Anu Reporter - 20 Oct 96

Laser tweezers provide powerful tool

BY MARITA BLACK

NEW ANU research using "optical tweezers" to manipulate polymer molecules may improve understanding of the nature of DNA and the engineering problem of fluid flow.

Dr Edith Sevick, a new Fellow in the ANU's Research School of Chemistry (RSC), is initiating a novel experimental program with laser tweezers in collaboration with Dr David Williams in the Research School of Physical Sciences and Engineering (RSPhysSE).

Essentially consisting of a microscope and a laser, the tweezers are a powerful tool, with many potential uses yet to be explored.

"The tweezers are a very exciting new technique and the only method we have for studying the behaviour of single polymer chains," said Dr Sevick.

A latex bead is chemically attached to the tail of a polymer to be studied (any large molecule with a repeating structure, such as DNA), and the laser used to pull the bead and stretch the polymer into a linear form. With the aid of a fluorescent dye and microscopy, a single molecule of a polymer can be visualised and quantitatively measured as it unwinds from its three-dimensional coiled state.

One of the ongoing questions in molecular biology is how to effectively separate DNA molecules of differing sizes. Gel electrophoresis is the commonly used technique, which involves passing DNA samples through a gel matrix by applying an electric field which separates molecules on the basis of differences in chain length. Smaller DNA molecules move more quickly through the gel and their progress can be visualised with a fluorescent dye under ultraviolet light.

However, there are restrictions to electrophoresis, especially when separating very large DNA molecules. Tactics such as varying the gel concentration or oscillating the field may be used but are not always satisfactory.

"Using computer chip technology and optical tweezers, we may be able to provide researchers with a technique giving much more control over the separation of all combinations of different sized DNA molecules, without the need for calibration," said Dr Sevick.

According to Dr Sevick, DNA could be separated on a device like a computer chip, with specially etched obstacles in the form of posts or wider barriers. The DNA, suspended in solution and placed under an electric field, would be forced to move around the posts in a way which is dependent upon its length, so that DNA of different lengths would move apart.

The key to the technique is to know exactly how DNA molecules behave when confronted with obstacles of various widths and spacings, so that conditions can be optimised for the separation of different combinations of DNA molecules.

Optical tweezers would allow researchers at RSC to watch DNA, normally coiled in a complex three dimensional structure, unwind into a linear form to pass around barriers. Mathematical models to describe the behaviour of the DNA can be developed, tested and adjusted, alongside the experimentation.

The dynamics of polymers also relates to another applied problem of engineering; the flow of fluids through micro-conduits. Microconduits are lined with polymers to reduce the drag generated by fluid flow. The tweezers could provide a way of studying why some polymers work better than others with particular fluids, putting the response of single polymer chains to fluids literally under the microscope.

Other possible uses for the optical tweezers include the chemistry and mechanical properties of surfactant (detergent) films and biological "motors" such as adenosine triphosphate or ATP. ATP powers most biological reactions by converting chemical energy into mechanical work.

Formerly an Assistant Professor at the University of Colorado in the US, Dr Sevick draws her expertise in the physics of polymers from a number of areas, reflecting the cross-disciplinary nature of the field. Her undergraduate studies were in chemical engineering, followed by a doctorate in polymer science and postdoctoral research in condensed matter physics.

Published throughout the academic year ANU REPORTER - VOL 27. NO 19 30 OCT 96

Basic ANU chemistry research picked up by pharmaceutical giant

BY KAY BARNEY

CHEMICAL research at the ANU has been picked up by American pharmaceutical giant Merck, Sharp & Dohme to develop a new generation of antibiotics that can be used against penicillin-resistant infections such as golden staph.

When Dr Chris Easton's research group at the Research School of Chemistry (RSC) published its work on a method to make a synthetic peptide, Merck, Sharp & Dohme picked up on it and developed it to the stage where the new "peptide antibiotic" is now in clinical trials in the US.

Although Dr Easton's group did not benefit financially from this development, much of the research done by the group involves working on externally-funded projects with commercial/industrial partners.

"Research groups must be a certain size in order to make a contribution at an international level. It is very difficult to maintain that critical mass unless we seek outside funding – funding from the university alone cannot sustain the research," he said.

"We also have an obligation to our PhD students to ensure that our work is world class, because the students are examined internationally and must be up to standard.

"While the primary role of university research is to provide training for the postgraduate students that are involved, hopefully the opportunity to participate in projects of relevance to commercial and industrial partners adds to the breadth of their training, and makes the students more aware of the strengths and constraints of industry."

When it comes to developing drugs and chemicals, Dr Easton points out the importance of researchers taking into account marketing and practical aspects of the drug that they are trying to develop. Factors such as the taste of the drug and the solubility in water, its potency so that people do not have to take a tablet the size of a horse, are all essential when working on developing new drugs. Otherwise, the pharmaceutical companies just aren't interested.

"The benefits of interactions between students and commercial and industrial partners are substantial, provided the principal functions of postgraduate education and training are not compromised," says Dr Easton.

And the projects are more interesting to students because they are more relevant.

Currently, an important part of the research group's collaborative efforts is in studying cyclodextrins, which are carbohydrates.

Since their discovery, cyclo-dextrins have attracted the attention of chemists because they form host-guest complexes.

The cyclodextrins are doughnut-shaped and other chemicals and molecules can form complexes by hiding inside the hole of the doughnut.

Studying the basic characteristics of how the cyclodextrins react with other molecules has resulted in the identification of potential applications for the chemistry, such as food additives and in making soluble forms of drugs. This work has been carried out mostly by postgraduate students at the ANU and the University of Adelaide.

The cyclodextrins also are soluble in water and tend to form complexes with water-insoluble guests because the "guest" molecule is hydrophobic (water-hating) and so it hides in the hole of the doughnut to avoid contact with water.

