

The possibility that Australia might soon have a new neutron-scattering facility, capable of being used for world-class research was, as far as he knew, remote at present, though countries such as the United Kingdom, the USA, and the USSR had such a capacity. There was also talk of some of the developing Asian countries taking an interest in such technology. It might be of value to become associated with one or other such project.

ANU Reporter
11·4·86

Pure chemistry bears fruit

Research in the University's Research School of Chemistry promises to overcome problems with plant growth hormones so that they can be used to increase crop yields, without using additional fertilisers and weed-killers.

Field tests with apples have been successful and expectations for many other food crops — apricots, citrus fruits, pistachios, pecans, coffee and lettuce — are high. Patents filed on behalf of the University have produced commercial interest.

The chemistry has been done by the School's organic synthesis group, led by Professor Lew Mander. The group has been collaborating with biologists from the CSIRO Division of Plant Industry, from Adelaide and Melbourne, Canada, Japan, the USA and the UK.

Professor Mander's work has been concerned with gibberellins, a group of hormones that regulate growth in higher plants.

Japanese researchers isolated gibberellins from a fungus, *Gibberella fujikuroi*, which caused rice plants to elongate and fall over. The structure of gibberellins was analysed in the 1950s and finally determined using X-ray crystallography in 1963.

Agricultural applications of gibberellins have been to promote the formation of larger cells (and so, for example, larger grapes), to delay ageing (and so keep the skins of apples and lemons in good condition) and to by-pass sexual fertilisation (and so breed better cucumbers). Brewers found the hormones speeded fermentation and gardeners used them to make camellias bloom earlier. Commercial quantities of the growth promoter were produced from the fungus.

But there were problems: the early promise of gibberellins could not be delivered in full. In nature, the levels of the hormones waned and waxed, for example, in spring. But the forms of gibberellins available from the fungus, when added, could not be eliminated from plants. Treated seeds germinated well, but the seedlings grew too tall. The skin of apples could be cleared of blemishes, but the next season's flowering was suppressed: the hormones aggravated the normal biennial cycle of heavy crops alternating with light yields. Agriculturists could not control gibberellins' persistence, which produced undesirable effects.

The complexity of structure and biological properties of gibberellins appealed to synthetic chemists like Professor Mander. Attempts at synthesis were initially 'a kind of mountain-climbing exercise', he said.

'But we were inevitably drawn into trying to establish an understanding of the compounds' biological activity at the molecular level.' This led to attempts to produce compounds and techniques that could be commercially exploited.

The team at the Research School of Chemistry began to analyse the structure of gibberellin molecules and in 1980 found an efficient technique to convert more persistent gibberellins to the less persistent, more agriculturally desirable, forms.

After further testing on Golden Delicious apples in Australia and British Columbia, where the aim was to eliminate the russetting that marred the skins, the technique was judged too expensive. Commercial interest flagged.

Professor Mander turned his attention to other problems in the synthesis of gibberellins. In 1984, one of his research students, Mr Alex Chu, discovered a new procedure for the synthesis of the agriculturally desirable form. It turned out to be a much cheaper way of making a semi-synthetic analog of the gibberellin wanted.

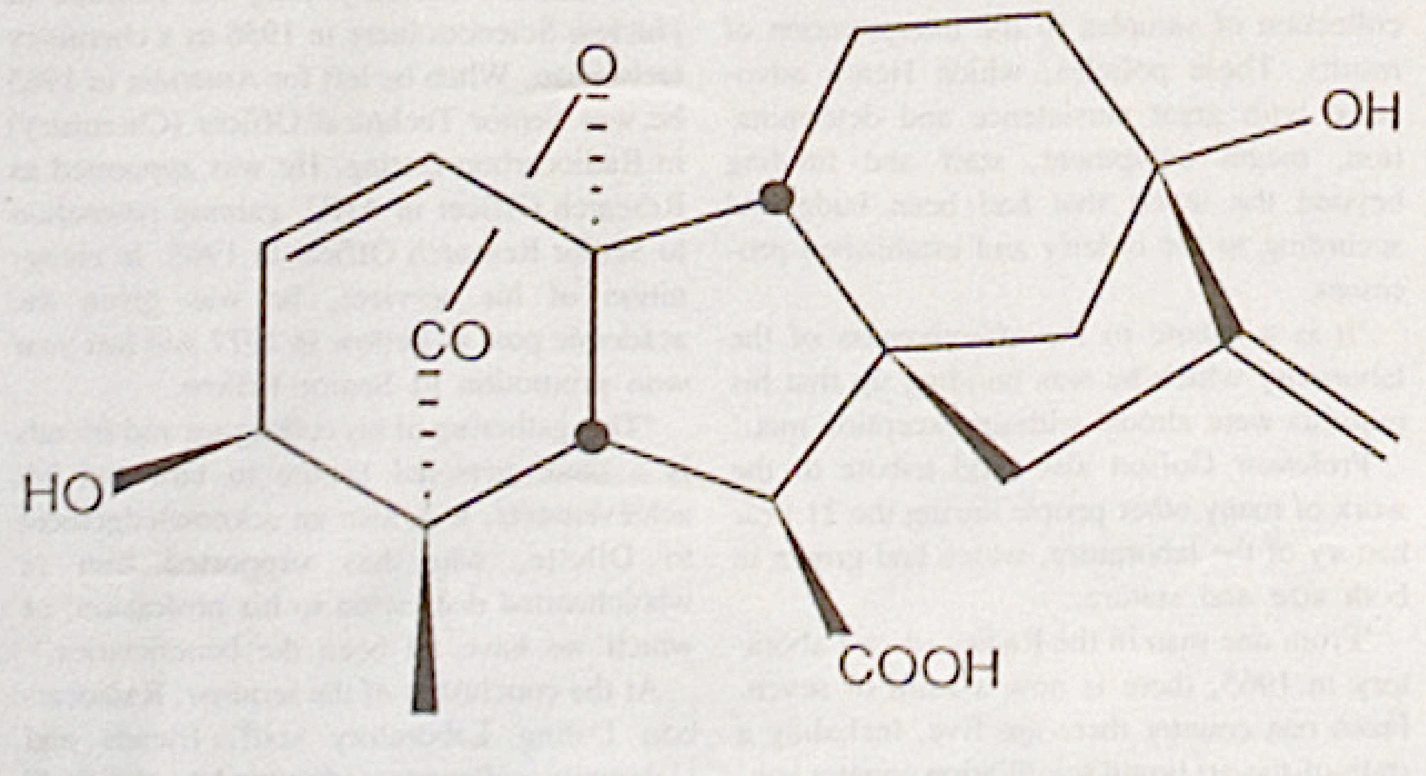
The RSC-gibberellin was tested in British Columbia last summer. Not only did it stop the russetting of the apples but, surprisingly, it also enhanced flowering the next season. 'We felt we'd hit the jackpot,' said Professor Mander.

Professor Mander is now making other gibberellin-like compounds in the hope of enhancing other aspects of plant growth. The compounds will probably be useful for many other species. Commercial interest has returned.

The secret has been to find a fast-acting substance that produced a short-pulsed effect, but did not persist in the plants.

Because the new compounds are closely related to naturally occurring growth hormones, they are unlikely to affect human consumers of the foods grown. The gibberellins should be an alternative to the fertilisers and other chemicals usually used on fruit.

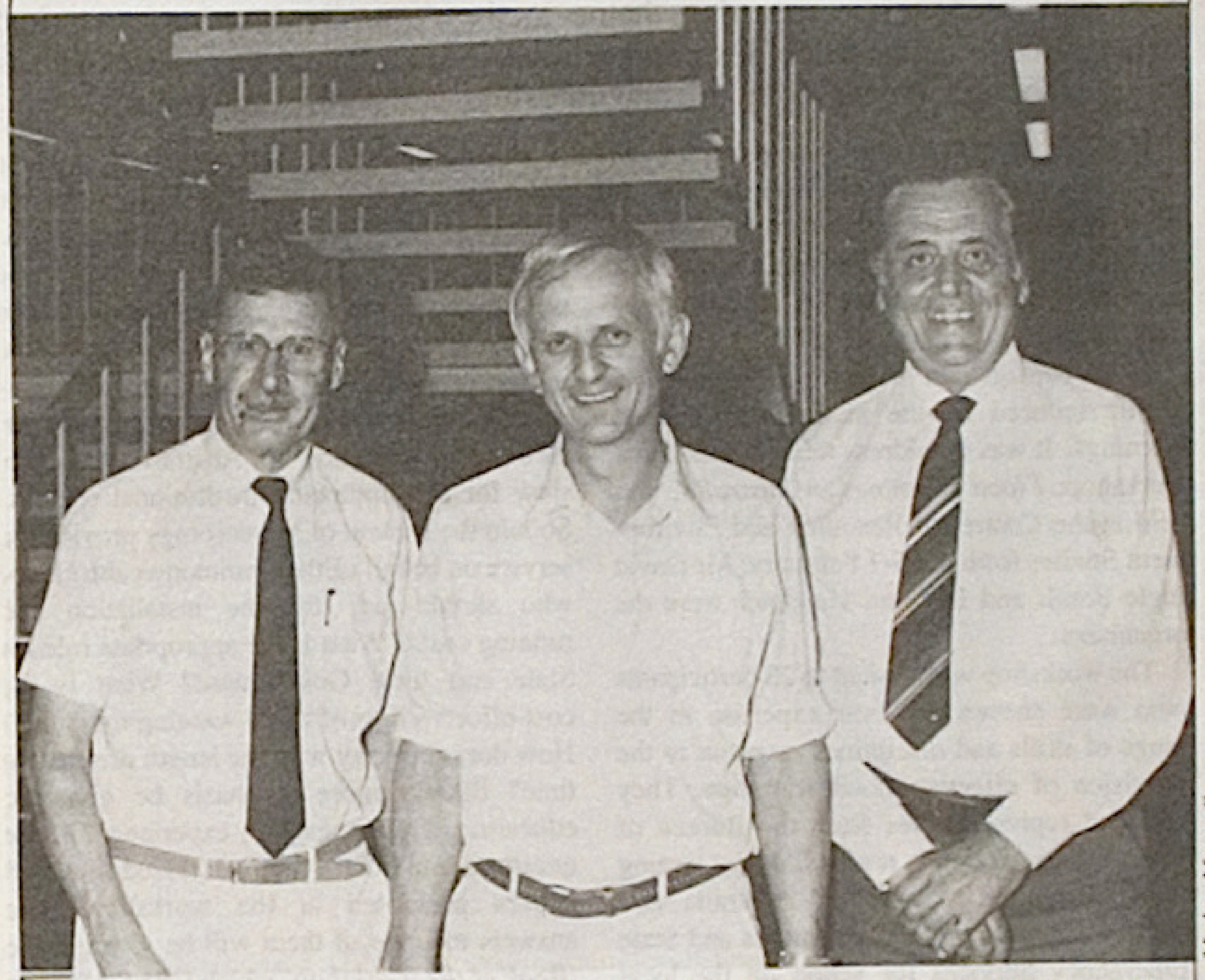
Professor Mander is pleased that curiosity-motivated research, carried out in a broader biological and agricultural context, has produced rewards.



One of the gibberellins that has been part of the RSC's research.

ANU Reporter
11·4·86

CHANGES AT RSC



Marlee Maxwell

At a recent function in the Research School of Chemistry the new Dean, Professor Alan Sargeson, left, acknowledged the five year contribution of his predecessor, Professor Lew Mander, centre. The School also farewelled its first Laboratory Manager, Mr John Harper, right. Mr Harper started at ANU in 1955, as a laboratory technician in the John Curtin School of Medical Research, and joined the Research School of Chemistry as Laboratory Manager in 1965, when the School was 'a football field and a set of sketch plans.' In 1983 he was seconded to be the University's Assistant Secretary; he was confirmed in the position in November last year.

17 April 1986

Vol 17, No 6, Friday, 9 May, 1986

Bull market for bull kelp extract

An analytical technique developed in the Research School of Chemistry to assist in the study of fundamental plant physiology seems likely to have a major commercial spin-off. Use of the method — stable isotope dilution gas chromatography-mass spectrometry — is expected to help to promote sales of an extract of Tasmanian Giant Bull Kelp, *Durvillea potatorum*, in the lucrative US agricultural market. The analysis showed that the kelp (or seaweed) extract contained natural plant growth hormones, cytokinins.

Based on the results of field trials, the presence of cytokinins in seaweed extracts has been claimed to increase crop yields, increase plant resistance to frosts and fungal infections and improve the storage abilities of fruits. In addition, the kelp extracts contain a large proportion of organic matter and a wide range of trace elements. Thus, such extracts can serve several functions, for example, as a fertilizer, a soil conditioner, a plant growth promoter and a pesticide.

The first natural cytokinin, zeatin, was isolated by Dr Stuart Letham in New Zealand in 1963, from immature kernels of maize. Early analysis methods for the presence of this class of phytohormones were based on bioassays, which were quite variable and did not reveal the structure of the individual cytokinins (about 30 such compounds have now been identified from natural sources).

When Dr Letham came to the Research School of Biological Sciences in the early 1970s, he enlisted the help of the Research School of Chemistry's specialist in mass spectrometry, Dr John MacLeod, in a collaborative study of the metabolism of cytokinins in plants. They were able to establish the structures of several new cytokinins related to zeatin.

Dr MacLeod's research group then synthesised stable-isotope (deuterium) labelled analogs of all the known zeatin-derived cytokinins. After adding known amounts of the labelled compounds to plant extracts, the cytokinin-containing fractions were purified and run through the combined ...

Tasmanian Giant Bull Kelp on the coast of King Island in Bass Strait.

With this firm evidence of the presence of cytokinins in Seasol, the Australian manufacturer and their US distributor have taken their case to Washington to have Seasol recognised as a plant growth promoter. At a recent North American Seaweed Symposium held at Clemson University, South Carolina, Dr MacLeod presented the results of the Seasol analysis to an audience consisting of seaweed extract manufacturers, formulators, distributors, researchers and consultants. An outcome of the Symposium was the formation of the North American Kelp Association, whose aim is to set standards for certifying and promoting seaweed products for agricultural use and to develop the market for seaweed products.

Given the problems that American farmers are having from overuse of chemical fertilizers and pesticides, the latter causing pollution of water tables, Dr MacLeod stated that the time appears ripe for the promotion of seaweed products such as Seasol as a viable alternative to these in large-scale agriculture. This could

9 May 1986

Recent reports in the general media as well as *ANU Reporter* on the compositions of Comet Halley emphasised the presence of organic compounds in general and amino-acids in particular. Some reports implied that these compounds from space could have contributed to the origin of life.

It is noteworthy that meteorites usually have a component of amino-acids. Particularly rich in these compounds is a meteorite recently found in Antarctica. However, the amino-acids have proved to be of inorganic origin.

The synthesis of organic compounds by inorganic processes has been performed in laboratories (Sagan, Miller and Orgel and

by soaking my arms in hot water. Driving the car was agony, especially as the gearshift stiffened initially in cold weather and had to be moved into position with some force.

1986

Our first Break in at R·S·C.

Jewellery is stolen

Thieves broke into a house in Hyndes Crescent, Holder, on Monday and took jewellery valued at $2500 from a bedroom, police said yesterday.

Eight other burglaries were reported in the 24 hours to noon yesterday, including houses in Bedford Street, Deakin (stereo cassette player valued at $200), Faulkner Street, Chapman (property valued at $780) and Booroondara Street, Reid (wine and cash to a total value of $180).

Other burglaries were reported from the ANU research school of chemistry (property valued at $450); Gowrie Primary School (small amount of cash and stationery); Yarralumla Primary School (photocopier valued at $1600); Waramanga Primary School (television set valued at $495 and radio valued at $80); and the chemistry building, Duntroon (dishwasher).

Two attempted burglaries were reported at houses in Duffy Street, Ainslie.

Monday 2nd June 1986

ANU Reporter

13th June 1986

TWENTY-SIX YEARS AND STILL SMILING!

Mr Pat Kinnane can still remember his first day at ANU. On 14 December 1959, he drove to the Research School of Physical Sciences to start work as a storeman. Later that day he came face-to-face with the School's eminent Director, Professor Sir Mark Oliphant. Mr Kinnane had parked in Sir Mark's car space!

'The University's been good to me,' Mr Kinnane told *ANU Reporter*. It has enabled him to bring up his nine children — seven sons and two daughters. Mr Kinnane, who is 60, retires on 9 July.

After seven years in charge of the RSPhysS store, he moved to Student Administration in 1966. There he has been in charge of students' personal files. Mr Kinnane estimates he has dealt with tens of thousands of records.

His office houses files back to 1960, when ANU gained undergraduate teaching from Canberra University College. There are even a few drawers of files of students before that.

One of the biggest changes to Mr Kinnane's flow of students occurred last year, when ANU joined the Universities Combined Admission Centre in Sydney. This has meant more time this year sorting through admissions, though Mr Kinnane said the new system would eventually save a lot of work.

For Mr Kinnane the year's 'peak season' of student enrolments is over. He waved his arm towards the compactuses full of orderly files, in differently coloured folders for different years, and said with a characteristic laugh, 'At least I'm leaving it tidy!'

There have been a number of other retirements after long service with the University. After 28 years and two months service, **Mr Ian Reid**, head technical officer in organic chemistry in the Research School of Chemistry, retired on 9 May.

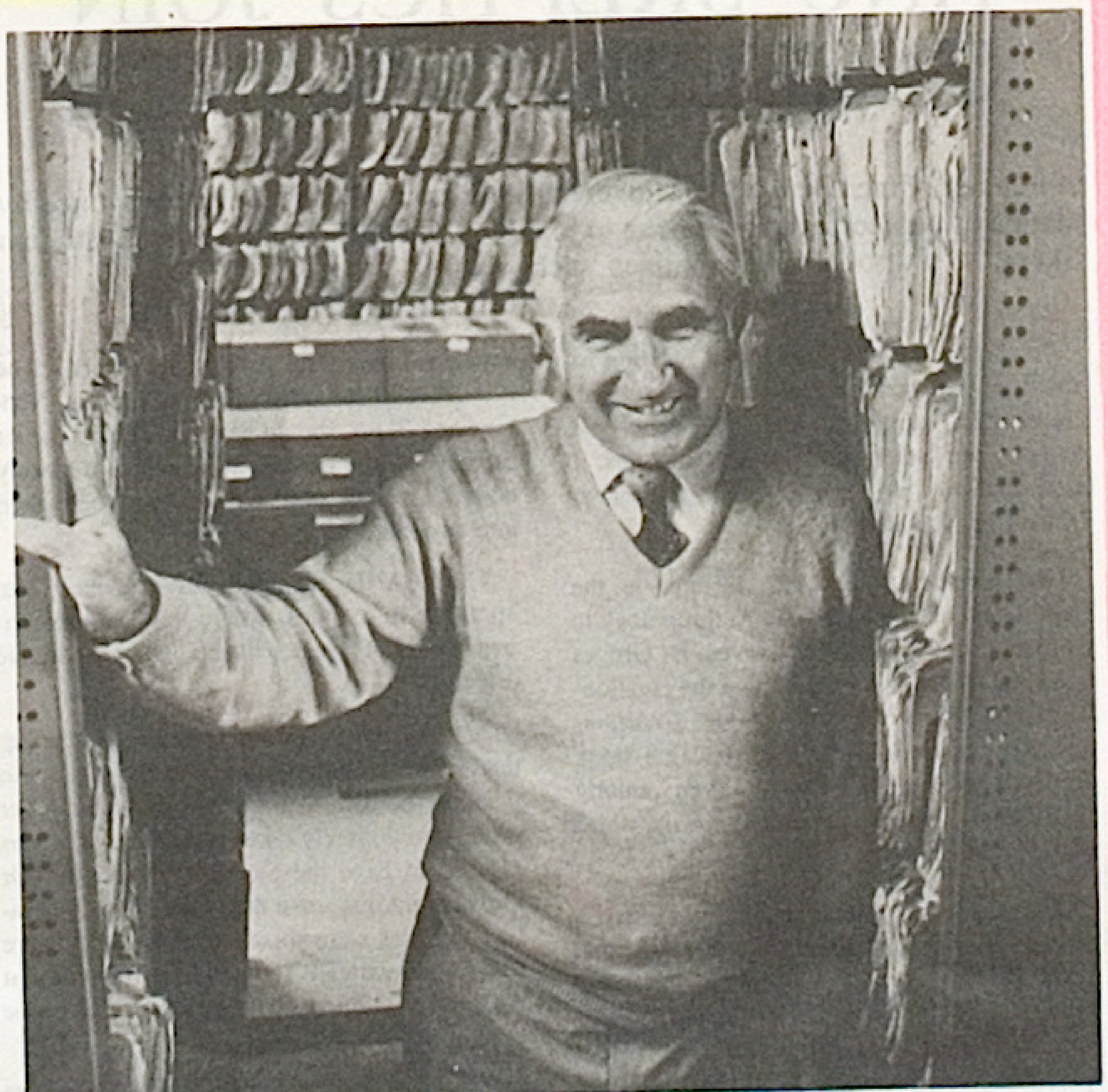
Mr Len Dowen retired on 16 May after 23 years and five months service, all of it spent with the Research School of Physical Sciences.

Mrs Brenda Boyce, the secretary/manager of Graduate House, retired on 14 May after 15 years.

The senior technical officer in the Science Faculty's Department of Geology, **Mr Ross Freeman**, retired on 20 May after 13 years.

Next month, after 23 years service with the University, the technical officer in the RSC's physical and theoretical chemistry section, **Mr Simon de Vries**, will retire.

The University appreciates all their work and their many friends and colleagues wish them well in their retirement.



Mr Pat Kinnane is in characteristically cheerful mood as he stands beside just some of the mountains of files in Student Administration.

Canberra Times
Monday 9 February 1987

Student hurt in ANU lab explosion

A chemistry research student was taken to hospital yesterday when his experiment exploded at the Australian National University.

The student was taken to Royal Canberra Hospital after suffering cuts and burns to his face and upper part of his body.

The explosion occurred at about 1pm in an exhaust cabinet, and caused a small fire which was put out by the fire brigade.

Ainslie Fire Station officer Mr David Moore, said the student had been experimenting with lithium aluminium hydride.

Lithium aluminium hydride is a metallic compound commonly used as a reducing agent for organic compounds, and is one of a class of metallic compounds being investigated as a potential hydrogen-storage medium for hydrogen-powered vehicles. Metal hydrides are unstable, and can react violently when exposed to water or air.

The manager of the laboratory at the Research School of Chemistry, Mr George McLaughlan, said yesterday that the student had been carrying out a routine experiment which had "overheated". He would make no further comment until a report had been prepared today.

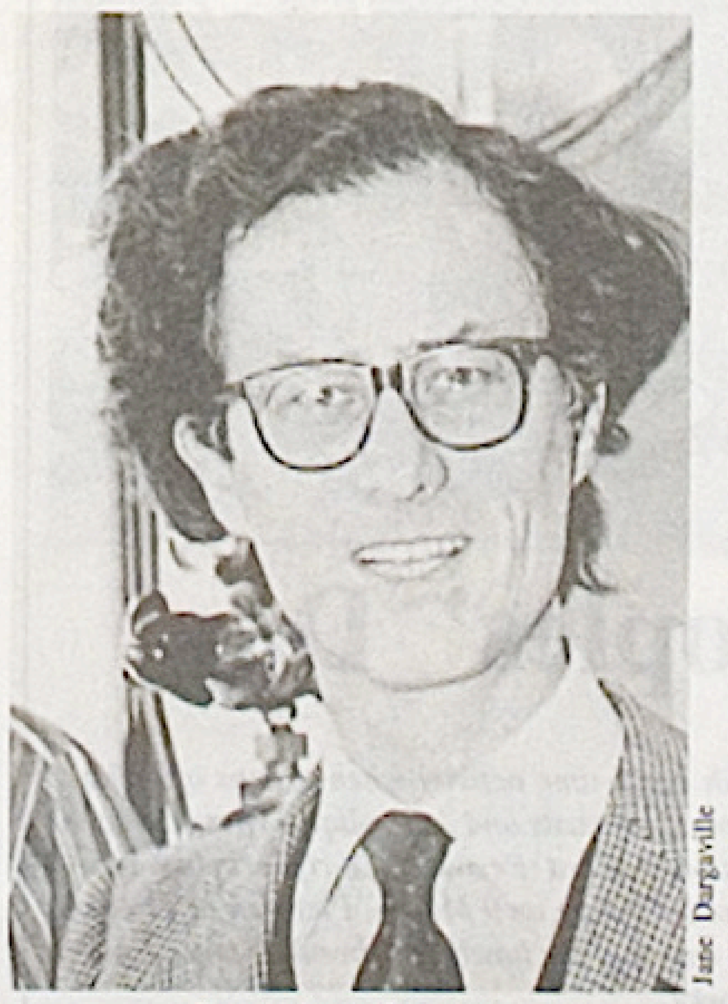
ANU Reporter 10/4/87

Superconducting oxides successfully synthesised

An ANU physicist has successfully synthesised a high temperature superconducting material made from the oxides of copper, barium and yttrium.

Dr Andrew Stewart, a Senior Fellow in the Department of Applied Mathematics, Research School of Physical Sciences (RSPhysS), has been working in collaboration with colleagues in the Research School of Earth Sciences (RSES) and the Research School of Chemistry (RSC).

The ANU material was made superconducting — at a temperature of minus 180 degrees Celsius — just four days after the CSIRO Division of Applied Physics had announced that they had fabricated similar material. The oxides were discovered in the United States and reported only last month.



Jane Dargaville

Dr Andrew Stewart

The new technology is expected to have far-reaching effects on Australian industry; the low cost of operation can be expected to bring about a revolution in some industries, according to Dr Stewart.

Superconductors — metals that conduct electricity without generating heat — are at present used to make powerful magnets and some unusual computer and electronic components. Until now, the major drawback has been the high cost of keeping them cool, using expensive liquid helium. By contrast, the new oxides can be kept cool with liquid nitrogen, which is plentiful and cheap.

The new superconductors are expected to be used across a wide span of electrical technology — from transmission lines, to motors, generators, magnets for levitating electric vehicles, CAT scanners, and computer technology.

According to Dr Stewart, the minerals from which the oxides are made are abundant in Australia. However, the country will benefit most if the materials can be refined and processed domestically, which will call for a deep understanding of the materials science and technology of the oxides.

ANU is uniquely placed to contribute to this quest: RSC has expertise in oxide chemistry; RSES specialises in the physics of minerals; and RSPhysS investigates the physical phenomena associated with superconductivity. A research team drawn from the three schools has already begun collaborative work on the oxides.

ANU REPORTER
FRIDAY 8 MAY 1987

Superconducting team

The ANU team that recently made a new high-temperature superconducting material came from three schools, the Research School of Chemistry (RSC), the Research School of Earth Sciences (RSES) and the Research School of Physical Sciences (RSPhysS). Those pictured are, from left to right, Emeritus Professor 'Judge' Bevan (RSC), Professor Bruce Hyde (RSC), Dr Ray Withers (RSC), Dr Andrew Stewart (RSPhysS), Mr Peter Barlow (RSC), Dr John Fitzgerald (RSES), Dr John Thompson (RSC), Mrs Jan Bitmead (RSES) and Professor Mervyn Paterson (RSES). Two others, absent, are Professor John Anderson (RSC) and Mr Tim Sawkins (RSPhysS). The teamwork is continuing to find other materials that superconduct (possess unusual electrical and magnetic properties) at higher temperatures.

ANU Reporter

Vol 18, No 7, Friday 22 May 1987

ANU chemist uncovers secret of oil catalyst

An ANU chemist has helped uncover the structure and means of formation of a valuable catalyst used to convert gas to petrol. The discovery could contribute to the design of more selective catalysts for the petrochemical industry.

The Professor of Physical and Theoretical Chemistry in the Research School of Chemistry (RSC), Professor John White, made the discovery a few weeks ago at the Argonne National Laboratory, part of the University of Chicago, where he collaborates with Dr Lennox Iton. The Argonne Laboratory, one of the best in the USA, named the joint ANU-Argonne work as outstanding in its March 1987 submission to the US Department of Energy. ANU and RSC were both mentioned in the citation.

Soon after he came to ANU from Oxford University, in 1985, Professor White won the University of Chicago's prestigious Argonne Fellowship and Prize. He saw this as a way to build up a relationship between ANU and Chicago. For a joint project he chose a new and interesting field of academic and applied value, the chemistry of gels.

A gel is a solution, mostly water, that behaves in a seemingly rigid way. A silica gel looks like thick white glue. The structure and behaviour of gels is a physico-chemical mystery of similar difficulty to that of polymers.

The problem also has great industrial interest. Some years ago the petroleum company, Mobil, found a way to change the floppy gel into a crystal, called zeolite. These crystals have become the basis of the New Zealand gas-to-petrol conversion industry and other petroleum refining but no-one knew how they were formed.

Zeolites have aluminium and silica in their crystal structure, with lots of small holes. These pores allow the entry of crude hydrocarbon molecules which can then be 'cracked' and reformed into other, useful hydrocarbon chains. The particular zeolite used in New Zealand to convert methanol gas to petrol is called ZSM-5. It is a fine white powder of almost pure silica, which is totally penetrated by regular holes.

Professor White sought to understand the formation of ZSM-5 zeolite by using a new technique that he pioneered in Europe — small-angle neutron scattering. In this technique a powerful stream of neutrons is piped out of a nuclear reactor, a wavelength is selected and a focused beam is then passed through a sample of gel, or whatever, to a detector. The small-angle scattering pattern on the detector gives some idea of the sample's structure.

The advantage of neutron scattering is the ability to 'see' different parts of the structure. This 'contrast variation' is achieved by changing the refractive index — the tendency to scatter neutrons — of the medium containing the sample. That way, different parts of the structure can be made 'invisible' to neutrons, so other parts can be seen more clearly.

Small-angle neutron scattering has been applied successfully to biology, particularly in determining the structure of simple spherical viruses. In such viruses a core of genetic material (RNA) is surrounded by an envelope of protein. The protein and RNA scatter neutrons to different degrees. Placing the virus in a medium with the same refractive index as the protein made the protein envelope disappear and enabled the neutron beam to show up the RNA. By changing the medium to one that scatters as much as the RNA, the neutron beam revealed the details of protein structure.

Using small-angle neutron scattering, Professor White and Dr Iton could see how zeolite crystals were formed. In a normal gel, long strands of silica were tangled together. The strands could be made to grow, like snowflakes, into crystals or amorphous silica. This process can be controlled using a template molecule, in the case of ZSM-5 this template is the tetrapropyl ammonium ion. Added to the gel, the template molecules got the strands of silica to wrap around them, forcing the tangle to become more organised. It is this step that has been clearly visualised in the present work, even for gels at room temperature. Finally, after heating, ZSM-5 becomes a pure silica structure of vertical and horizontal pipes.

Once the silica structure is fixed, the template molecules are burnt out, leaving the pores that do the catalytic job.

Professor White says that he is still uncertain of some aspects of zeolite formation. He is working to demonstrate paradigm cases with predictable results from the use of templates. Recent work shows this may be possible. Then other templates could be used to produce different zeolite crystal structures and new uses. More selective catalysts could make refining more efficient.

The value of existing zeolites and the potential for new ones means that the research is of great interest to petrochemical companies. AMOCO has already expressed interest in Professor White and Dr Iton's work.

The potential of neutron scattering has also made the technique a top priority for Australian research. The Australian Atomic Energy Commission hopes to attach such an instrument to its nuclear reactor at Lucas Heights in Sydney. With existing chemical expertise, this could help Australian scientists catch up with Europe and the USA.

Professor White believes the exciting results with zeolite show the value of the ANU-Argonne collaborative project. He hopes that future collaboration can take place on superconducting materials — an area of rapid international progress — and other unusual materials, such as mixtures of metals and minerals that have unusual properties and may make new ceramics.


Warwick Green

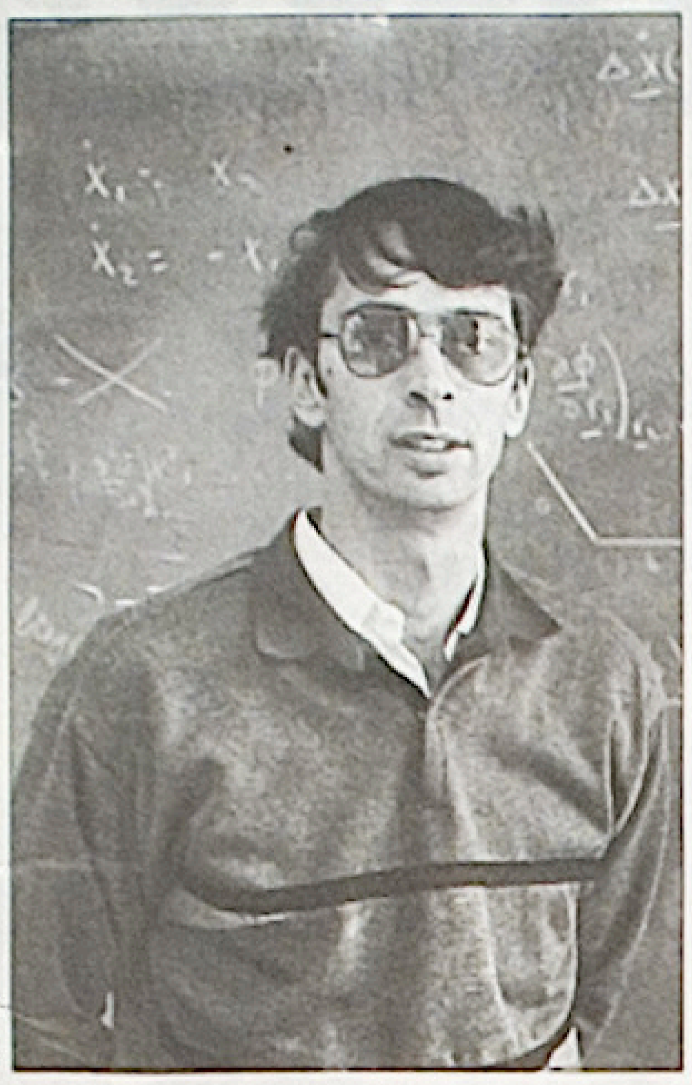
Professor John White.

ANU REPORTER 22 MAY 1987.

ANU research features in *New Scientist*

The highly respected British journal *New Scientist* has detailed research on molecular structures carried out by a team from ANU, headed by Dr Leo Radom, a Senior Fellow in the Research School of Chemistry. The report carries the prediction by the team of the existence of exotic, positively-charged molecules containing bonded carbon and helium atoms. The scientists are the first to counter the 70-year-old theory that helium is so inert that it will not combine with anything.

Cost-savings from equation are in pipeline



Roger Green

Dr Denis Evans

ANU chemists have worked out new statistical mechanical equations which help explain the properties of some very unusual fluids. An earlier version of the theory has already assisted in the design of chemical plants in the USA.

The research group led by Dr Denis Evans, a Senior Fellow in the Research School of Chemistry (RSC), is now trying to extract useful results from the theory to apply to the design of pipelines, among other things.

An understanding of the mechanics of fluids is important for the design of objects that move through fluids, such as boats, aeroplanes and space vehicles, and the design of things which transport fluids, such as pipes and chemical plant machinery. Fluid mechanics also helps the manufacture of polymers, such as paints and plastics, and has medical applications which include the study of the movement of blood through arteries, veins and capillaries.

Various levels of theory can be used to model the behaviour of fluids. Physicists could look at the elementary particles that make up the fluid and use mechanical theories — classical, after Newton, or quantum, after Schrodinger and Heisenberg — to predict the behaviour of the fluid from the dynamics of its constituent particles. In practice, there are too many particles and equations of motion for this approach to work.

Late last century, physicists worked out statistical methods to explain the behaviour of bulk matter such as fluids, in terms of the interactions of its constituent molecules. Statistical mechanics as it is called, has enabled the calculation of equilibrium properties such as the melting and boiling points of fluids in terms of molecular parameters. An equilibrium system is one which has been allowed, in the absence of external influences, to come to a state of quiescence. An American physicist, J. Willard Gibbs, worked out the basic equations of equilibrium statistical mechanics at the turn of the century. These equations still form the basis of the subject.

But Gibb's equations only work for equilibrium systems. Until 1985, no equivalent set of equations was known for steady state systems away from equilibrium. One of the main achievements of the liquid state group in RSC, has been the derivation of a nonequilibrium analogue of Gibbs' equations for equilibrium fluids.

Two centuries ago Newton defined the viscosity of a fluid. The viscosity is the resistance to flow. He imagined that the viscosity of a fluid should only be a function of the temperature and density of the fluid. Such fluids are called Newtonian. At the present time there is no simple — analytic — theory capable of correctly predicting the viscosity of even the simplest Newtonian liquid at high density.

Non-Newtonian fluids get thicker or thinner with stirring or with the passage of time. Their viscosity is not simply dependent on temperature or pressure. Examples are crude oil, molten plastics, paint, blood, very thin air in the upper atmosphere, plasmas and 'silly putty'. Understanding these fluids is thus very important for commerce, transport, including space travel, medicine and energy production.

An important class of nonequilibrium systems are called nonequilibrium steady states. Although not at equilibrium, because of the application of external forces, these systems are time independent — steady. Although water may flow steadily through a pipeline, it is not at equilibrium. Molecules at the centre of the pipe stream past those at the boundaries.

All this brings us to Dr Evans' field — nonequilibrium statistical mechanics. It is a field where Gibbs' equations do not apply; where stirred fluids climb up the stirring rod, where liquids swell when they emerge from a tap and siphon themselves from one container to another. Where Gibbs' equations describe the behaviour of systems at equilibrium, the equations derived by Dr Evans and his colleagues describe all types of nonequilibrium fluids — Newtonian or non-Newtonian. These new equations, like Gibbs', are very general, but very difficult to solve. They give exact expressions for the time-dependent many-particle distribution function. Once this distribution is known all mechanical properties of the system can be calculated.

COLLABORATION

Dr Evans built on work in the field done in Japan in the late 1960s. He collaborated with researchers in the USA and in RSC. These collaborators were Professor William G. Hoover of Lawrence Livermore Laboratory, Dr Brad Holian of Los Alamos National Laboratory, Professor Howard Hanley of the US National Bureau of Standards and Dr Gary Morriss, a Research Fellow in RSC.

Though the breakthrough came three years ago, Dr Evans told *ANU Reporter*, 'At the time we didn't realise how important it would be.' About a year after the initial work, further properties and formulations were worked out and computer simulations were used to test the validity of the theory.

The importance of understanding the transport properties of fluids and fluid mixtures was evident in Australia a couple of years ago, when an oil pipeline carrying a very waxy crude oil seized up in winter. In theory, but not yet in practice, when combined with computer simulations, Dr Evans' equations should be able to predict phase transitions, from liquid to solid, in non-equilibrium, non-Newtonian fluids. The effects of varying the flow rate and adding 'anti-freeze' chemicals could be predicted.

The first application of early versions of the theory of nonequilibrium steady states was the development of a computer program which predicted the transport properties of mixtures from an experimental knowledge of the properties their individual components. This program is being used by large American oil and chemical companies to help design petrochemical plants. Improvements in the prediction of thermophysical properties can substantially reduce the cost of plants which presently are overdesigned to compensate for inadequate data.

However, there is still a great deal of theoretical work to be done. Much of this will be done using computer models to test the statistical mechanical theory. The University's new supercomputer will be particularly well-suited to these simulations, which require considerable computing power. Dr Evans said the supercomputer would be a relatively cheap and highly convenient laboratory in which to explore the theory. Nearly all of the presently used algorithms for simulating nonequilibrium flows at a molecular level were derived by Dr Evans' group in RSC.

Dr Evans said it was still too early to know the ultimate applications of the theory of nonequilibrium systems. He mentioned very dilute fluids, such as the upper atmosphere, where the conventional hydrodynamics for flows around re-entry vehicles breaks down. The flows of plasmas must also be understood to allow the controlled use of fusion energy. Like other work in fluid mechanics, the RSC research might still arouse interest in one or two centuries.

ANU REPORTER FRIDAY 12 JUNE 1987.

In the eye of the beholder . . .

This untitled strangled female form was one of 114 works of art on display recently in the foyer of the Research School of Chemistry (RSC). They were by students at Hawker College and staff at RSC. This painting is by Hawker student, Annie Duke. Photograph by Stuart Hay.

ANU REPORTER FRIDAY 11 SEPTEMBER 87

The Research School of Chemistry (RSC) celebrated its 20th anniversary this month. Asked to come as they were 20 years ago, women staff put their mini skirts back on while the men seemed still to be wearing the same suits and sweaters. Students, on the other hand, dressed up in nappies and sucked dummies. Obviously against regulations, they were cheerfully served at the bar despite their age!

In his address to the gathering, the Dean of the School, Professor Alan Sargeson, (pictured blowing out the candles) paid tribute to the founding fathers, many of whom were among the invited guests, and recalled that the running of the School was set up to be as flexible as possible so it could adjust to rapid change. He said the School had been a wonderful success, with staff and students honoured with awards and elected to learned societies. He said international recognition was forthcoming, but local recognition was very tardy. He said that he hoped better public relations on the part of the school would rectify that.

In the future, he said, he hoped budget cuts would not interfere with scientific progress and stressed the need for increased funding to support RSC's reputation and standing. He was proud, he said, of the School's record and felt it had lived up to its obligation to perform well. Photo: Byam Wight.