In the pharmaceutical industry this property of cyclodextrins is being exploited to prepare solution formulations of drugs so they can be given orally and intravenously.

Other fundamental chemistry research at the ANU has resulted in the development of synthetic cyclodextrins. They can be tailored to meet specific requirements, such as increased solubility.

By making synthetic versions of the chemical, you can make better versions that are more effective for the job you want them to do. As a consequence, any complexes of the modified cyclodextrins are more effective.

Some of the research has involved the students looking at how to make synthetic versions of the cyclodextrins to alter the shape o the doughnut and the charge in it i order to get different interactio with different "guest" chemicals.

Part of this work was recent published in *Chemical Society R views*, the chemistry review jour of the Royal Society of chemistry the UK.

Rather than manufacturing s thetic cyclodextrins on a comm cial basis, the research group l at how to develop the method modifying them which chemica pharmaceutical companies can adapt to develop drugs in com cial quantities.

In a similar manner, a pr which began as an analytical synthetic study of lipids assoc with metabolic disorders ha sulted in the identification of acids and related species, h physiological activity which cates that they may be suitab use as pharmaceuticals.

The ANU Reporter 16 October 1996

New magnet brings ANU up to date in important analytical technique

BY LIZ TYNAN

THE ANU has been brought up to date in the vital field of Nuclear Magnetic Resonance (NMR) with the installation of a new and more powerful NMR spectrometer.

The new machine has a much stronger magnetic field (14 tesla compared with the 11.4 tesla of the existing machine), enabling more sensitive and sophisticated NMR spectroscopy, according to Head of the NMR facility, Dr Max Keniry.

NMR spectroscopy is the most important analytical technique for structural and synthetic organic and inorganic chemistry. It also has many biological, medical and natural science research applications. In chemistry, NMR enables researchers to examine experimentally the molecular structure of the chemical substances they have created. It is often used to complement other analytical techniques, such as X-ray crystallography and electron microscopy.

RSC's NMR facility was established in 1984 by Professors Ian Ross and Lew Mander to maintain the University at the forefront of research in this field. Dr Keniry said that by this year, however, it was clear that the University had fallen behind quite considerably in world terms, and new equipment was needed. The joint Research School of Chemistry (RSC) review committee strongly recommended an upgrade of the equipment.

The console associated with the new magnet has been manufactured by Varian, a diversified California-based company with an Australian subsidiary based in Melbourne. The console is controlled by a Sun Workstation. The magnet assembly itself, which was so large it had to be lowered by crane through a window, was built by Oxford Instruments in England.

The magnet now stands in a 1.5m hole, necessary to keep the magnetic field a critical distance away from other experimental work and mobile metal objects on the floor above which may be affected by it.

NMR works by placing a sample in a strong external magnetic field within which electromagnetic radiation is absorbed by a nucleus under study. NMR spectra may be collected as one, two or three dimensional datasets which can be interpreted by NMR experts to reveal structural characteristics that can't be obtained by other means.

An associated technique, known as Magnetic Resonance Imaging (MRI) is used in medicine to produce high-resolution images of body tissue for diagnostic applications.

The new machine will be used for a variety of experiments, including Dr Keniry's own research. His varied work has included investigating an unusual form of DNA, known as DNA quadruplex, a unique structure which apparently "ties up" the end of chromosomes and may have a role in ageing and in cancer. Dr Keniry and colleagues solved the DNA quadruplex structure and published their results last year.

Dr Keniry also has other types of analytical work with various colleagues, such as Professor Richard Shafer at the University of California at San Francisco. They are working on anti-cancer drugs binding to DNA. Work will continue on various protein structure projects, including an unusually active insulin-like growth hormone and the "theta subunit" of DNA polymerase.

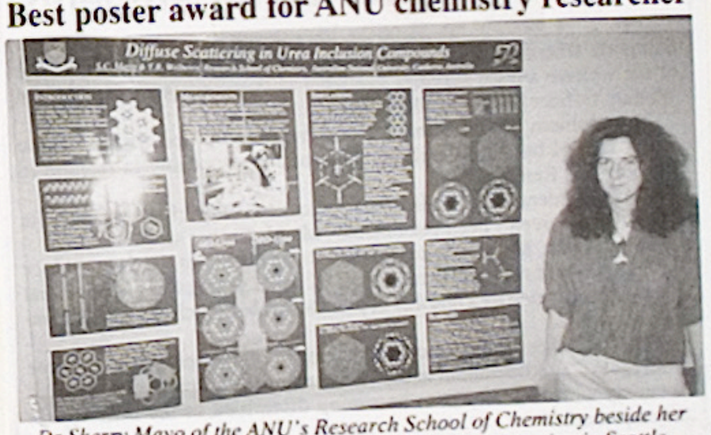
In addition, he has been involved in advancing NMR techniques themselves. His group improves published pulse sequences, obtaining spectral information that would otherwise be difficult to obtain. This honing of techniques is typical of NMR – "the field is 50 years old and has continually developed," said Dr Keniry. "It is an incredibly vibrant, versatile science."

The University's NMR facility provides a service to all the ANU research schools and faculties. A new Research Fellow, Dr Marco Casarotto, has been appointed to encourage the use of the NMR facilities by the biological schools.

Photo: Darren Boyd, Coombs Photography

Dr Max Keniry with the new NMR spectrometer

Best poster award for ANU chemistry researcher



Dr Sherry Mayo of the ANU's Research School of Chemistry beside her prize-winning poster at a recent crystallography meeting in Seattle

ANU gains top marks in ranking of uni research

AUSTRALIAN 21-8-96

By MADELEINE COOREY

THE Australian National University is Australia's top performer, a new survey shows.

A survey by the prestigious American-based Institute for Scientific Information, rates ANU and the University of Melbourne as the two best producers of research in the country, as measured by the number of times its research is cited in specialist journals.

The rankings of 26 Australian universities, are based on the ISI's database of citations in journals from 1990 to 1994.

The survey measured the universities' performances in 21 academic fields by impact of research (measured by average citations per paper produced by the university) and by total citations.

Published in the ISI's newsletter, Science Watch, the survey found ANU and its research wing, the Institute of Advanced Studies — which was included in the ANU count — were particularly strong in the physical sciences.

ANU was ranked in the top three research universities in 14 of 21 fields by impact and in 11 fields in the total citations.

While ANU dominated the physical sciences, Melbourne University had a similar profile in the life sciences.

Melbourne was ranked top in impact and total citations in immunology, microbiology, biology and biochemistry, molecular biology, neuroscience and pharmacology. It also topped the total-citations in clinical medicine.

The University of Sydney was named in the top three in 14 fields in total citations and mentioned in four fields in the impact figures, capturing the top spot in the ecology/environmental sciences.

The University of NSW was ranked in the top position for impact in mathematics and in the best three in six other fields. For total citations it was ranked first in psychology/psychiatry.

In the impact measure — where smaller universities can compete on a more level playing field with larger institutions — Adelaide's Flinders University topped medical science; Sydney's Macquarie University, psychology, psychiatry; and Melbourne's Deakin University, education.

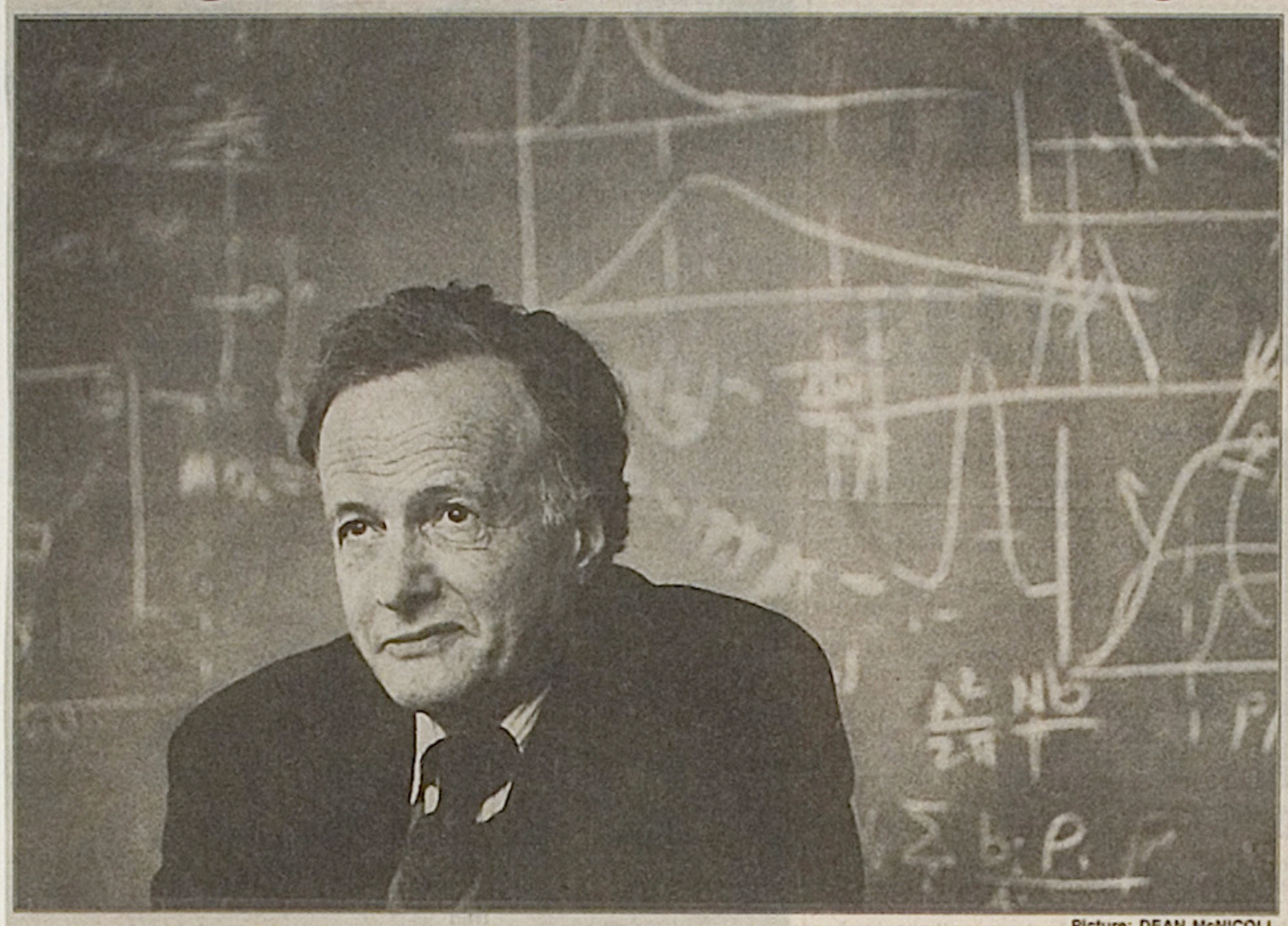
Professor Paul Bourke, of the Research School of Social Science at ANU, said the figures presented a snapshot of Australian research universities which was broadly accurate.

Professor Bourke said some of the smaller universities like Flinders and Deakin had strengths in niche areas which came out in the research.

Science Watch also did a survey of the overall impact of universities' research in all fields from 1981 to 1994. In this, the IAS scored the highest with an average of 12.89 citations per paper.

Higher Education starts — Page 29

Budget axe may fell intellectual giants: academic



Picture: DEAN McNICOLL

University of Toronto Professor John Polanyi . . . warned that excessive Budget cuts could lead to a knowledge deficit.

By CHERYL JONES,
Science Reporter

A visiting Nobel laureate has warned that a "panicky" response to the Budget deficit could lead to a knowledge deficit or shackle scientists to industry.