A.N.U REPORTER FRIDAY 25 SEPTEMBER 1987

PROF SARGESON.

RSC 20th BIRTHDAY PARTY

P. RICHARDSON PROF J. WHITE PROF L. MANDER PROF R.A. HOHNEN.

PROF I ROSS. DR. G. FISHER PROF A. BIRCH

RSC 20th BIRTHDAY 20.9.87

G. McLAUGHLIN. L. HARLAND L. WELLING. C. TOMKINS.

L. SCARR C. GARRETT L. HARLAND B. BUCKLEY
H. JAUNCEY C. WHITFIELD.

N. EVENS. P. HIRST. I. HOOD
P. DUGGAN SIMON CRABTREE
E. MILES T. JONES.

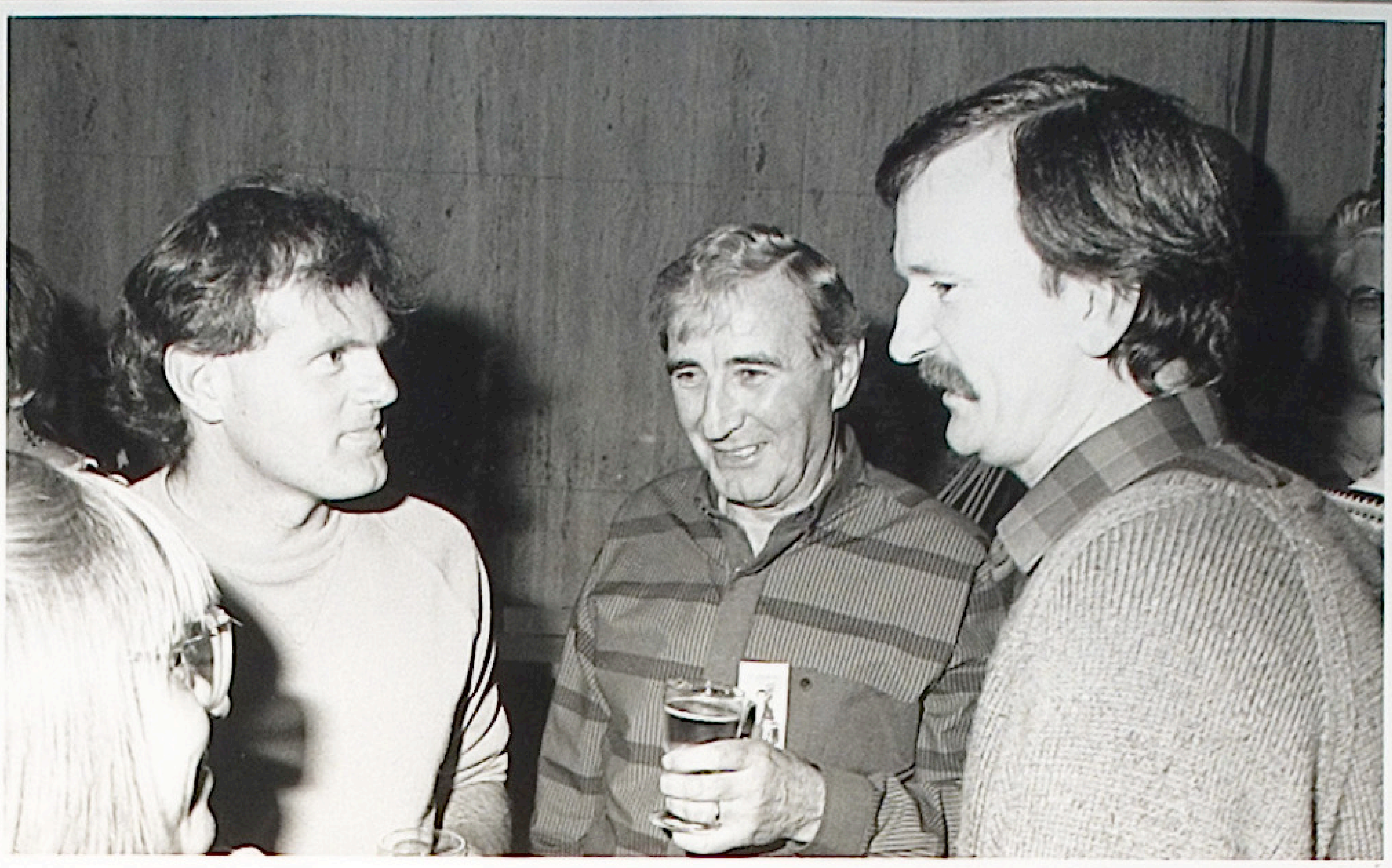
S Thomas P. Brown. B Buckley.

Dr. M. Bennet J. Eichholzer J. Harper J. Hush.

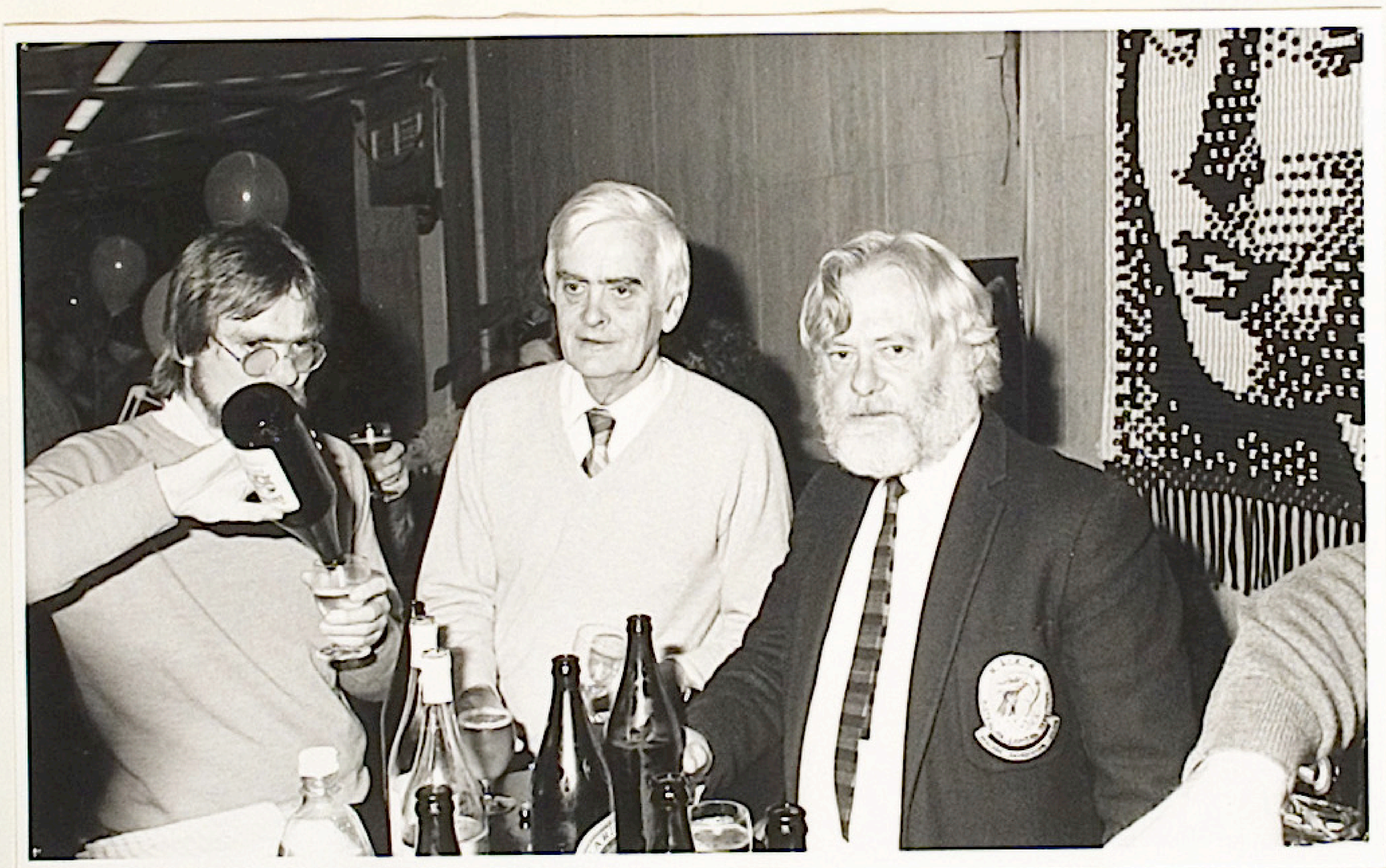
Ross Hohnen Prof J. White. Prof L. Mander.

1987

RSC 20th BIRTHDAY 20.9.87.

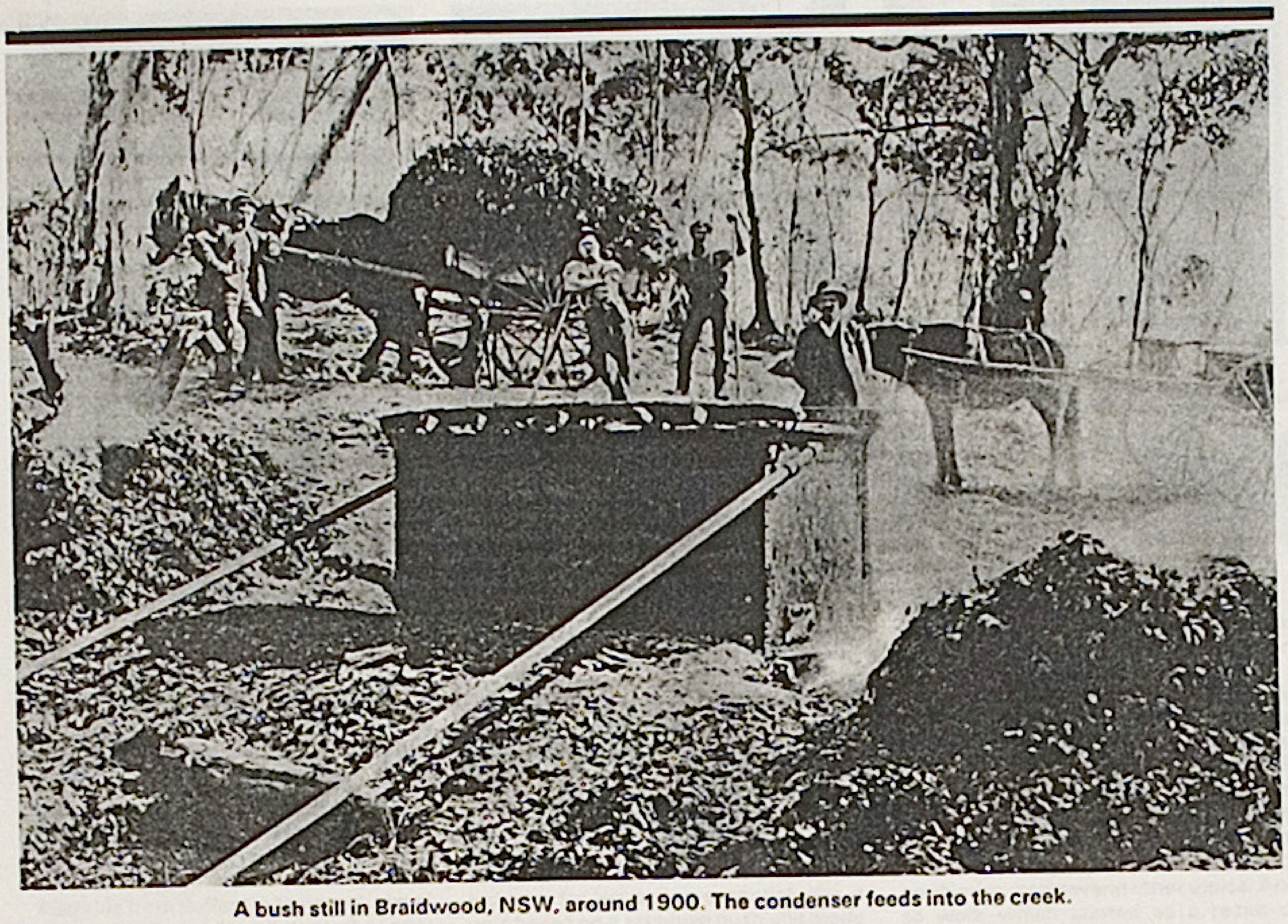


Ms. S. MURRAY. Mr. P. BARLOW. Mr. N. SARI. Mr. J. EICHHOLZER.



Dr. MESSENHAUSER Dr. G. ROBERTSON Mr. B. FENNING

Dr. L. BROWN. PROF KARMEL Dr R. DUBBS.



A bush still in Braidwood, NSW, around 1900. The condenser feeds into the creek.

Chemistry in Australia: 200 years on

Arthur J. Birch

This year marks 200 years since the first European settlement of Australia. As a continent separated from others for 60 million years, Australia has provided a wealth of opportunities for scientific investigation. Most obvious were those associated with the country's rich flora and mining, but chemistry became important for the survival of the settlement.

In 1788 communications between Australia and Europe were difficult—it took my grandmother, for example, three and a half months to sail from Portsmouth to Van Diemen's Land (now Tasmania) in 1852. The distance between major cities was vast (*ca* 700 miles) so cooperative enterprises were difficult. Not surprisingly, therefore, the original English and Scottish scientists who went there were more interested in their home bases and careers in Europe or the US, rather than the local scene. But despite this, certain 'gentlemens' clubs' were established in the 1840s—most notably the Royal Societies of Tasmania, New South Wales, and Victoria—which provided a local means for the publication of science, some of which was chemistry. With prominent members such as Sir John Franklin and Governor Brisbane, and members from the merchant and squatter classes possessing commercial power, science was encouraged. Later, more specialised societies were formed, including the Linnaean Society in 1874 for botany, followed by societies for entomology and geology. The Royal Australian Chemical Institute was not formed until after World War I; Australian chemists of the 19th century were elected fellows of the Chemical Society of London. In 1852 the University of Sydney was founded, followed by the University of Melbourne in 1854. These universities established a fundamental training ground for science.

Chemists were prominent at an early stage in the organisation of science in general. Archibald Liversidge, professor of geology and chemistry at Sydney University in 1881, formed a society in 1886 which became the Australia and New Zealand Association for the Advancement of Science. Although a competent, rather than a great chemist, his influence was important, and he is commemorated by three Liversidge lectures, one in the UK and two in Australia. Another chemist, David Orme Masson from Melbourne, was one of the cofounders of the Indian Institute of Science in Bangalore and during and after World War I he helped to solve scientific industrial problems. Masson persuaded the Commonwealth Government to set up a major research organisation, which, in the mid 1920s, became the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The first head of the CSIRO was another chemist, David Rivett, a student of Masson.

Organic chemistry

The international era in organic chemistry began in 1915 with the appointment of

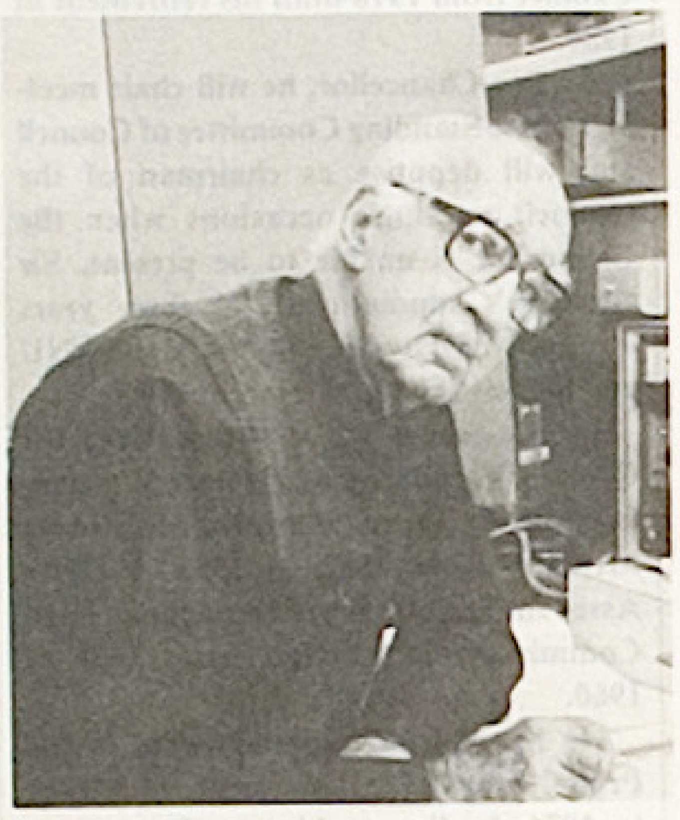
'Chemistry in Britain' April 1988

J.S. Anderson — 80 not out

Professor Anderson ('J.S.' to many) celebrated his 80th birthday on 9 January, 1988 — still in harness. He retired from the Chair of Inorganic Chemistry at Oxford in 1975 to an Honorary Professorial Fellowship at the University College of Wales at Aberystwyth, from which he retired again in 1981 to take up a Visiting Fellowship in the Research School of Chemistry. But this was by no means his first sojourn in Australia: indeed he was a 'wandering scholar' long before he retired.

Briefly, after education at Imperial College (London) he continued at the University of Heidelberg, returning to an Assistant Lectureship at Imperial College in 1932. 1938 to 1947 was spent at Melbourne University, 1947-1953 at A.E.R.E. Harwell, 1954-1959 as Professor and Head of Chemistry at Melbourne University, 1959-1963 as Director of the National Chemical Laboratory (U.K.), 1963-1975 as Professor of Inorganic Chemistry at Oxford University.

Professor Anderson is a Fellow of the Australian Academy of Science and of the Royal Society. His many honours include the Davy Medal of the Royal Society (1973) and the Longstaff Medal of the (U.K.) Chemical Society (1975). He was the Australian Academy's Matthew Flinders Lecturer in 1965, and has given all the possible Liversidge Lectures (in Australia and the U.K.). But he is best known for two things: his book 'Modern Aspects of Inorganic Chemistry' with H.J. Emeleus, first published in 1938 and continuing through at least three editions and 16 printings up to 1963; and as a pioneer in solid state chemistry, starting with his work in Melbourne — his students including (now) Professors Ray Martin (Monash), Norm Greenwood (Leeds), 'Judge' Bevan (Flinders), Tom O'Donnell (Melbourne). His work continues: he is active in research on the new superconductors (that hit the headlines last year). Indeed one hallmark of his career has been and still is his penchant for working at the bench.



J.S. Anderson

His remarkable memory makes him a mine of information and stories, and a unique colleague, especially for the younger research workers in the laboratory. Not surprisingly, having been a pillar of the society of solid state research for 50 years and the supervisor and/or colleague of a large proportion of present day workers in the field, he is also the subject of many tales — a legend on the way to becoming a myth.

A small group of his immediate colleagues gathered to celebrate and honour appropriate his long career and longevity during the week of his birthday.

A.N.U. Reporter Friday 25 March 1988

New Fellows of academy

Three scientists working at the Australian National University have been elected Fellows of the Australian Academy of Science.

They were elected this week at the annual general meeting of the academy in Canberra. They are:

Dr Graham Farquar, who has made outstanding theoretical and experimental advances in the study of how plants use carbon, nitrogen and water, and in the mathematical description of photosynthesis.

Dr Ian McDougal, who pioneered the dating of young basaltic rocks using the potassium-40-argon-40 method. In collaboration with palaeomagnetists, he determined the timescale of reversals of the earth's magnetic field and the motion of ocean plates.

Dr Leo Radom, who is the leading practitioner in Australia and one of the international leaders in the application of the theory of molecular orbitals to the understanding of structure and mechanism in organic chemistry.

CAN. TIMES 30-4-88

Canberra Times 30-4-88

THE AGE, Thursday 19 May 1988

Of ribosomes and neutron beams

By GRAEME O'NEILL

What is a ribosome? Even scientists had little idea until recently. Now the secrets of this tiny, vital cellular structure are finally coming out.

Two scientists at an ANZAAS seminar on the uses of radiation for research told how neutron beams could be used as a powerful research tool, with applications ranging from the study of how painted surfaces weather, to authenticating antiques and art, to winkling out some of biology's hidden secrets — such as the structure and function of the ribosome.

A ribosome is a vanishingly small factory that turns the raw information of genes into the myriad proteins and enzymes that make up a human. It comprises a cluster of 21 enzymes and a piece of genetic material, that collectively, read the genes' instructions and then synthesise the proteins.

Professor John White of the Australian National University, told the seminar how researchers in the United States had performed a brilliant piece of analysis using neutron beams to make this discovery.

He said that every element, whether in living or inert materials, scattered neutrons in a characteristic way. By immersing biological specimens in different liquids of known density, the parts of the specimens that were of the same density as the liquid could be rendered transparent to a neutron beam. This allowed the fine internal structure of the object of interest to be discerned.

The geometry and inter-relationships of the 21 enzymes that made up most of the ribosome had been determined by neutron beam analysis, he said. As a result, scientists had gained precious insights into how proteins were synthesised.

Professor White said that Australian industry could use neutron beam analysis to capitalise on its expertise in protein analysis.

The information that was being acquired, he said, tied in directly with rapid advances in DNA technology. (DNA — deoxyribonucleic acid — plays an important part in protein synthesis and in the transmission of hereditary characteristics.)

Tissues

The professor said that scientists could now predict from a gene's DNA code how the protein that it encoded would enfold, and what role it might play in living tissues.

Neutron beam studies, by providing a close view of the structure of proteins and enzymes, could provide a vital link with genetic engineering, the professor said. This meant that scientists could begin thinking of redesigning proteins or enzymes for specific medical or industrial purposes.

Earlier, Dr Roger Bird, of the Australian Nuclear Science and Technology Organisation, invited industry to take advantage of the neutron beam accelerator at the organisation's Lucas Heights nuclear reactor, the nation's only such facility. He sub-titled his talk "Have Accelerator, Need Work."

Dr Bird said various analytical techniques based on neutron beams could be of great benefit to industry.

For example, ANSTO had used neutron beam analysis to show BHP steelmakers at Wollongong how painted steel surfaces weathered with exposure — the surface coating showed a dramatic loss of hydrogen atoms as it aged, allowing its durability to be analysed and enhanced.

Dr Bird said he had analysed a fragment of white pigment from an oil painting by his wife to determine its elemental composition, and had found that a tiny blue brush streak contained cobalt. The technique, he said, could be used to analyse the composition of pigments in old oil paintings and determine their authenticity.

In southern Australia, it had been possible to determine that saline groundwater came from two different sources — ancient intrusions by the oceans, and dissolved mineral salts — by measuring variations in chlorine isotope composition.

Neutron beam analysis had also shown that water flowing out of the Great Artesian Basin near Lake Eyre, was more than a million years old, which would help establish how users were affecting the artesian water resource.

THE AGE THURSDAY 19 MAY 1988

Four now Fellows of Royal Society

LONDON: Four Australian scientists have been honoured by the Royal Society for their outstanding contributions to scientific research.

The scientists were among 40 scientists from Britain and Commonwealth countries elected as Fellows of the Royal Society at a meeting in London on Thursday.

The four Australian scientists were Professor Athelstan Beckwith, an organic chemist from the Australian National University, Dr Alan Head, the acting head of the Division of Material Science and Technology at the CSIRO, Professor Noel Hush, a theoretical chemist from the University of Sydney, and Dr Robert Symons, a reader in biochemistry at the University of Adelaide.

Election to the Fellowship is recognised as a high honour around the world. Fellows are chosen for their contributions to science, both in fundamental research and in leading and directing scientific and technological progress in industry and research establishments.

The society, founded in 1660, is an independent self-governing body for the promotion of the natural sciences.

Sydney Morning Herald 19.3.88

'Relevance' in research: a question of terminology

by Arthur J. Birch

Comment

This is the second of a three-part series by Emeritus Professor Birch, who was recently awarded the prestigious Tetrahedron Prize (see photo below).

What does 'relevance' imply? To examine this we must look at valid classifications of research.

In 1977, with the problem of CSIRO reorganisation, I invented new classifications to replace the vague terms still currently in use: 'pure' and 'applied' (all research is both); 'long-term' and 'short-term' (which indicates commitment, not kinds of work or even possible outcomes); 'curiosity-motivated' (which trivialises by association — the emotional drive is the quasi-religious awe of revelation and beauty), and 'relevant' (which needs detailed examination).

My new classifications of research were: *fundamental* (or *basic*) *uncommitted; strategic* (basic but *mission-oriented*), and *tactical* (converting difficulties into defined problems and solving them within the paradigm). They form a complex interrelationship, not a hierarchy; they all employ the same rational methods of thinking and experiment and often the same people, acting both as discoverers and inventors.

Creativity

The first two classes are usually technically identical, involving high levels of creativity and novelty, which many academic researchers may find surprising if 'strategic' is styled baldly as 'applied'. They differ in the reasons they are undertaken and in some possible outcomes. They both seek new understanding for the world disciplinary matrix, but a strategic project is explicitly defined also to set a basis known to be lacking for the solution of national problems. Researchers within strategic areas have to say, 'I am doing this because . . .', with reasons outside the narrow discipline.

Also, they cannot follow up adventitious outcomes without reclassifying these, often as 'uncommitted' work within the support available for that other category. Such organisational twists are often repugnant to dedicated scientists, mainly interested in pursuing their technical work, but they have to live in the real, and expensive, world. I am told that our marine projects under the Australian Marine Sciences and Technologies Advisory Committee, in areas decided by those technically competent in conjunction with the research contractors, seeking to distinguish strategic research from the uncommitted funds of the Australian Research Grants Scheme, have nevertheless acted as a rudder on the ship to induce a considerable change in direction of fundamental research in marine science as a whole in Australia.

Senior Minister would say that fundamental researches and their subsequent applications have been on the world geographic and historical scale, but that Australia needs now to carry out *'relevant'* research. A difficulty is that there is no real dialogue about what 'relevance' implies. The word tends to represent insufficiently examined prejudices of protagonists, rather than clear concepts. Interpreters are very few and usually not of very high standard, and active scientists should accept a much higher obligation and profile, since they alone know how research really works.

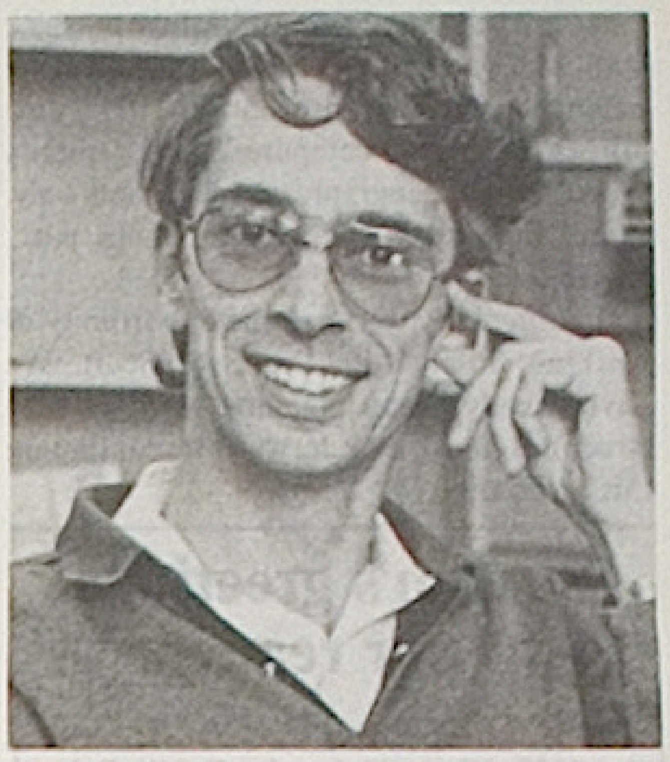
Tactical

The research which is usually politically understood as 'relevant' (particularly to manufacturing industry) is tactical, with a rather grudging tribute to time-limited strategic work. 'Uncommitted' research is politically considered to be largely irrelevant in the Australian context: an expensive and selfish luxury, since its direction is determined mainly by those engaged in prosecuting it (those who can do so). However, while the results of tactical 'problem-solving' work can be more immediately seen, and more or less equate in extent with the resources employed, they are less revolutionary. For this reason, unless a problem is specifically Australian, we are at a great disadvantage if we are in competition with the enormous research machines of the USA, Japan or the new USSR. And we need strategic results for any major competitive change.

I have used 'relevant' with different meanings for many years in many parts of the world and in many academic, industrial and governmental contexts. Common factors to evaluate are social and economic objectives, national tasks, obligations and advantages (e.g., in Australia the Barrier Reef, the southern heavens), all considered within the available social and economic resources. But also the availability of the right people is of critical importance. The correct formation of scientists, technologists and engineers is a major national need. Policies and money are useless for practical outcomes without ideas and the people who can generate them, such as those who foresaw 15 years ago the potentialities of genetic engineering and micro-chips and laid the fundamental basis for today's problem-solving.

Beside the fountain outside the Research School of Chemistry were (from left) the Dean of the School, Professor Alan Sargeson, with Professor Athelstan Beckwith, Emeritus Professor L.W. Nichol, after Professor Beckwith had presented Professor Birch with the Tetrahedron Prize, a prestigious international prize awarded every two years for creativity in organic chemistry. Professor Birch was the Foundation Dean of the School of Chemistry. Photo: Stuart Hay.

A.N.U. REPORTER FRIDAY 22ND JULY 1988



Dr Denis Evans, pictured above, has received the inaugural Distinguished Young Chemist Award of the Federation of Asian Chemical Societies, whose membership includes the chemical societies of Australia, Malaysia, Singapore, Hong Kong, Korea and Japan.

The award was made on the basis of work in the field of physical chemistry. The awardee had to be less than 40 years old on 1 January 1989.

Dr Evans is a senior fellow in the Research School of Chemistry and is also Deputy Academic Director of the ANU Supercomputer Facility. He was awarded the Rennie Medal of the Royal Australian Chemical Institute in 1983.

A.N.U. REPORTER FRIDAY 9 DECEMBER 88

Winners of Crawford Prizes announced

Organic chemistry, Sikhism and trade-union security in Australia were the subjects of the winning theses in the 1987 J.G. Crawford Prizes. Dr Carl Schiesser, of the Research School of Chemistry, won a prize for his PhD thesis, *The Regio- and Stereo-Chemistry of some Alkenyl Radical Cyclizations.* The selection committee said Dr Schiesser had carried out an extensive, imaginative and demanding laboratory program to evaluate the theory, which provided to be uncommonly reliable. The insight displayed in his work had attracted wide notice.

Dr Harjot Singh Oberoi, Asian History, Faculty of Asian Studies, won a prize for his thesis, *A World Reconstructed: Religion, Ritual and Community Among the Sikhs, 1850-1909.* The committee said his work had been described as 'the most ambitious and sophisticated approach to the study of the Singh Sabha to date'.

Ms Phillipa Christine Weeks received the prize for her master's thesis in law, entitled *Trade Union Security in Australia — the Federal Legal Regime.* A research paper based on Ms Week's thesis has been published by the Parliamentary Library.

The J.G. Crawford Prize Fund was established in 1973 to recognise Sir John Crawford's outstanding contributions to the University, both as Vice-Chancellor for five years and as Director of the Research School of Pacific Studies for the preceding seven years.

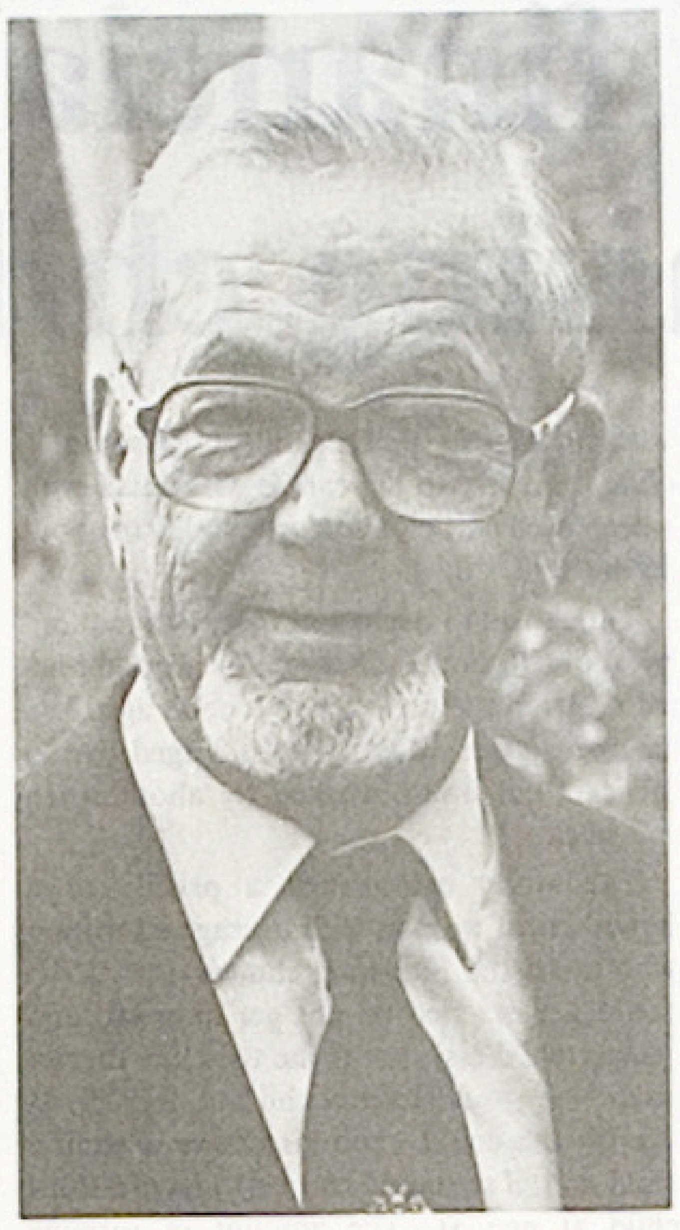
A.N.U. REPORTER FRIDAY 9 SEPTEMBER 1988

Mrs Betty Moore is now enjoying retirement after 21½ years' service at ANU. Mrs Moore began her career at the University in the John Curtin School of Medical Research. In 1968 she moved to the Research School of Chemistry, where she worked firstly as secretary to Professor Arthur Birch and then, until her retirement, as assistant to Professor Lew Mander. Mrs Moore is planning a holiday in Queensland to see family, and next year hopes to take a trip overseas. She says RSC was a 'terrific' department in which to work and she will miss very much the many colleagues she came to know there over the years.

A.N.U. REPORTER 28 OCTOBER '88

Fundamental research in science: what does 'relevance' mean?

*by Arthur J. Birch



A Senior Minister: 'Ninety-five per cent of pure research is wasted.' My reply: 'Minister, I disagree with you and I can tell you why. But even from your political viewpoint I would like to know which 95 per cent. In good Australian terms, you have 20 horses in a race; you know only one can win — why bother to run the other 19?'

This is some of what I wanted to tell him. Fundamental researches in natural science, and other human endeavours, have been responsible for the practical bases of our modern world. The success of the rational cause-effect thinking used has altered profoundly and irreversibly the way we see our universe and ourselves. Science-based civilisation of a type never previously existing provides the material production and the organisational bases, if we choose to take the opportunities, to exercise moral and spiritual imperatives for the social benefit of the whole of humanity. There are of course irrational aspects of our nature, good and bad, which are not the province of scientific thinking and investigation, although they affect its directions. I have never, for example, been able to set up a completely rational scientific basis for ethics, or for beauty. As a scientist I am dismayed by the irrationality of nationalism and racism and atomic bombs.

I regard as the major outcomes of science its discoveries, inventions and ideas which reveal the beauties, orders and disorders of the physical universe, and of our own evolution and nature: the mysteries which we are always probing but never quite resolving. It is the most fundamental of all human endeavours, obligatory because we have the ability to undertake it. If science were funded purely for this reason, perhaps we might expect it to be politically equated, at the most, with the sum of the other arts. It suffers in one sense by being useful, since this tends to obscure its outstanding cultural and philosophic value, and introduces tensions into the pursuits of scientists which are often not found in other academic and cultural endeavours.

Researches for the sake of understanding of what is 'there', rather than for direct use, have been the obligatory foundations of practical social revolutions through new and readily available goods and services in food, health, energy, transport, communications, amusements, cultural activities and political and social organisation. Atom bombs and pollution involve misapplications by social choices. People take for granted that turning a switch puts on the light, that a car or aeroplane awaits for transport, that a refrigerator preserves food, that water is clean, that antibiotics cure infections, that large towns are organisationally possible.

Comment

This is the first in a two-part series. The second will be published in the next issue of *ANU Reporter*.

Even as a septuagenarian, I recall reading in bed with a candle, travelling in hansom cabs, eating rather 'high' meat from a meat-safe designed to keep away the blowflies, and that appendicitis was once almost a death sentence. One of the earliest miracles of my childhood was to see Charlie Chaplin in *The Kid*, in flickering black and white with a sentimental piano accompaniment. As the result of science, yesterday's dreams have become today's conventionalities.

I need to examine some fundamentals about various kinds of research to cut across the woolly thinking of many non-scientists and politicians (I wish more were like Barry O. Jones), and, indeed, of many scientists who, when they bother to think about it, subscribe to the tidy theories of the historians and philosophers of science while doing something different in their laboratories.

All research results, ideas and rationalisations, on the world scale, are incorporated into an international fluid matrix, which we share, in which they can be rearranged, conjoined and modified by reference to each other. The ability to apply them to new needs can emerge either from the interior by perceived opportunity (science-push) or from external demand (community-pull). Senior Minister is wrong, because everything obtained for whatever reasons goes into the matrix, and practical configurations which emerge in a given context are frequently not predictable by examining any single result. The potential of basic research is often denigrated by attributing falsely to scientists the 'linear-model' picture: one discovery, its development, then its application. While this is true occasionally, a discovery usually contributes by permitting a greater or lesser rearrangement of the whole matrix, which is then involved in any application. Unpredictability of outcomes is the major difficulty in selective policy decisions.

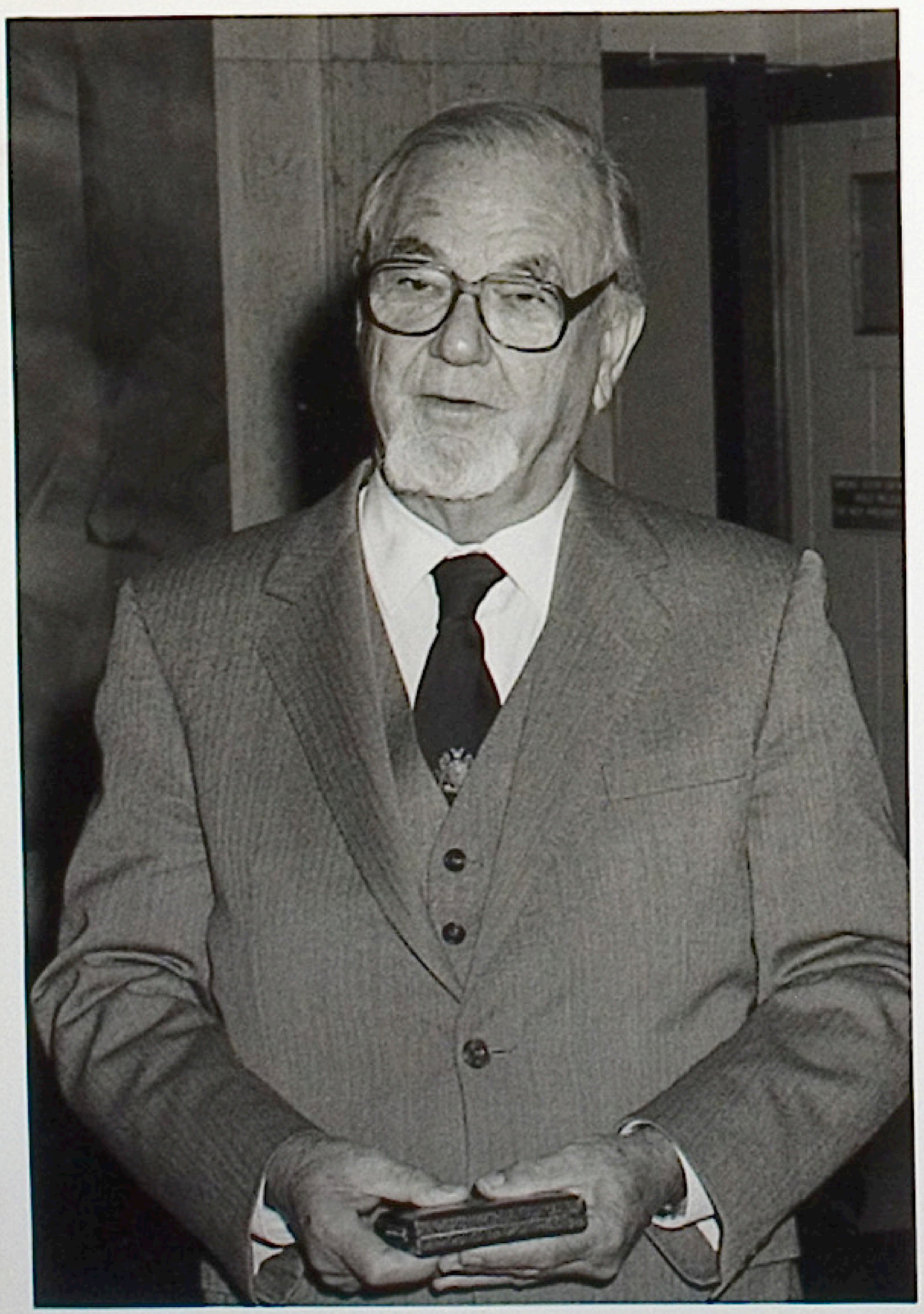
National use of the *international* matrix of information and understanding cannot be made without intervention of another *national* matrix of people who are as creative, as perceptive, as technically skilled, as active at the cutting-edge of progress, as those anywhere who are adding to the world understanding. This makes nonsense of the statement: 'Australia produces two per cent of the world research contribution to fundamental science: that means we import 98 per cent. Why not forget about the two per cent and import the lot?' Those who do not understand cannot predict, ask, find, select, transfer or adapt, and industry cannot buy at all or obtains inferior quality. High prices are paid in technology with nothing to sell.