Professor John Polanyi, of the University of Toronto, said concern by governments world-wide about budget shortfalls was understandable.

"The fear that I have is that in remedying the Budget deficits in a panicky sort of way, they will create a different sort of deficit — a deficit in which you expend intellectual capital without replenishing it."

The comments come amid angst about cuts to research and higher education funding as the Federal Government moves to tighten fiscal policy.

Professor Polanyi, whose visit was sponsored by the ANU and the Academy of Science, said there were parallels between Australia and Canada.

"My greater concern is . . . that the money that is spent on basic science may be constrained in a way that is very damaging to excellence in basic science. There may be a panicky attempt to get the university science community . . . to respond to the current needs of Australian industry." That would deliver short-term gains only.

Professor Polanyi's research on the molecular motions in chemical reactions earned him the Nobel Prize in 1986. The work spawned a new generation of lasers — worth billions of dollars — based on the vibrational excitation in molecules. It also gave rise to new methods of chemical extraction. The commercial potential was unforeseen when Professor Polanyi embarked on his pure research.

He will deliver a public lecture at the Academy of Science Dome today.

ANU Reporter Nov 28-1996.

ARC Fellows Awards

The Australian National University has maintained its position as the pre-eminent host institution in Australia for ARC Fellows. Of the 100 new awards announced this month from over 800 applications, 23 were made to researchers who wish to work at the ANU.

Australian Senior Fellowships
Dr M T Batchelor, Science, Exactly solved lattice models and pattern formation in statistical physics. Dr H Morphy, Arts, Multi-perspective Biography of Narritijin Maymurru.

Australian Research Fellowship
Dr M-C Hong, School of Mathematical Sciences, Geometric variational and evolution problems for mathematics and physics.

Queen Elizabeth II Fellowships
Dr BH Andrews, School of Mathematical Sciences, Regularity theory, limiting behaviour, and applications of geometric evolution equations. Dr R Gore, Research School of Information Science and Engineering, Proof theoretical investigations of computer science logics. Dr R G Heinsohn, Science, Unique co-occurrence of cooperative breeding, reverse plumage dimorphism and biased sex allocation in eclectus parrots. Mr D C MacDougall, Arts, Reconsidering visual anthropology: Towards a theoretical framework for anthropological visual research. Dr E Wenger, Science, Early transition metal acetylides and related MxCn complexes. Dr G J Stuart, John Curtin School of Medical Research, Active properties of neocortical pyramidal neuron dendrites and their role in synaptic integration in the cortex.

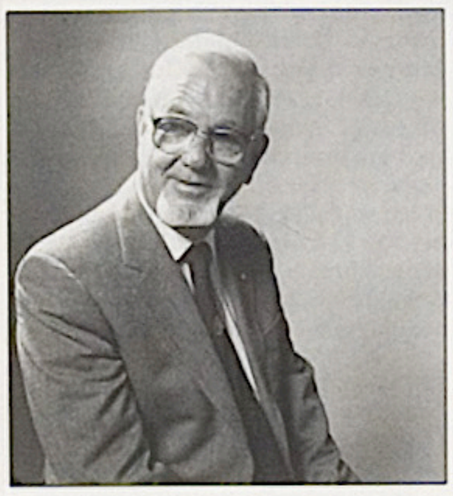
ARC Collaborative Grants
Dr S Roberts, Science, ACTEW, Catastrophic flooding in urban areas. Dr P Bayne, Law, Administrative Appeals Tribunal, The law of the AAT – an analytical and critical review.

Australian Postdoctoral Fellowships
Dr A J Berry, Research School of Earth Sciences, Speciation of Metal Ions Responsible for Ore-Metal Transport at Elevated Temperatures and Pressures. Dr F R Bongiorno, Arts, Bernard O'Dowd and Australian culture: A biographical study. Dr S E Brown, Research School of Chemistry, Structure and function of the bacterial DnaB helicase. Dr F D Bulbeck, Arts, Origins of complex society in South Sulawesi. Dr G Chelvanayagam, John Curtin School of Medical Research, Methods for matching protein sequences to known protein fields. Dr R M Eves, Arts, Christianity, fundamentalism and identity in the Pacific. Dr T D McCarthy, Research School of Chemistry, Reaction of nitrile oxides with chiral allylic amines and application to the synthesis of biologically important molecules. Dr M Onishi, Arts, Papuan languages of southern Bougainville. Dr M W Ramsey, Science, Ecology and evolution of dioecy in Wurmbea (Lileaceae). Dr R K Schmidt, John Curtin School of Medical Research, Hybrid quantum mechanical and molecular mechanical studies of the reaction mechanism of lactate and malate dehydrogenases. Dr T J Senden, Research School of Physical Sciences and Engineering, Correlational methods in Force Microscopy. Dr Y Tabira, Research School of Chemistry, Metal atom and oxygen vacancy ordering in non-stoichiometric zirconia-containing pyrocholres. Mr H H Tan, Research School of Physical Sciences and Engineering, Ion beam processing of vertical-cavity-surface-emitting lasers. Dr S Zhang, Research School of Earth Sciences, An experimental study of overpressurized fault fluids and earthquakes.

Australian Postgraduate Awards (Industry)
Dr M Barwell, RSC, Dunlena Pty Ltd, The total synthesis of Herboxidiene. Dr I Campbell, Dr J Palin and Dr R Loucks, RSES, Kalgoorlie Consolidated Gold Mines, Origins and Composition of Ore-forming Fluids in the Giant Golden Mile gold deposit, Kalgoorlie, WA. Drs A Cuevas and Dr A Blakers, Engineering, FEIT, Solahart Industries, Development of a 20-30 sun silicon photovoltaic concentrator cell for a photovoltic trough. Dr C Easton, RSC, McFarlen Laboratories Pty Ltd, Stereospecific Synthesis and Evaluation of 24-Hydroxysteroids. Dr R Loucks, Dr I Campbell and Dr J Palin, RSES, BHP Pty Ltd, Stability of Receding-horizon control laws. Dr J Love, Optical Sciences, RSPhysSE, AOFR Pty Ltd, Planar Optical Devices for Wavelength Division Multiplexing.