• • •

In the second part, Professor Birch examines and rejects accepted nomenclature used to describe different kinds of research — pure, applied, long-term, short-term, curiosity-motivated — and suggests alternatives which permit rational analyses of situations. He in particular discusses what 'relevance' implies in different contexts, and whether the present drive for limited relevance may be counter-productive even for the objectives of its protagonists.

** Emeritus Professor Birch, AC, CMG, FRS, FAA, was the Foundation Dean, Research School of Chemistry, ANU, and is a former President of the Australian Academy of Science and of the Royal Australian Chemical Institute. He is currently Chairman of the Organising Committee of the National Science and Technology Assessment Group Forum 1988, on the theme* Science, Technology and Engineering for Policies, a Manifesto for the Times.

ANU REPORTER FRIDAY 8 JULY 1988



Father of the Pill wins world award

The Canberra scientist known as the father of the contraceptive pill, Emeritus Professor Arthur Birch, will be presented with the highly regarded Tetrahedron Prize at a special ceremony at the Australian National University on Monday.

The international prize, which is awarded only once every two years for creativity in organic chemistry, consists of a gold medal, a citation and prizemoney of $14,000.

Professor Birch, who retired seven years ago, was the foundation Dean of the ANU's Research School of Chemistry, a position he held for a total of eight years under a system of rotating deanships. He was appointed to the position in 1965.

His career has spanned five decades. While a research fellow at Oxford University in 1943, he helped to devise the synthetic reaction now known as the Birch Reduction Method, which led to the development of the oral contraceptive pill.

He also made the first synthetic male hormone, sometimes used as an anabolic steroid by women athletes. Since then Professor Birch has devised and proved a theory of biosynthesis, which explains the origins of many natural products, such as the colours of flower petals, and some antibiotics.

Although supposedly retired, Professor Birch is still actively pursuing his scientific interests. In 1986 he held talks with the Pope on the moral responsibility of scientists, and early last year he visited China to help put the finishing touches to a technical laboratory and instrument-centre program to be incorporated throughout the country's 1600 universities.

Professor Birch

He is an examiner in science and technology policy for the Organisation for Economic Cooperation and Development, and is working on a book for the American Chemical Society, called *To See the Obvious*, which will bring together his 50 years of research.

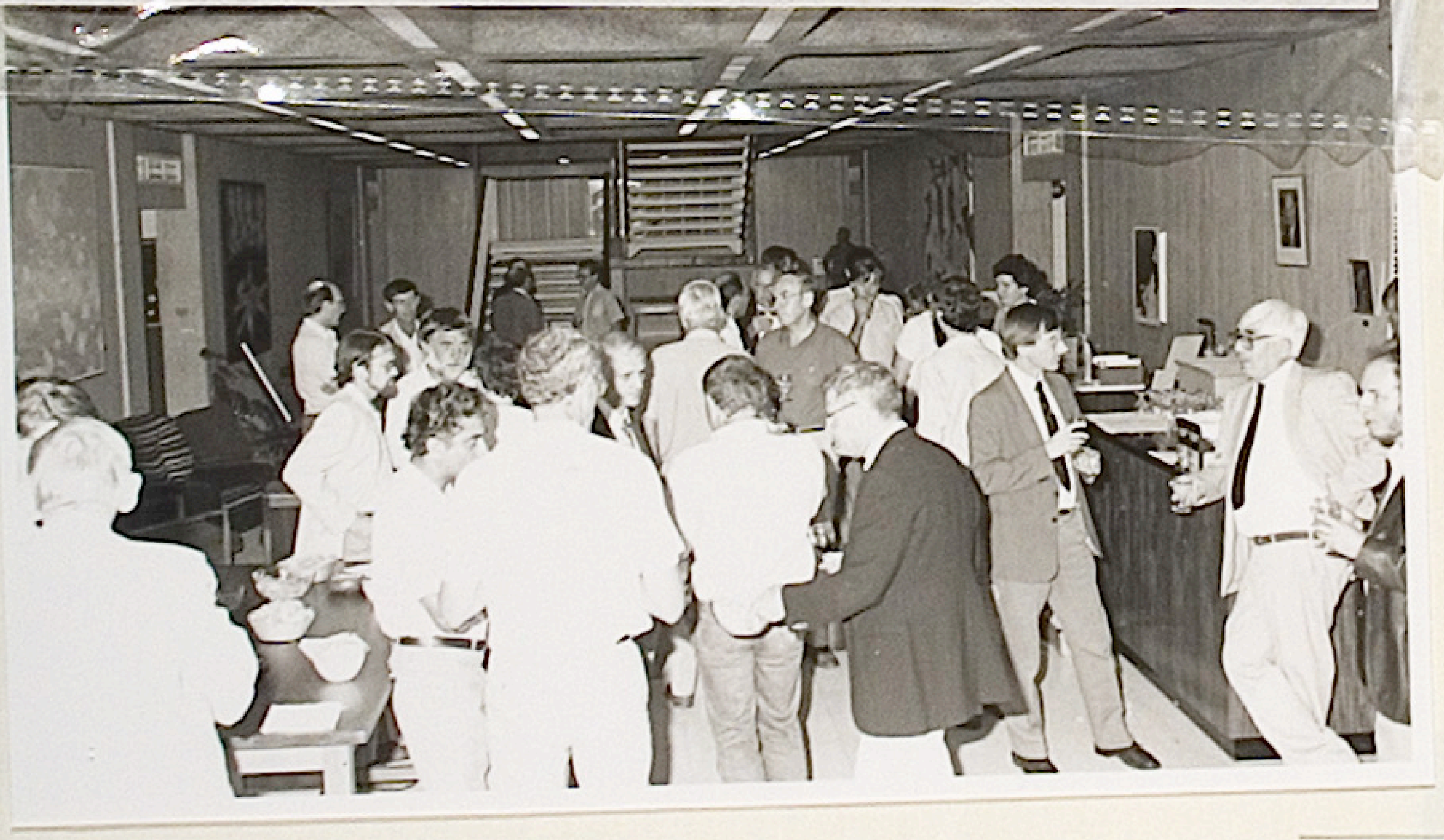
The Tetrahedron Prize was founded in 1980 by the editors and publishers of the journal *Tetrahedron*, to honour the memory of its founding co-chairmen, Professor Sir Robert Robinson and Professor Robert Burns Woodward.

CANBERRA TIMES SATURDAY 9 JULY '88

1989 BIRCH LECTURE

PROF. DUNITZ

27 FEB 1989



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Gathering at Christmas Party, 1988

1988 School Photo taken at 1988 CHRISTMAS PARTY

ANU helps combat asbestos problem

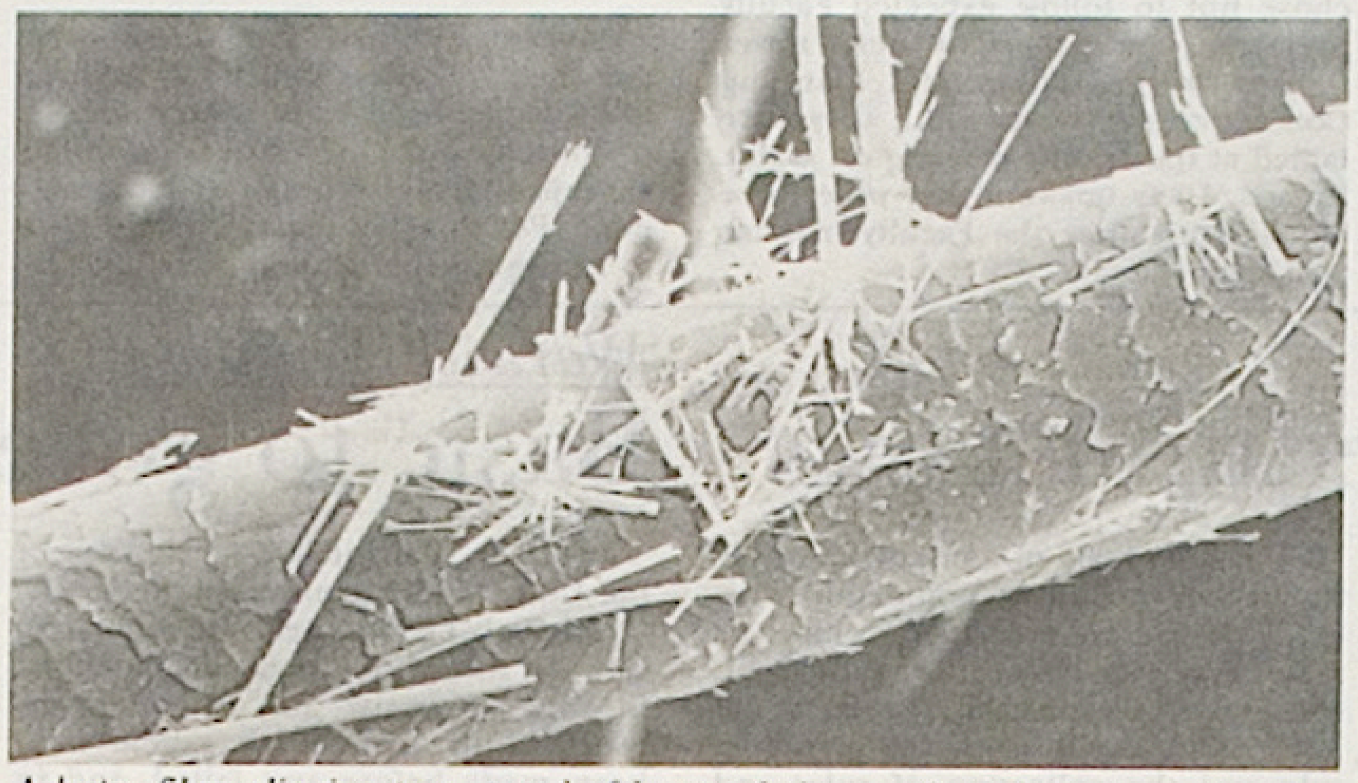
The ANU is serving the wider ACT community through the testing of asbestos samples in the University's laboratories.

In 1988, at the request of the ACT Administration, scientists from the Scanning Electron Microscope Unit and the Mineralogy Research Centre began participating in a feasibility study and evaluation of testing methods using electron microscopes. The fibre samples were taken from air suspected of harbouring asbestos fibres in private houses.

The study is being undertaken in conjunction with Anutech, the University's marketing company. Part of the study is being conducted by staff of the Scanning Electron Microscope (SEM) Unit, recently incorporated into the University's Electron Microscope Unit, Research School of Biological Sciences, under the direction of senior technical officer Mr Roger Heady.

A parallel study is being conducted by the ANU Mineralogy Research Centre, a collaborative venture formed in 1985 between the Research School of Chemistry (RSC), the Research School of Earth Sciences (RSES) and the Department of Geology in the Faculty of Science. Technical officer Mr Peter Barlow (RSC) and research officer Dr John Fitz Gerald (RSES), are carrying out the work.

Dr Fitz Gerald said he had been approached by the ACT Administration last November with a proposal to use the Centre's analytical transmission microscope to evaluate North American methods of analysing airborne asbestos.



Asbestos fibres clinging to a strand of human hair seen through the scanning electron microscope and magnified 1300 times. Photo: Roger Heady and Nick Mackie.

He said that even before the ACT Administration's study began, identification of asbestos fibres was already one of the SEM Unit's activities, largely due to the initiatives several years ago of Mr John Preston, then in the Unit and now with the University's Faculty of Science.

For transmission microscopy, asbestos, a naturally occurring rock fibre, needed to be studied in a place like the Centre which was created to study minerals. The ANU was well set up to assist the ACT Administration, since properly equipped electron microscopes were already in place on the campus and the expertise was available for examining the minerals which comprise asbestos materials.

There was agreement world-wide that proper mineral identification was essential whenever asbestos problems were to be assessed fully, Dr Fitz Gerald said.

'The samples of airborne dust are gathered by passing air through a filter which contains holes as small as 0.2 micron [one micron is one-thousandth of a millimetre]. Any concentrated solid matter clinging to the filter can be tested for asbestos fibres. These fibres which float around in the air are so small that you cannot see them with the naked eye,' he said.

Dr Fitz Gerald said there were three methods currently used for testing airborne asbestos – by optical microscope, by scanning electron microscope and by transmission electron microscope.

'The optical microscope provides the quickest and cheapest way of testing for asbestos, but it cannot be used to chemically analyse the fibres, nor determine their crystal structure if the phased contrast method is used,' he said.

A filter could be prepared in 10 seconds, examined in 10 minutes and fibres as small as about half a micron could be identified. The cost was about $30 per test.

'The scanning electron microscope can chemically analyse individual fibres and, with a magnification capacity of at least 20,000 times, can detect smaller fibres, although it cannot analyse crystalline structures. The test filter could be prepared in 15 minutes, and would take about half an hour to examine, at a cost of up to $165,' he said.

'The transmission electron microscope uses high magnification imaging of up to 550,000 times to detect fibres and measure their size and shape. At the push of a button, the crystal structure of each fibre can be determined by using diffraction and a chemical analysis made. Test filters would take two hours to prepare, half to a full day to examine at a cost of up to $1000 each.'

Dr Fitz Gerald said asbestos testing by the transmission electron microscope, which is valued at more than one million dollars, was the only absolutely foolproof method of detecting and identifying minute airborne fibres. However, he believed the very high cost of such tests and the long testing time would prove prohibitive for the Government.

Cont. on Page 4

Help with asbestos problem

From Page 1

So far, Mr Barlow and he had spent three weeks conducting a feasibility study and evaluating testing methods, while the SEM study had been in progress for a longer time.

The Asbestos Survey Manager for the ACT Administration, Mr Ken Holmes, praised the work done by the University's scientists. 'We've been really pleased with their help,' he said.

Mr Holmes said his branch had been looking at methods of asbestos testing in the United States and United Kingdom, where phased contrast optical microscopy (PCOM) was widely used. On the basis of overseas results, and because of the inordinately high cost of more complex testing, the branch would probably opt for PCOM testing overall, with random samples taken for spot checks by scanning and transmission electron microscopes.

Tenders would be invited for the testing of asbestos, although the Administration was obliged to use a laboratory accredited by the National Analytical Testing Association (NATA).

Mr Holmes said the Government had accepted responsibility for removal of asbestos in Canberra. Asbestos insulation had been a common method of insulating Canberra houses until the late 70s, when its danger to health became known. One single Canberra contractor between 1969 and 1979 had installed asbestos in 1100 houses in the ACT.

From left, technical officer Mr Peter Barlow, research officer Dr John Fitz Gerald and senior technical officer Mr Roger Heady, all ANU staff members, and Ms Jennifer Michelle, of the ACT Administration's Asbestos Branch, with the University's scanning electron microscope used for part of the testing of asbestos fibres. Photo: Darren Boyd.

[Different standards apply in different countries – in 1971, asbestos became the first material to be regulated by the US Occupational Safety and Health Administration, according to an article in *Chemical and Engineering News*.]

Mr Holmes said Canberra's houses had been tested for asbestos and, where found, it had been sealed. Asbestos removal would begin in August, using large, truck-mounted vacuum units. Roofs would be completely covered with a plastic membrane to isolate them from the environment during the two to three weeks it would take to complete each removal. Occupants of affected houses would have to move out during the operation. Airborne dust monitoring would be used to check the removals.

The National Occupational Health and Safety Commission's guide to the control of asbestos and code of practice for its safe removal states that significant health risks may arise from the inhalation of airborne asbestos fibres and their passage into the lungs. Inhalation of high concentration may result in asbestosis, a progressive scarring of lung tissue.

The two main forms of cancer associated with the inhalation of asbestos are lung cancer and mesothelioma. Generally, fibres below three micrometres in diameter and greater than five micrometres in length are potentially carcinogenic, and the risk of cancer increases as fibre diameter decreases, according to the guide.

Mr Holmes said that in the ACT Administration's program, all airborne asbestos fibres were currently being tested, including those under one micrometer long and less than 0.1 micrometer in diameter.

DAPHNE CHRISTOFETY
PENNY'S OFFICE
~ 1980'S

1989 BIRCH LECTURE

27 FEBRUARY.

Dr. L. RADOM. Dr G. HEATH PROF DUNITZ.

PROF I. ROSS. PROF A. BECKWITH PROF A. ALBERT.

PROF A. BECKWITH PROF I. ROSS. G. McLAUGHLIN.

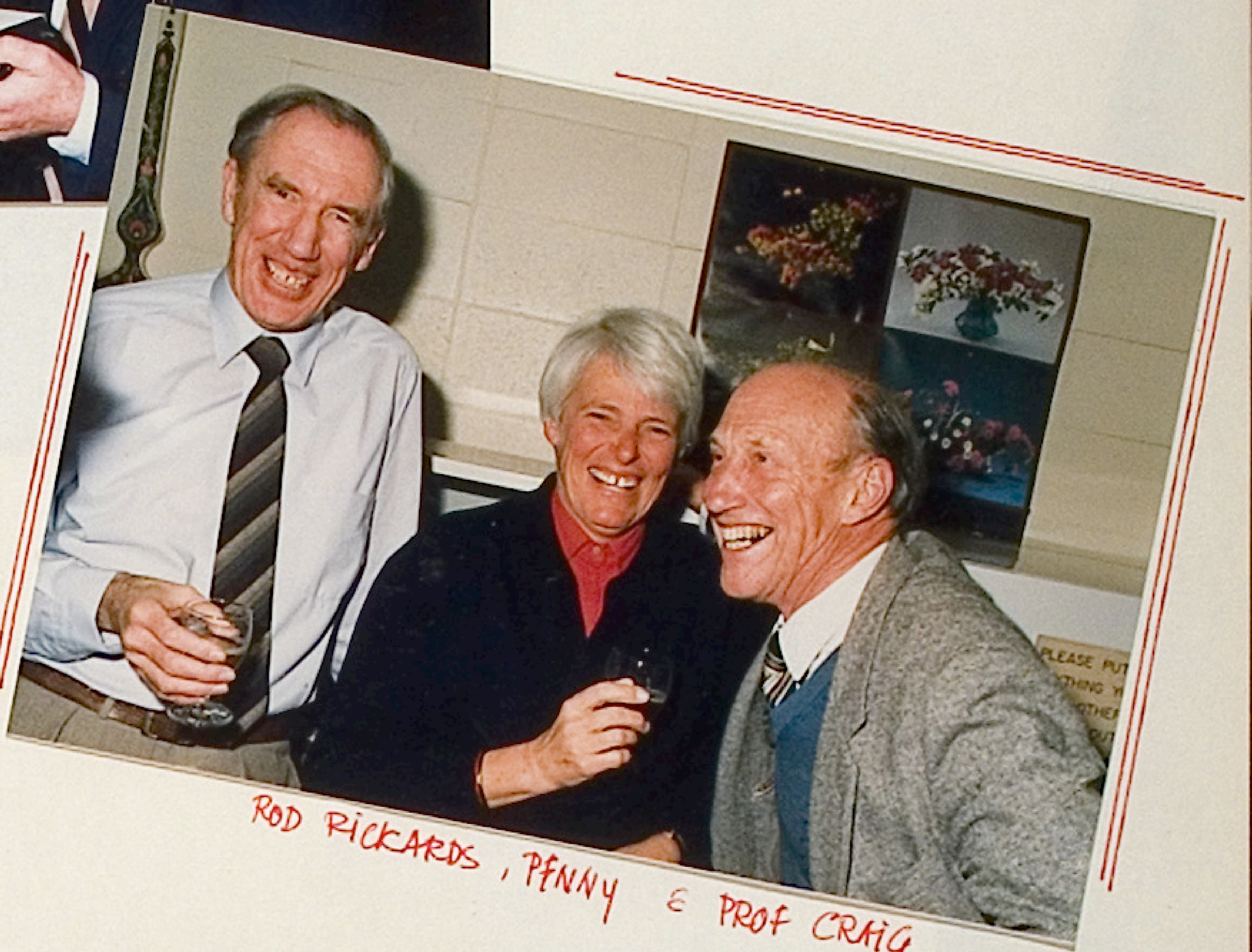
PROF G. HAIGHT PROF PERKINS. PROF A. SARGESON.