Number 31, January–March 1996

Arthur Birch



Arthur Birch, one of Australia's finest organic chemists and a former President of the Academy, died in Canberra on 8 December. He was 80 years old.

Born in Sydney, he coasted through his primary school years at Woollahra Primary in the eastern suburbs, soon discovering a taste for geology and chemistry. Along with his school friends, Birch would make crude explosives which they used to extract fossils from quarries and cliffs around Sydney. After graduating from the University of Sydney with first-class honours and the university medal in organic chemistry, he took up a scholarship to Oxford where he worked with Robert Robinson. There he gained his doctorate in 1940.

As his father was dead, he took his mother with him to Oxford where he cared for her for 10 years. He married her district nurse, Jessie, in 1948.

He held senior positions in Cambridge, the University of Sydney and the University of Manchester before taking up the challenge of establishing a research school of chemistry at the ANU. This imaginative concept was supported by Sir Robert Menzies, the Prime Minister of the time, and industrial and academic leaders. Birch became the first dean of the school in 1967, and retired as Foundation Professor of Organic Chemistry in 1980. His contribution as co-founder of the school (with Professor David Craig) was recognised on Birch's eightieth birthday with a ceremony to mark the naming of the Arthur Birch Building.

More than 400 publications document his contribution to the fields of organic chemistry and biochemistry.

Birch's research has given new dimensions to the art of organic and organometallic synthesis, and to the understanding of the structures and origins of natural products. He was responsible for formulating a procedure, known as the 'Birch reduction', which is now one of the most used procedures in synthetic organic chemistry. His research has formed the foundation for the manufacture of important drugs such as oral contraceptives and antibiotics used in human chemotherapy.

Not only did Birch contribute to the science world through his research, he also contributed to the formulation of science policy and administration. As chairman of the 1977 Independent Inquiry into the CSIRO, he proposed radical changes to the structure of the organisation, many of which were taken up by the government. Other eminent appointments include founding chair of the Australian Marine Sciences and Technologies Advisory Committee, consultant for an extended period to a UNESCO Development Program project, president of the Australian Academy of Science and president of the Royal Australian Chemical Institute. In 1994 he was given the rare distinction of honorary fellowship of the Royal Australian Chemical Institute.

Birch achieved wide recognition for his work, both from scholars and from the government. As well as being a Fellow of the Australian Academy of Science and the Royal Australian Chemical Institute, he was a Fellow of the Royal Society and the Royal Institute of Chemistry. He received honorary doctorates from the universities of Manchester, Sydney and Monash, and many medals and awards from around the world. He was a Companion of the Most Distinguished Order of St Michael and St George, and Companion of the Order of Australia.

He remained active in his retirement, even at the age of 79 travelling to India to discuss new research ideas with students. His professional autobiography, *To See the Obvious*, was published just before his 80th birthday.

According to Professor Rod Rickards and Emeritus Professor David Craig, 'His was an extraordinary talent.'

Bobbie Fenner

After a long fight against cancer, Mrs Bobbie Fenner died shortly after Christmas.

Ellen Margaret Bobbie Fenner, ARRC, OAM, was born in Ravensthorpe, in Western Australia, on 5 May 1911. She trained as a nurse and, after enlisting in the Australian Army, served with the 2/2 Australian General Hospital in the Middle East and in Queensland. In 1945 she was decorated as Associate of the Royal Red Cross for her work in charge of the blood transfusion unit. She worked as a scientific officer in Cairns, carrying out direct blood transfusions on volunteers who had been infected with malaria, examining blood slides and dissecting mosquitoes.

It was while working on malaria that she met Frank Fenner, who had been pathologist at the 2/2 Australian General Hospital. After discharge from the forces in November 1945, Bobbie worked with Frank as an unpaid technical assistant at the Walter and Eliza Hall Institute in Melbourne. They moved to Canberra in 1952.

Bobbie devoted much of her spare time to charities and, in 1980, her community work was recognised by an Order of Australia Medal.

Each year, from 1984 onwards, she made generous donations to the university for the promotion of medical research and for providing amenities in Fenner Hall, and to the Academy for annual conferences on environmental problems.

To many, however, she will long be remembered as a most loving friend, and, in the words of a one-time neighbour, 'a shining example of what kindness and generosity are about'.

Bobbie and Frank Fenner

1997

Andy McMurray

60th Birthday

1997

24-12-97

Conferring of
Honorary D.Sc.
at l'Université
de Bordeaux.
Extract from
"Ouest-Sud"
Sept – 1997

CHIMIE

Nobel et les docteurs

Tapis rouge à Bordeaux 1 pour faire deux illustres chimistes étrangers docteurs honoris causa. Et entendre le Nobel 87, Jean-Marie Lehn jongler avec les supramolécules

Les deux professeurs américain et australien docteurs honoris causa *(photo Michel Lacroix)*

Au livre d'or des docteurs *honoris causa* de l'université de Bordeaux ex-sciences et droit, le Général de Gaulle figure sur la page de garde. Depuis, l'honorable bouquin s'est allongé de centaines de signatures illustres. L'encre des deux dernières en date est tout fraîche et trace les noms d'Alan Sargesson et Sydney Abrahams.

Au commun des mortels, ces patronymes sont indifférents mais pas pour les chimistes, qui savent ce que l'Australien a apporté à la science des assemblages moléculaires et ce que l'Américain a fait dans le domaine des nouveaux matériaux, en particulier les céramiques. Ils savent aussi — surtout les Bordelais — la profondeur des liens scientifiques que les deux chercheurs de Canberra et de l'Oregon College ont tissé avec la fac de Bordeaux.