CHRISTINE'S FAREWELL

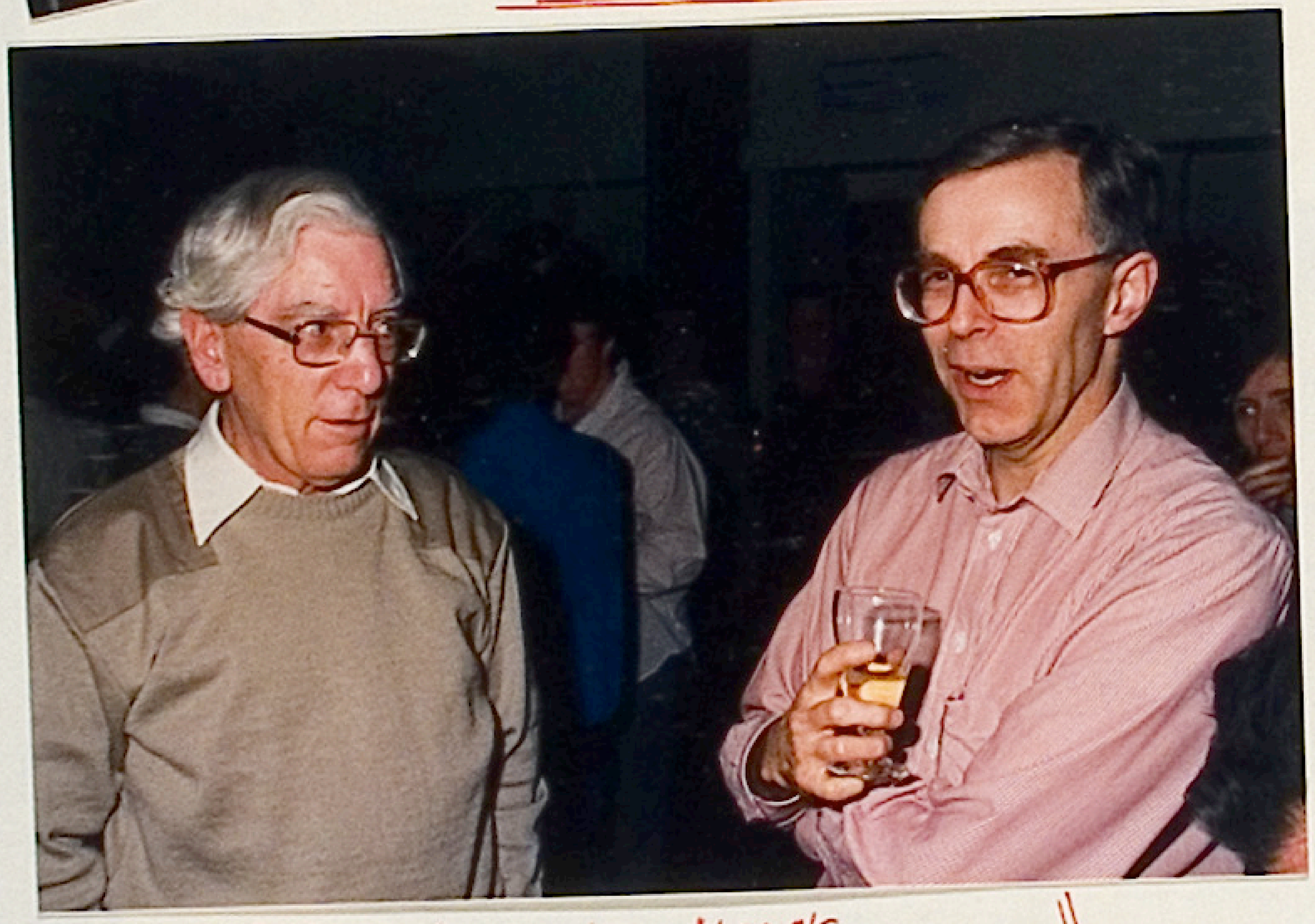
JULY 27th 1989

CHRISTINE BLOEM & PROF. ATHEL BECKWITH.

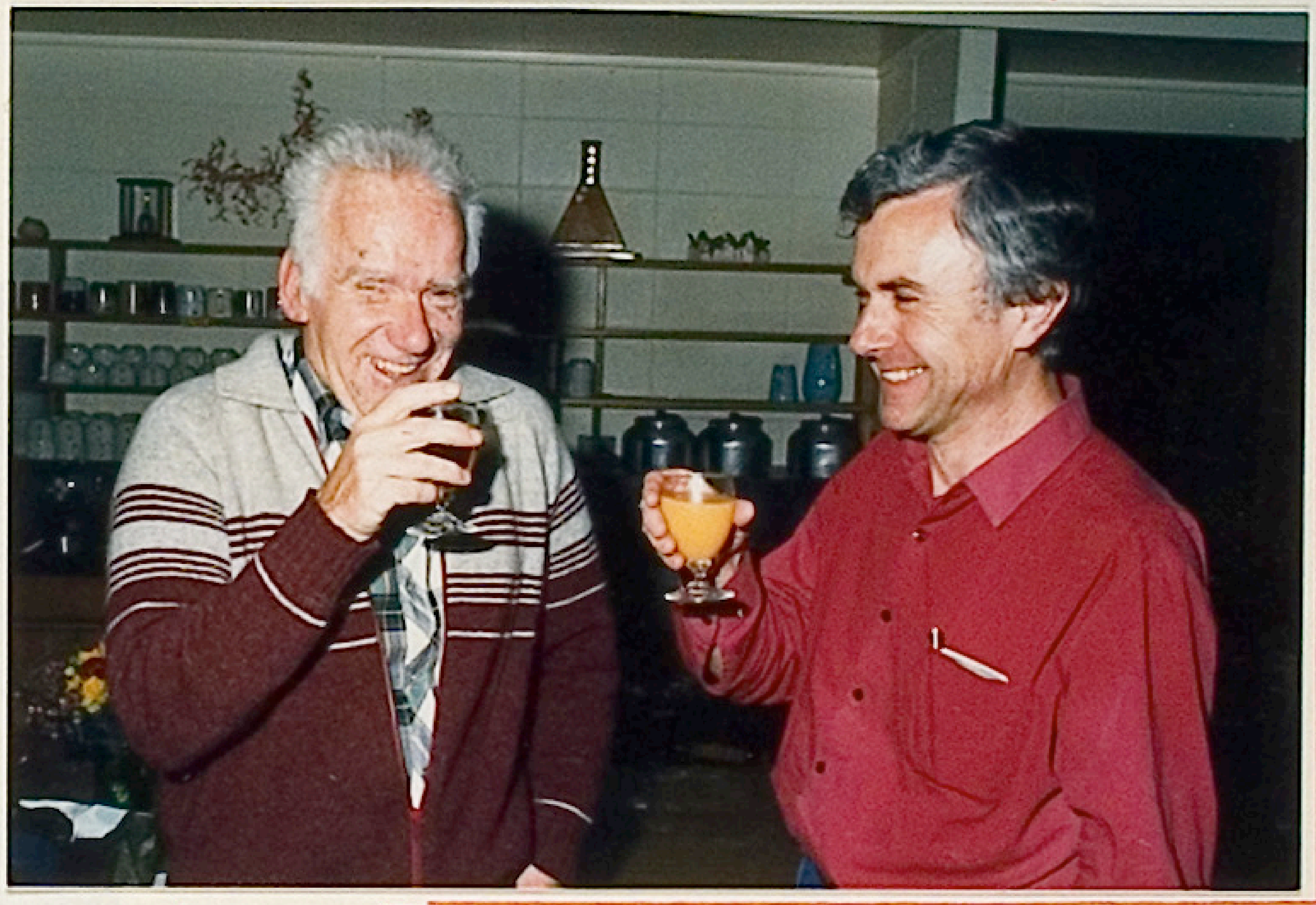
DR HARTMUT FRANK & DR JOHN MACLEOD



ROD RICKARDS, PENNY & PROF CRAIG



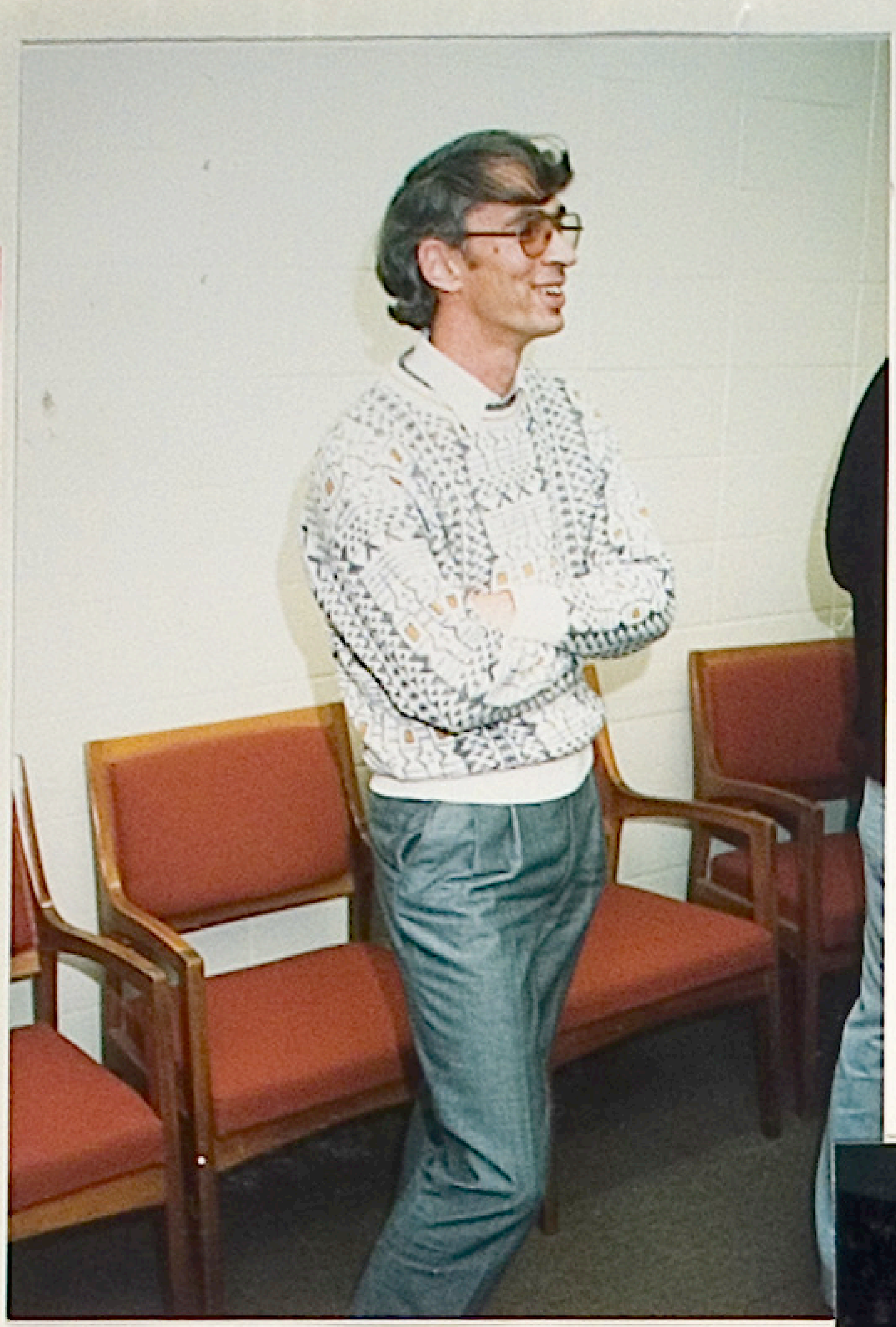
PROF. HYDE & NAT ALCOCK



ALEX WALLNER & HORST NEUMANN

CATHY & BARRY ON THEIR FOURTH BOTTLE!

TIN CULNANE, CHRIS BLAKE & PETA SIMMONDS



PROFESSOR DENIS EVANS!

FROM LEFT TO RIGHT

PROFESSOR CRAIG
PROFESSOR EVANS
PROFESSOR BIRCH
ROD RICKARDS
PENNY RICHARDSON

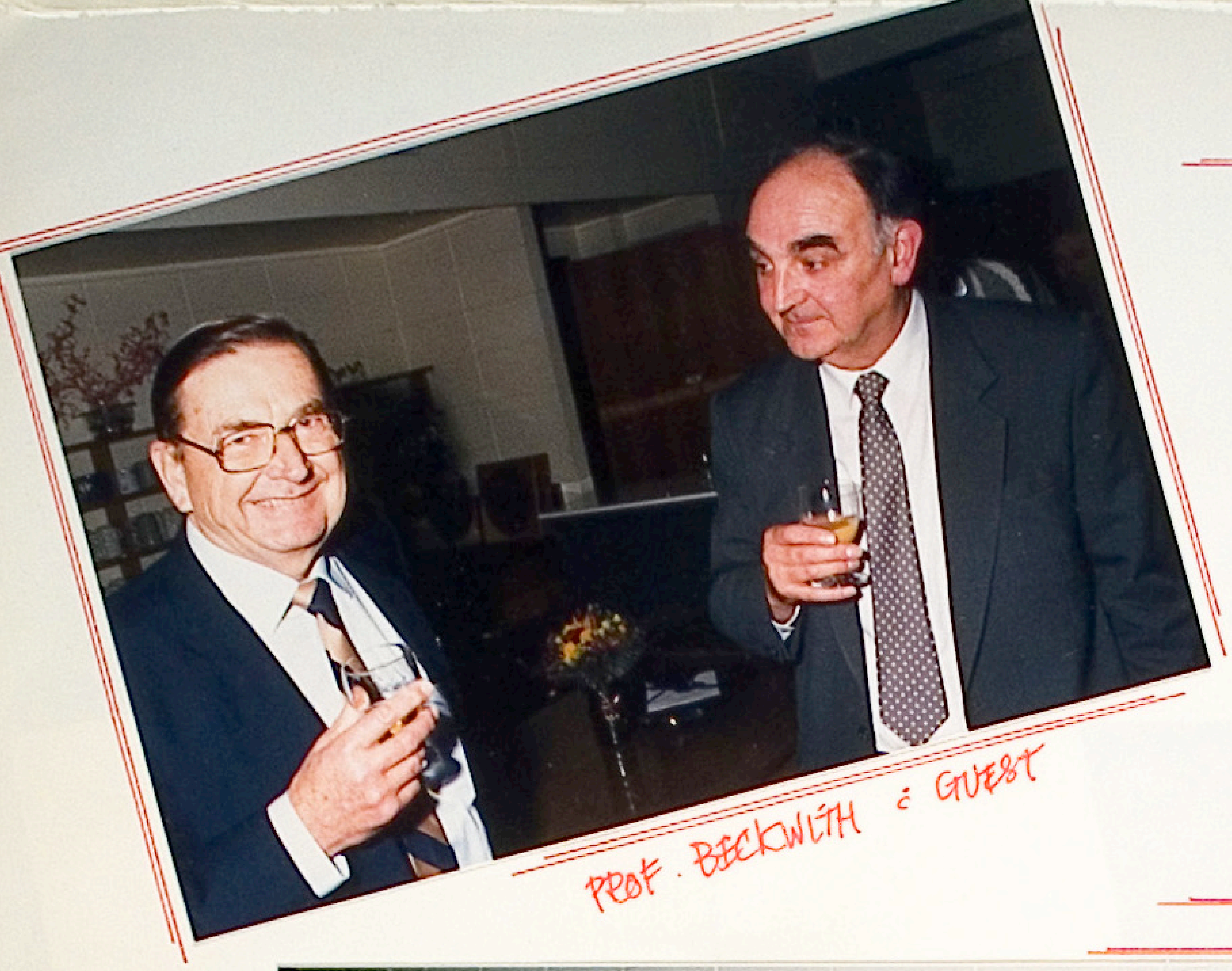
L TO R
PROFESSOR BECKWITH
PROFESSOR WHITE
PROFESSOR MANDER

July 27th 1989

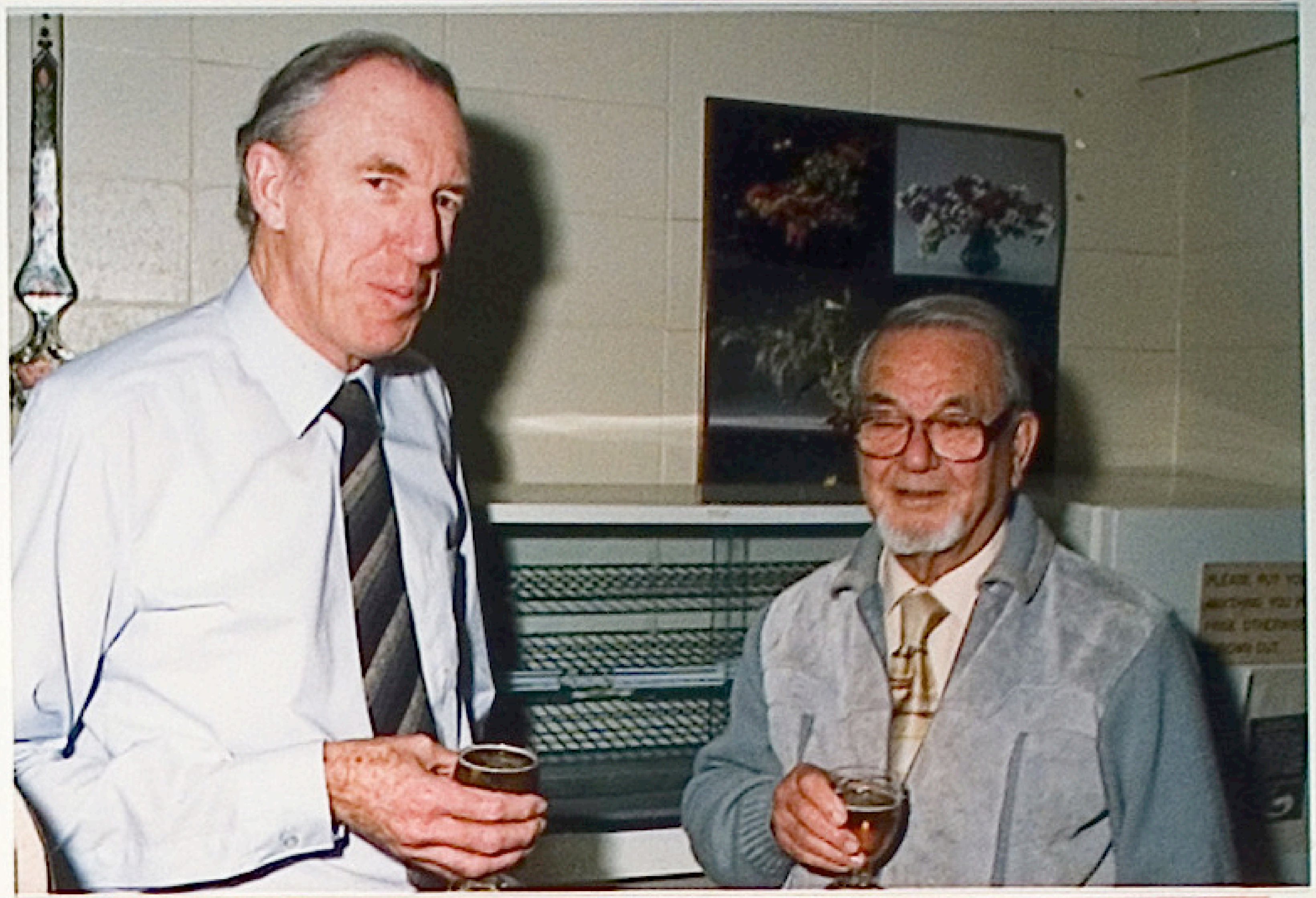
ANDY McMURRAY, JOHN MACLEOD & JOHN HUSH (NO THANKS!)

STEPHAN MARFURT, HELMUT HUEGEL, PETER DUGGAN

KIM FINNIE, VIMALA & ELMARS KRAUSZ



PROF. BECKWITH & GUEST



ROD RICKARDS & PROF BIRCH.

WALL FLOWERS ?!