C'est à Jean Ravez, pilier de l'ICMCB (Institut de chimie de la matière condensée de Bordeaux), qu'est revenu le soin de prononcer l'éloge d'Abrahams : un chimiste du solide avec lequel le chercheur bordelais a vécu une riche aventure de découvreur de nouveaux matériaux : une bonne quarantaine dit-on... Il fut imité par son collègue Didier Astruc : ce prof de chimie organique s'est chargé de montrer l'apport de son ami Sargesson dans les assemblages supramoléculaires, voie illustrée — ô combien ! — par l'autre grand invité de la matinée, Jean-Marie Lehn, prix Nobel de chimie en 1987.

« WALT DISNEY CHEMISTRY »

Avant que cet illustre membre du Collège de France ne prenne la parole pour la conférence de clôture de ce congrès de la Société française de chimie (SFC), le président de Bordeaux 1, Michel Combarnous, a remis officiellement aux nouveaux membres dans la confrérie des « *honoris causa* » l'épitoge en hermine, une médaille et un diplôme.

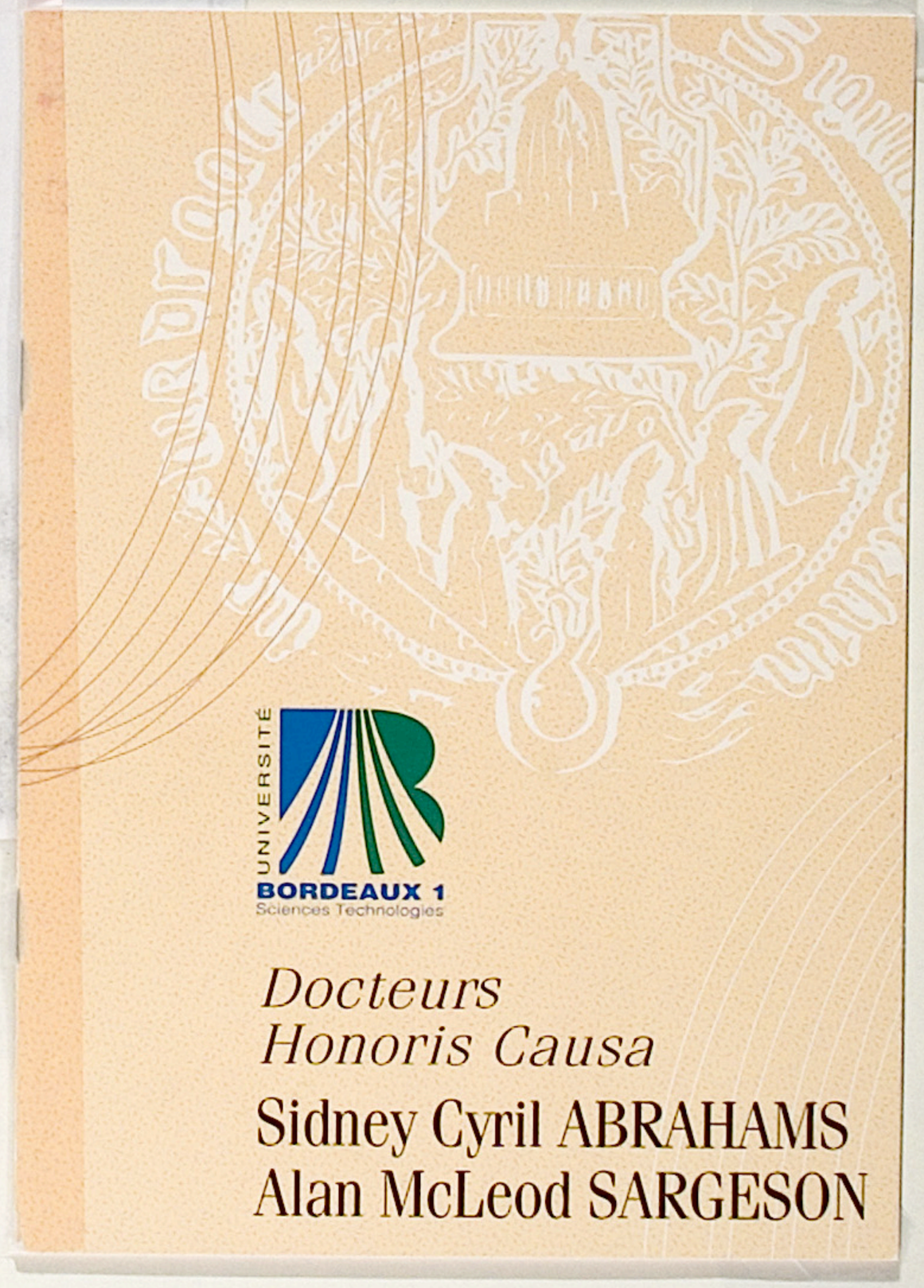
Si Jean-Marie Lehn n'a pas eu droit cette fois-ci aux honneurs de l'hermine, on se souviendra que le prix Nobel avait il y a peu goûté en Gironde aux charmes de l'intronisation dans une autre confrérie, celle des Hospitaliers de Pomerol. Hier, c'est à un exercice plus austère que le chercheur alsacien s'est livré — avec brio — en dévoilant les secrets des systèmes supramoléculaires.

Conscient que la science passe aussi par les images, le prix Nobel 87 n'a pas hésité à sacrifier à ce qu'il appelle « *la Walt Disney chemistry* », c'est-à-dire le recours fréquent à des croquis évocateurs des brins, hélices, briques, bref, des structures de ces « *molécules qui dansent la ronde en se tenant par les ions* », pour reprendre son expression.