NINA, REET AND RENA

MARIE, HEATHER, KAREN & JANET

GEOFF LINCOLN, NACI SARI AND KURT RUSSELL

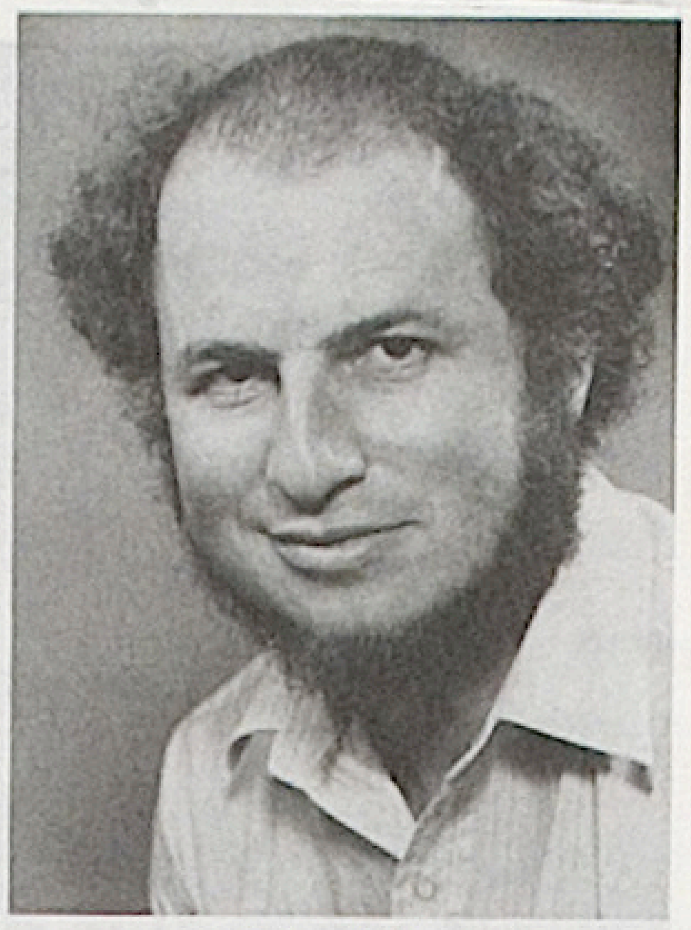
DAVID, CHRISTINE, PHILLIP, PHIL AND PETER

PROF. DENIS EVANS, PROF CRAIG AND LEO RADOM

ANU chemist honoured

ANU REPORTER
11 AUGUST 1989

Dr Leo Radom, senior fellow in the research School of Chemistry, has just been elected to the prestigious International Academy of Quantum Molecular Science. Dr Radom is only the second Australian scientist to be accorded this honour, the other being Emeritus Professor D. P. Craig, Foundation Professor of Physical and Theoretical Chemistry in the School.



Dr Leo Radom

Dr Radom's election is in recognition of his contributions to the application of *ab initio* computer calculations to the study of the structures of molecules and the mechanisms of the reactions which they undergo. Dr Radom is the youngest current member of the international academy. He was elected to the Australian Academy of Science in 1988.

Chemistry is traditionally a matter of mixing, separating and measuring liquids, gases and solids in the laboratory. But advances in the understanding of forces within molecules and in computer technology mean that many chemical experiments can now be performed quickly, cheaply and safely in a computer.

Dr Radom uses a mathematical procedure called *ab initio* molecular orbital theory to calculate the structures and stabilities of molecules. Remarkably, the calculations use no experimental information other than the values of fundamental constants such as the speed of light, but they can be very time-consuming. They would take many lifetimes if carried out by hand! However, high-powered computers like the University's Fujitsu VP-100 can do the calculations so quickly (at the rate of more than 100 million operations per second) that the theory, which is 60 years old, has had an international renaissance. In this, the ANU is a leading contributor.

The computer calculations have a particularly useful role to play in situations where experiments are either difficult or impossible, for example where molecules are dangerously reactive or where they only exist in interstellar space. Research in Dr Radom's group focuses on precisely such situations and has contributed to the discovery of new molecules, both in the laboratory and in the interstellar medium.

The work at ANU could one day provide the basis of knowledge for the development of *ab initio* molecular orbital theory for larger molecules and the application of the theory to industry and medicine. Computers could be used to scan large numbers of molecules in order to define a much smaller set of target systems for which the thoretical predictions suggest that further experiment may be warranted. This would cut down the vast and repetitive process of testing possible new pharmaceuticals or polymers.

ANU REPORTER
11 AUGUST 1989

Apprenticeship award

A senior laboratory craftsman in the Research School of Chemistry, Mr Steven Wood, 22, has won the ACT Electrical Apprentice of the Year award and will be among nominees for the national apprenticeship awards to be announced later in the year.

Mr Wood completed his apprenticeship studies in electrical fitting at the Belconnen TAFE while working at RSC under the supervision of Mr John Hush.

He is now studying for an Associate Diploma of Electrical Engineering at the Bruce TAFE.

NICK DIXON, JENNY BECK, PAT STAMFORD

A.C.T. APPRENTICESHIP 1936-89

A.C.T. Vocational Training Authority

A.C.T. Institute of Technical and Further Education

This is to Certify that

AUSTRALIAN NATIONAL UNIVERSITY

was the employer of

STEVEN JOHN WOOD

the outstanding apprentice of the year 1989 in the Trade of

Electrical Fittin...

The Vocational T... ...ed by the
A.C.T. Instit... ...ducation,
declar... ...-the-job
... ...to the

DIRECTOR,
A.C.T. INSTITUTE OF TECHNICAL AND FURTHER EDUCATION

A.C.T. APPRENTICESHIP 1936-89

A.C.T. Vocational Training Authority

A.C.T. Institute of Technical and Further Education

Outstanding Apprentice of the Year 1989

This is to Certify that

STEVEN JOHN WOOD

has been selected by the Vocational Training Authority as the outstanding apprentice of the year in the Trade of

Electrical Fitting

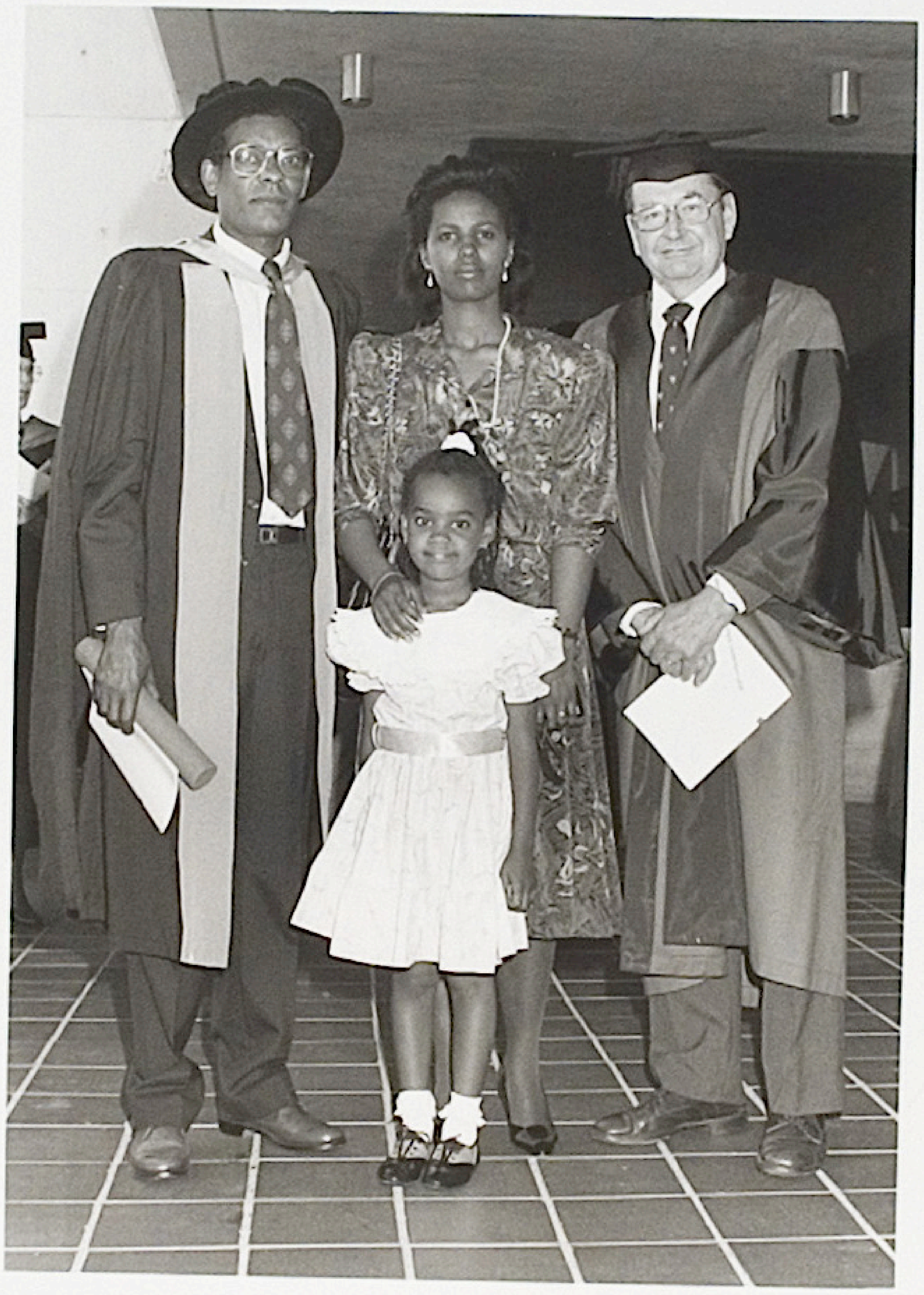
We the undersigned declare that during the year STEVEN JOHN WOOD demonstrated trade ability and attitude deserving of special mention and achieved distinction in the off-the-job component of the apprenticeship.

CHAIRMAN,
A.C.T. VOCATIONAL TRAINING AUTHORITY

DIRECTOR,
A.C.T. INSTITUTE OF TECHNICAL AND FURTHER EDUCATION

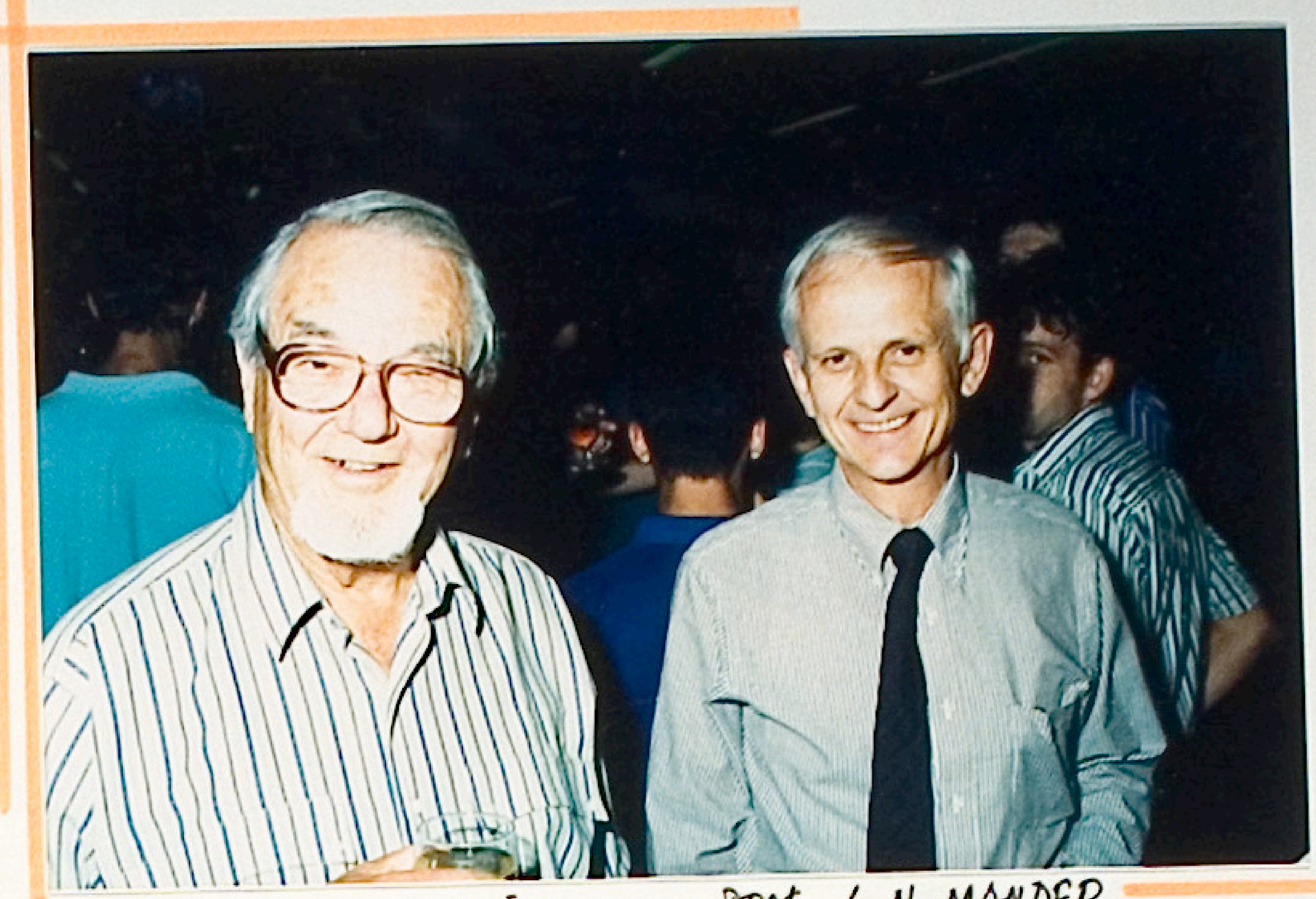
7th September, 1989
DATE

Conferring of Degrees ceremony



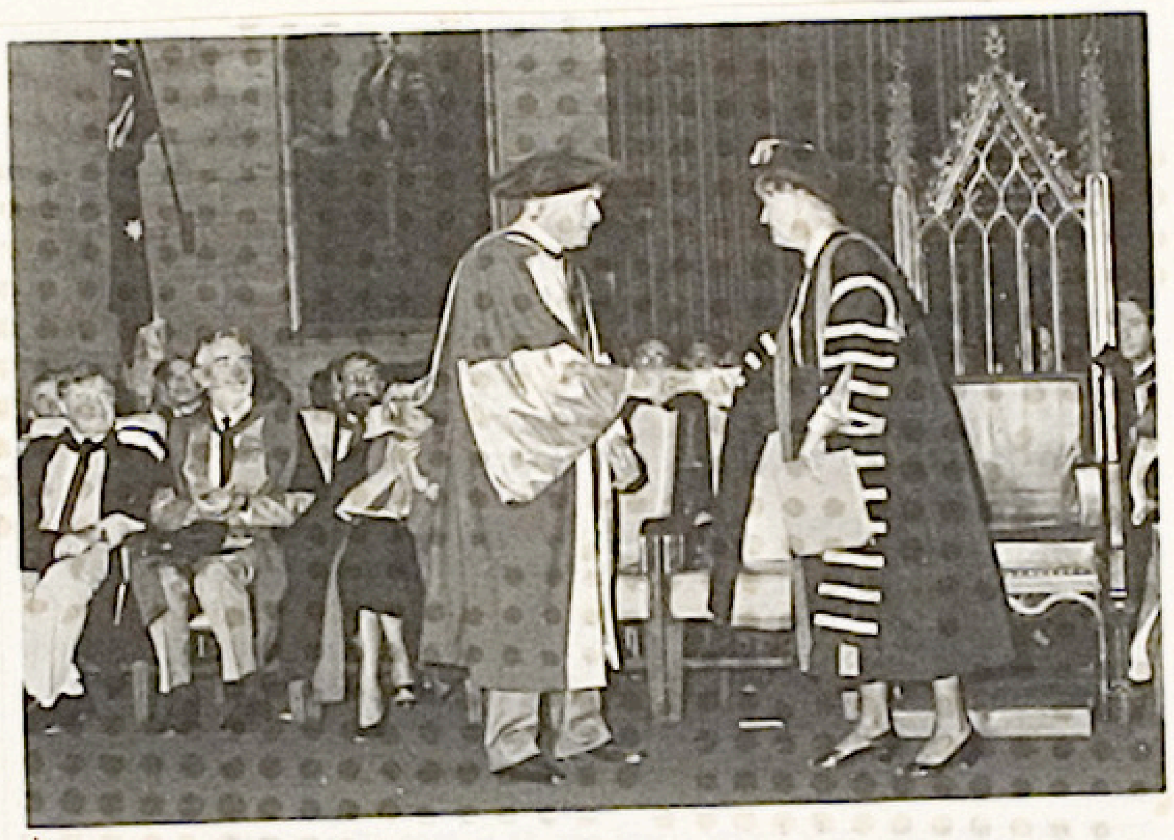
Ethiopian scholar, Dr Sendaba Gerba (left), his wife Fekerete and daughter Bethel, aged 6, with Professor A.L.J. Beckwith, Dean of the Research School of Chemistry, who was Dr Gerba's thesis supervisor.

MARCH '90



PROF. A.J. BIRCH AND PROF. L.N. MANDER

UNIVERSITY OF SYDNEY NEWSLETTER VOL. 22 No: 5.



▲ One of the University's most distinguished graduates in the field of Chemistry, Professor Alan McLeod Sargeson, was awarded an honorary Doctor of Science degree at a Conferring of Degrees ceremony in the Great Hall on 2 March.

Professor Sargeson, who has held the Chair of Inorganic Chemistry in the Research School of Chemistry, Australian National University since 1978, is well known for his work on the synthesis and characterisation of entire new classes of 'coordination compounds', that is chemical substances in which metal atoms are surrounded by one or more molecules which contain other chemical elements. These compounds are being used to gain insights into chemical processes which occur in living organisms.

Two elected to Royal Society

Two professors from the University's Institute of Advanced Studies have been elected to the Royal Society of London, one of the world's oldest and most prestigious scientific societies.

Professor Allan Snyder is foundation head of the Optical Sciences Centre, Research School of Physical Sciences and Professor of both Optical Physics and Visual Sciences. He came to the ANU from Harvard University, Yale University and University College, London.

Picture: Catherine Cox

Professor Snyder

He has received many honours for outstanding achievements in Physics and Vision research, including the Lyle Medal of the Australian Academy of Sciences.

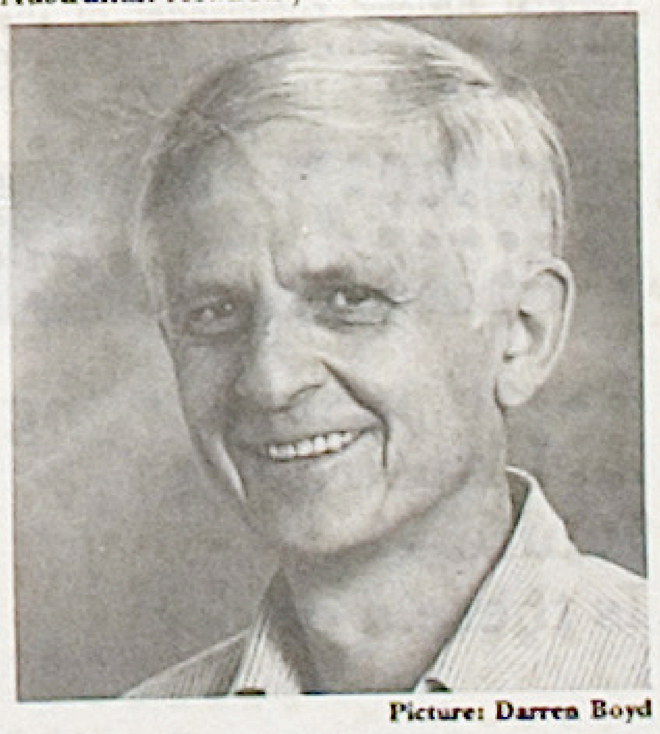
Professor Snyder told *ANU Reporter* that he is currently studying how the brain incorporates prior knowledge of the visual environment to simplify visual processing. In physics he is investigating fundamental aspects of light propagation in nonlinear glass fibres, work which is central to the photonics revolution.

'The driving motivation for my research is the excitement of playing with ideas and a deep desire to understanding the intrinsic simplicity and beauty of the natural world,' he said.

Professor Lew Mander, an organic chemist and former Dean of the University's Research School of Chemistry, is only the sixth Australian chemist to be elected to the Royal Society. Five of them are past or present members of the School.

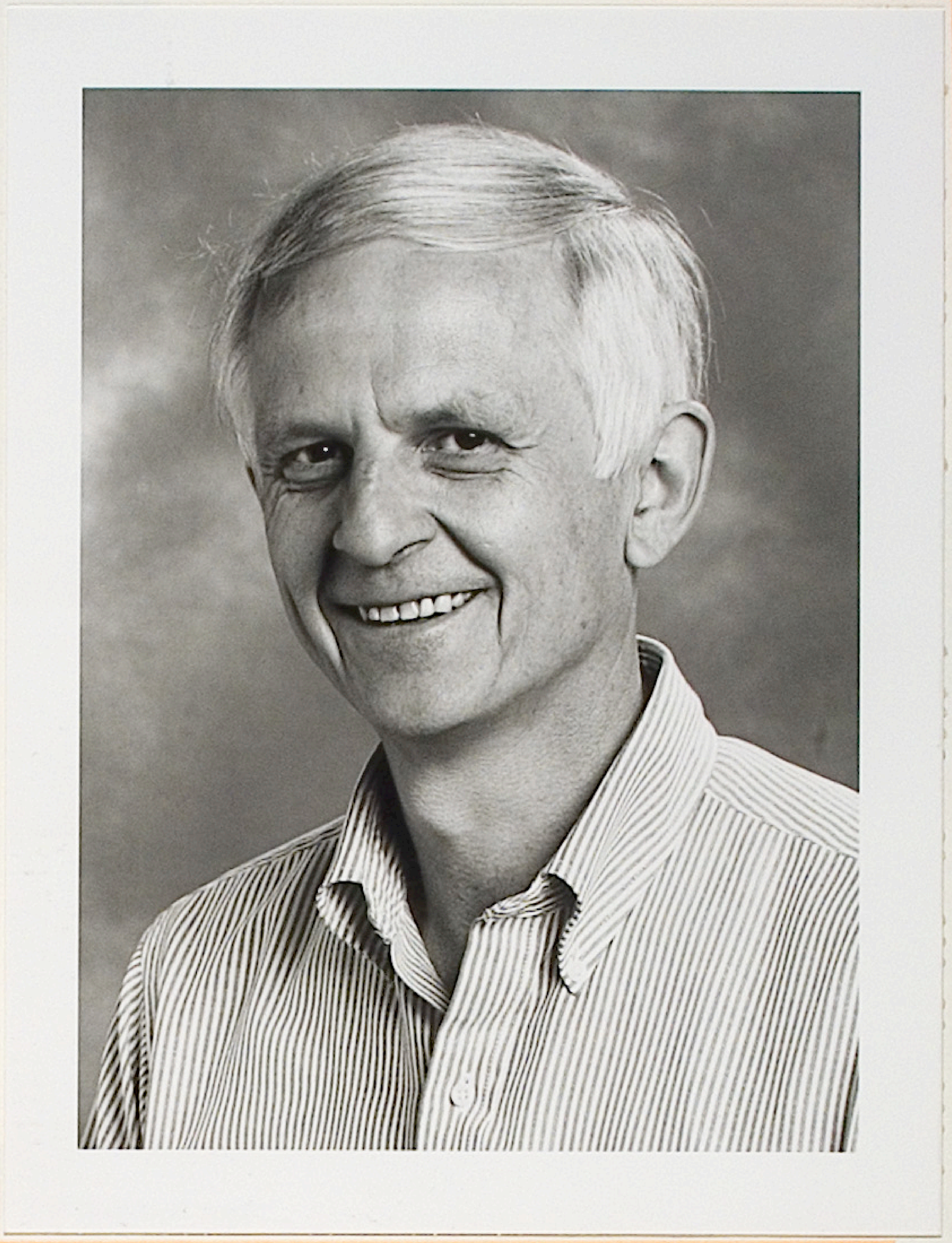
Professor Mander's research interests have been concerned mainly with the isolation, identification and preparation of rare substances involved in the regulation of plant growth and development — the plant hormones. He is one of only two scientists in the world (the other is Professor Corey from Harvard) who have synthesised gibberellic acid — the plant hormone which is widely used in horticulture and agriculture. This was an outstanding feat of molecular construction which attracted world-wide acclaim.

Professor Mander is recognised as a world leader in his field. His achievements have previously been recognised by the award of the H.G. Smith Medal by the Royal Australian Institute of Chemistry and the Flintoff Medal by the Royal Society of Chemistry. He was elected to the Australian Academy of Science in 1983.



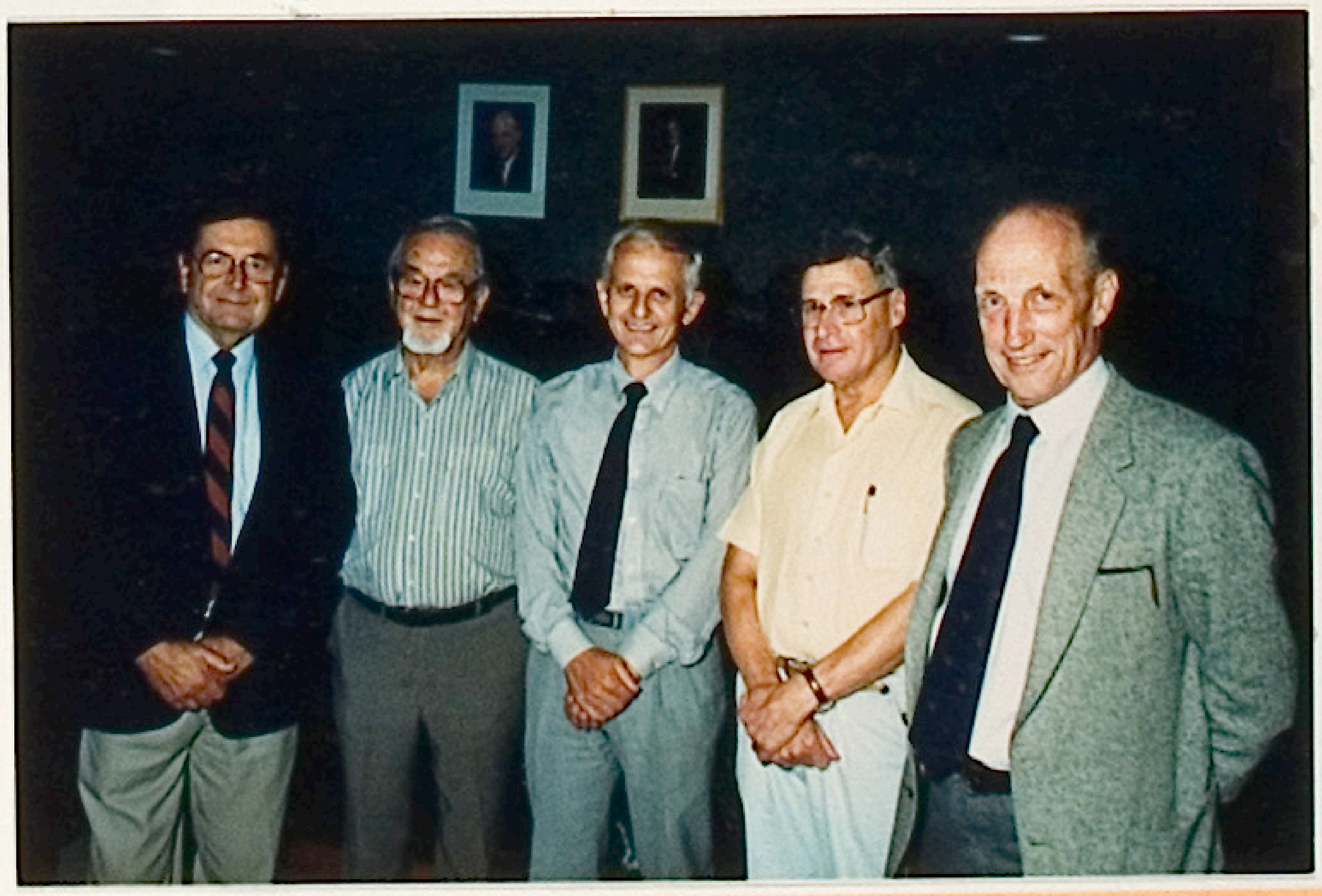
Picture: Darren Boyd

Professor Mander



PROFESSOR MANDER

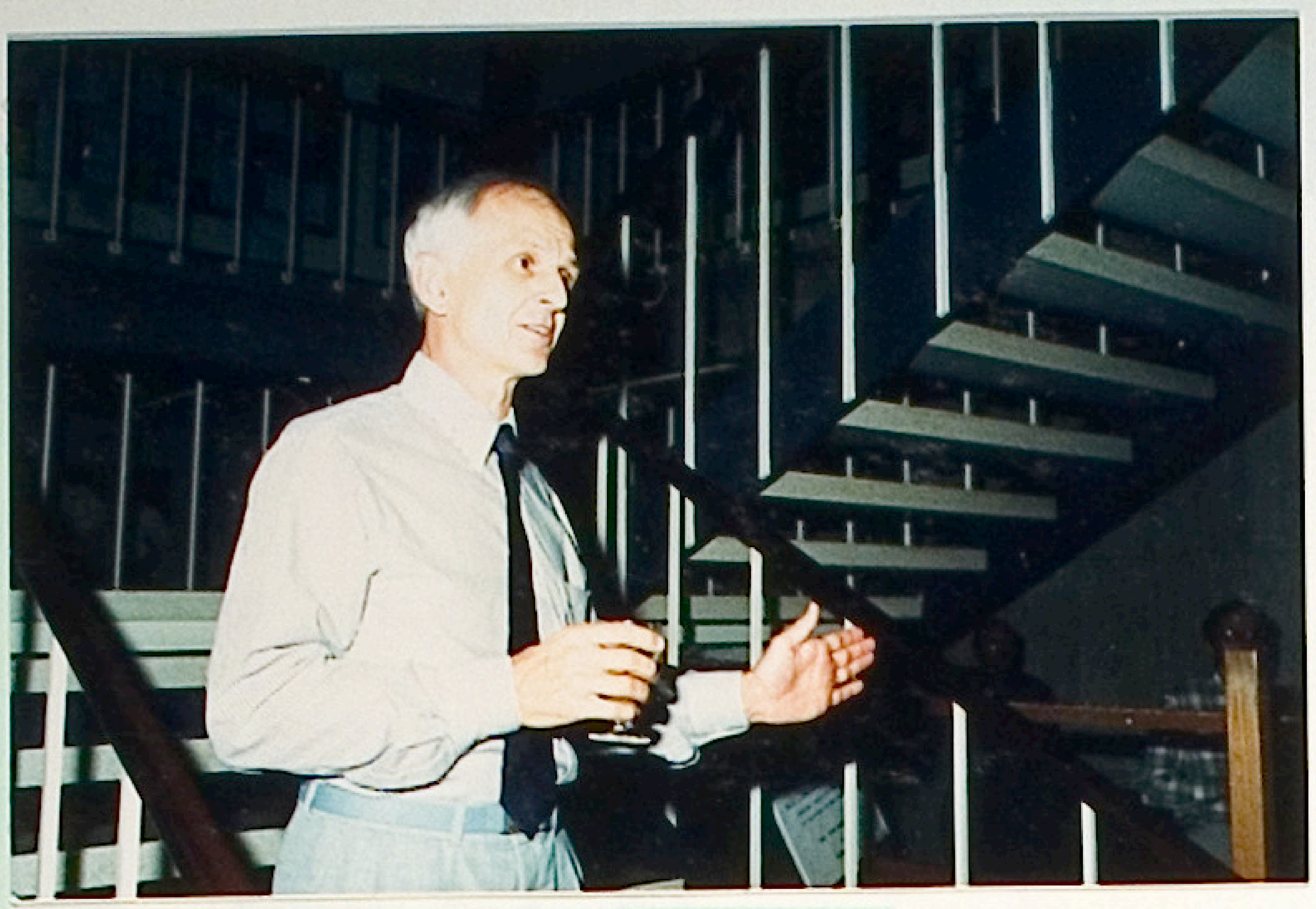
PROF. ATHEL BECKWITH



PROF. BECKWITH, PROF. BIRCH, PROF. MANDER, PROF. SARGESON, PROF. CRAIG

FEBRUARY 1990

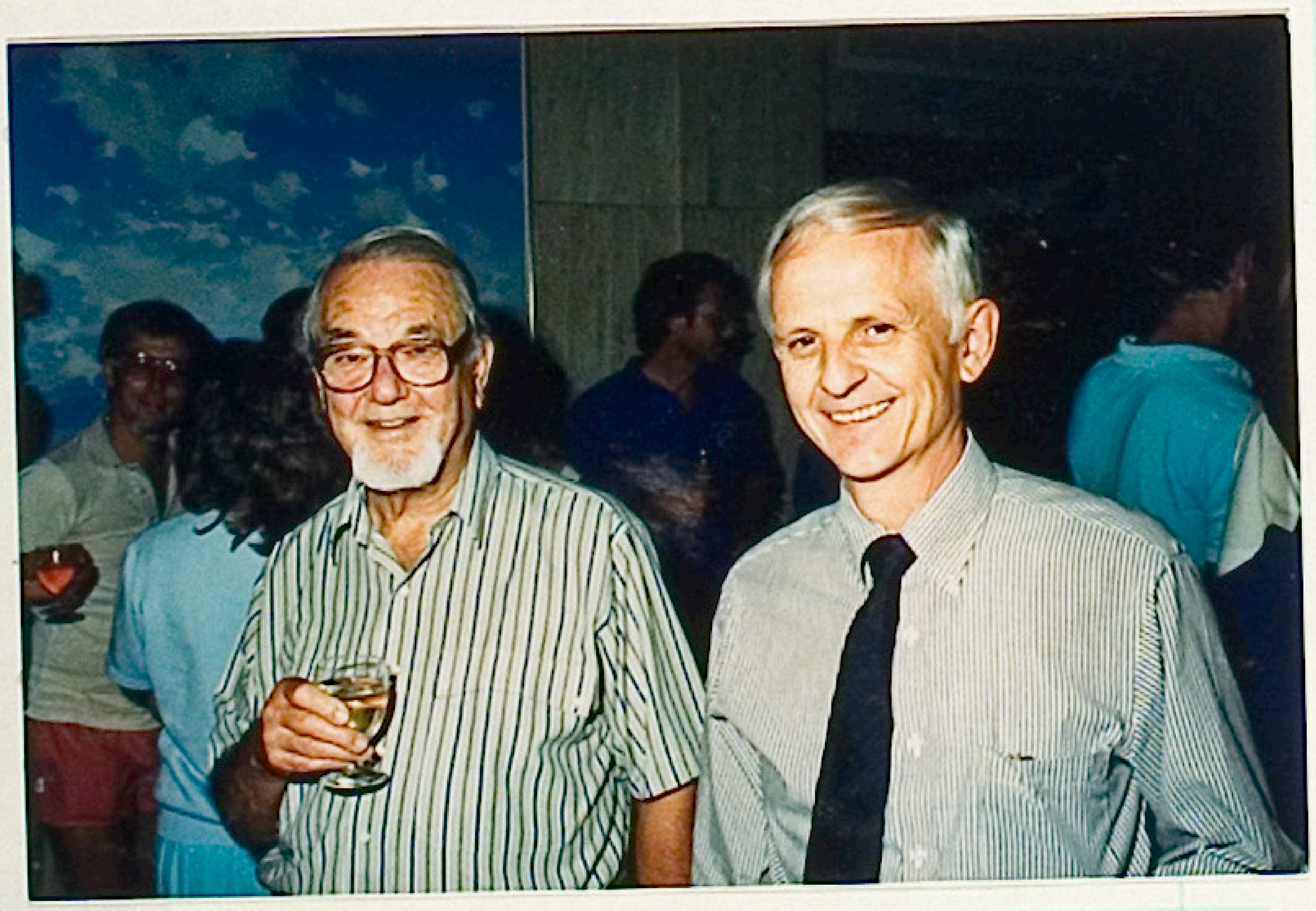
MARCH '90



SCHOOL FUNCTION

TO CELEBRATE

PROF. MANDER & FAMILY



PROF. BIRCH & PROF. MANDER

PROF. MANDER'S AWARD AS FELLOW OF

THE ROYAL SOCIETY!

PROF E. CRAIG, PROF. A. SARGESON AND PROF. MANDER

PROF. BIRCH, SARGO & PROF CRAIG

THE MAGNIFICENT FIVE!

DR BENNETT, DENIS EVANS & PENNY

I COULDN'T DRINK ANOTHER GLASS!

L. MANDER, JOHN MACLEOD & →

MARTIN KLINGENBERG

PROF MANDER & DR. LEO RADOM

R. WELBERRY, L. MANDER, A. BECKWITH, N. RIGGS & M. COLLINS

APRIL 1990

NACI-'S FAREWELL

FROM LEFT TO RIGHT:
STELLA O'CONNOR
GEOFF LINCOLN
KURT RUSSELL
NACI SARI
BRONWYN BUCKLEY
PETER DARIOL
SHIRLEY SMITH
LYNN DONAGHIE
CRAIG RITHERDON

WE ARE jolly GOOD FELLOWS!

PROFESSOR ATHEL BECKWITH with NACI

IN THE TEAROOM FOR N. SARI'S RETIREMENT/ FAREWELL SPEECH.

Chemists test life saving compounds

ANU chemists are collaborating with medical researchers to test remarkable chemical compounds which they believe have the potential to arrest a fatal disease in some children.

Alan Sargeson, Professor of Inorganic Chemistry in the Research School of Chemistry (RSC) and his group recently began work with Drs David Danks, Harry McArdle and Julian Mercer of the Murdoch Institute in Melbourne on an evaluation of compounds to combat Wilson's Disease, a congenital condition where copper accumulates in the liver and brain.

The compounds are organic cages containing nitrogen atoms which bind metal ions tightly in the centre of the cage. The molecules were originally discovered in the mid-70s by Tony Herlt, Dr Jack Harrowfield (now at the University of Western Australia) and Professor Sargeson in the RSC, and were dubbed 'sepulchrates' or 'sarcophagines' because of their ability to bury heavy metal ions in chemically stable and unreactive crypts. ANU has patents on the compounds.

Professor Sargeson said that this aspect of his research over the past fifteen years had focussed on exploring the chemical and biological properties of the cages. He said the caged metal ions showed extreme stability relative to comparable chemistry and displayed unusually fast electron transfer reactions.

The cages also were selective about the metal ions they encapsulate and in some cases were able to extract even minute amounts of heavy metals from solution. For example, Dr Darren Baldwin has recently shown that copper is removed from water in concentrations as low as one part per billion by a polymer made from the cages.

Exploration of biological applications of the cages developed as a spin-off from the basic chemical investigations, and Professor Sargeson said it was a logical development to consider them for toxicological studies.

In Wilson's Disease, 'Copper builds up in the affected children since they lack the mechanism for excreting it. Children who are not treated usually die early from liver failure,' Professor Sargeson said.

'Laboratory tests using mouse hepatocytes (liver cells) treated with the cage compounds have been very encouraging. The sarcophagines can prevent build up of copper in the cells, and are also effective in removing copper from the cells.'

A major advantage of using the cages in medicine is that the compounds, once they have captured the metal ion, are so stable they are eliminated readily in the urine. Also, the cages do not interfere with the sodium-potassium balance or calcium metabolism.

Professor Sargeson said that with medication, some people with Wilson's Disease can live well into middle age. Penicillamine is such a medicine but there are often side effects with the treatment. Alternative drugs are required for these and chronic cases.

Although penicillamine also has the capacity to capture copper, one of the results of the cage studies was to show that the drug neither removes the metal from liver cells nor prevents its uptake. It is effective, however, in helping the elimination of copper, but it is something of a mystery how penicillamine functions in these cases.

Tests of the cage molecules are about to be carried out on a mouse model which shows symptoms similar to the human forms of Wilson's Disease.

The caged metal ions also show considerable potential for diagnostic applications such as nuclear magnetic resonance (NMR) and radionuclide imaging. This work is being carried out by Drs Rodney Geue, Stephen Ralph and Sendaba Gerba (RSC), in collaboration with Dr Mike Tweedie of the Squibb Institute for Medical Research.

Professor Sargeson is also collaborating with Drs Carol Behm and Rick Pashley in the Faculties, ANU, on cage complexes with paraffin tails – new types of detergents. These compounds destroy nematodes and tape worms by their ability to insert into the organisms' membranes and destabilise them. The molecules also have unusual detergent properties.

Anthracene can also be tied to the cage and inserted between the bases on a DNA strand. Dr Philip Hendry (RSC) has shown that by irradiating the system with light with a wavelength of 320 nanometres, a photochemical reaction is triggered by the cobalt cage complex and the DNA is cleaved into fragments. The specificity of the process is currently being investigated.

Recently, Drs Rodney Geue, Arthur Höhn and Stephen Ralph (RSC) have synthesised larger cages which will take larger metals, and Dr Peter Osvath has made a cage containing sulphur atoms as the only binding sites for the metal.

These developments will assist with the imaging studies, and open new opportunities for industrial uses which include mineral purification, mineral capture (especially gold), and pollutant removal.

– Marietta McGregor

ANU REPORTER 23/11/'90

Birthday Boy!

THEY TOLD ME TO SIT THERE ALL DAY!

NOW THAT'S A PIECE OF CAKE!

Sarfo's 60th!

"October 13th 1990"

THIS IS WORSE THAN THE BREATHALYSER!

the Big Blow-out!!

and straight into it!