XXIe SIÈCLE

Sur le fond, c'est à un exposé d'une grande précision que M. Lehn s'est livré. Il avait en face de lui tout ce que la chimie française compte de spécialistes installés et de futurs chercheurs, réunis — comme tous les trois ans seulement — par la SFC. Le choix de Bordeaux — pôle majeur en France avec son éventail de huit labos couvrant toute la surface de la chimie — ne tenait pas du hasard.

A ce parterre de choix, Jean-Marie Lehn a répété une de ses certitudes : le XXIe siècle sera peut-être celui de la biologie, mais la chimie aura toujours son rôle à jouer, notamment par sa capacité à imiter les processus biologiques. Ce qui conduit ce scientifique à prédire un effacement des frontières entre ces deux disciplines...



Opening of Bramleys - Barbecue

Birch Lecture - 1997

Prof John White + Peter Day

Lesley Harland, Matthew Livingston, Hugh McGlinc

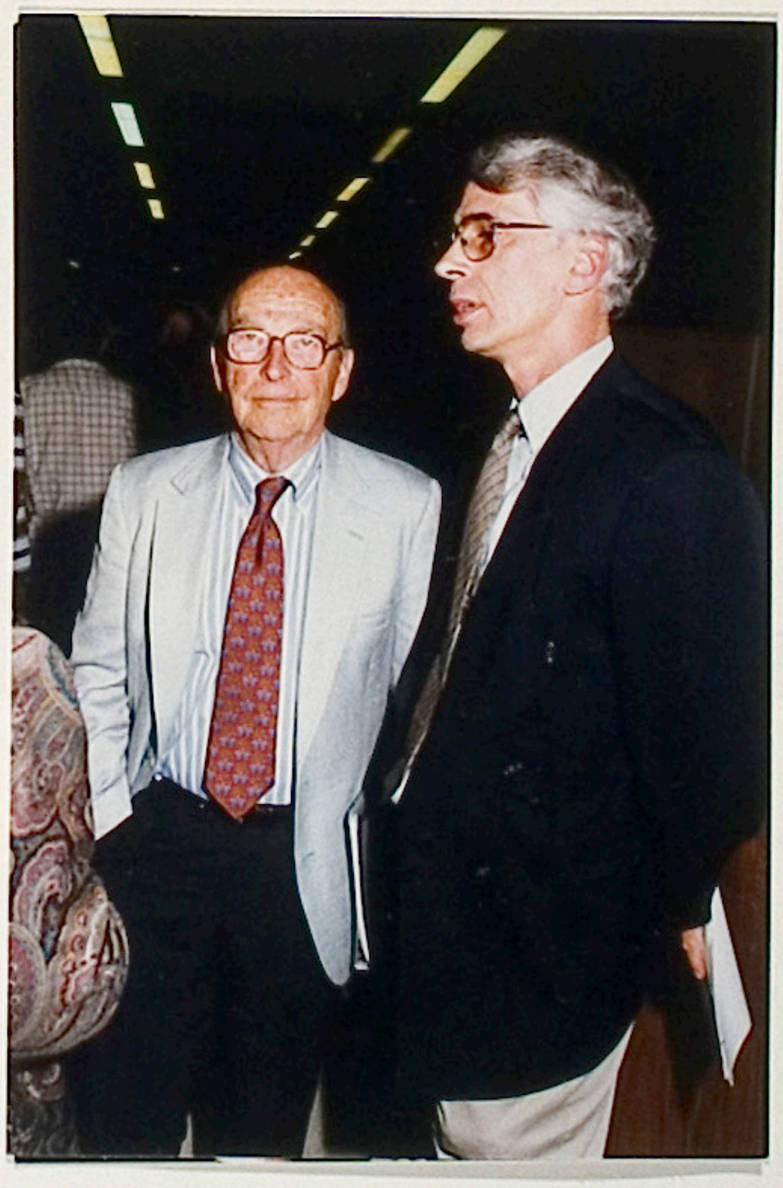
David Rae, Peter Day, Ben Selinger, Elmars Krausz

Birch Lecture -1997

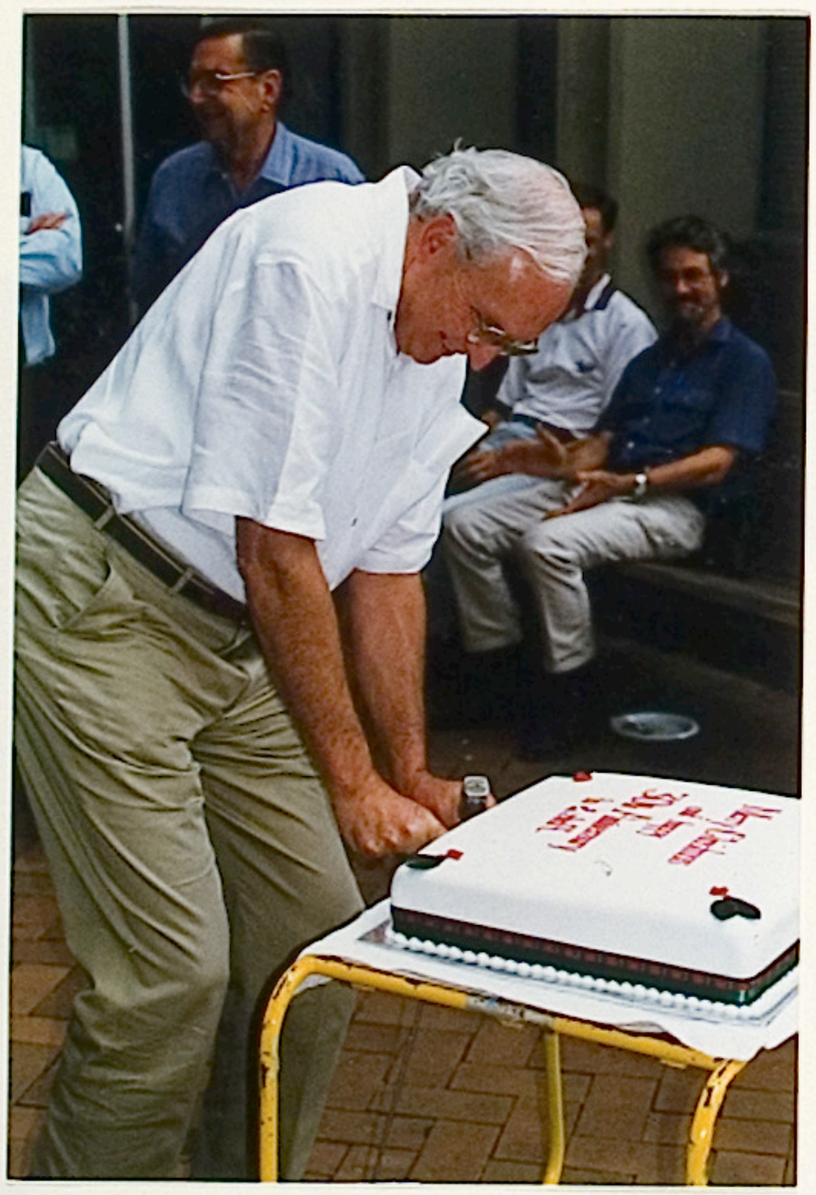
Prof John White + Peter Day

Lesley Harland, Matthew Livingston, Hugh McGlinc

David Rae, Peter Day, Ben Selinger, Elmars Krausy

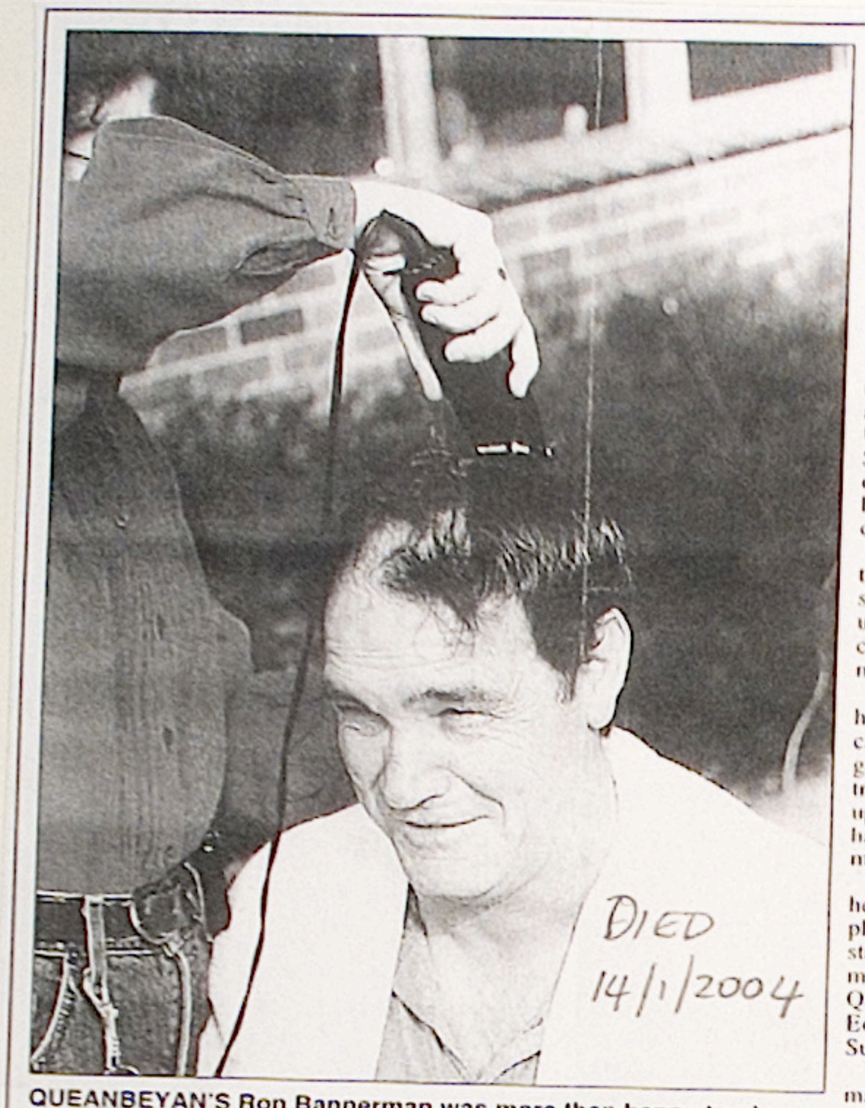


1997 CHRISTMAS PARTY



Staff Raising Money for Cancer Research

May 1998



QUEANBEYAN'S Ron Bannerman was more than happy to give up his luscious locks to raise more than $1000 for kids with cancer last month.

A cut for cancer

WHILE most men dread going bald, one Queanbeyan resident is more than happy to sport a bare head around town.

Of course, it's all for a good cause.

Last month, Queanbeyan resident Ron Bannerman, a security officer at Australian National University's Research School of Chemistry, decided he wanted to do his bit for kids with cancer.

He sent out a challenge to students and staff of the school, promising to go under the razor if they could sponsor him enough money.

Naturally, the kind-hearted staff and students came through with the goods, while two chemistry teachers agreed to give up some of their facial hair in a bid to raise even more money.

The much anticipated head and face shave took place on May 19, with staff and students raising more than $1050 for the Queanbeyan-based ACT Eden Monaro Cancer Support Group.

We hope Mr Bannerman has an endless supply of woollen beanies for those forthcoming winter nights!

Staff Raising Money for Cancer Research

May 1998

ast month.

A cut for cancer

WHILE most men dread going bald, one Queanbeyan resident is more than happy to sport a bare head around town.

Of course, it's all for a good cause.

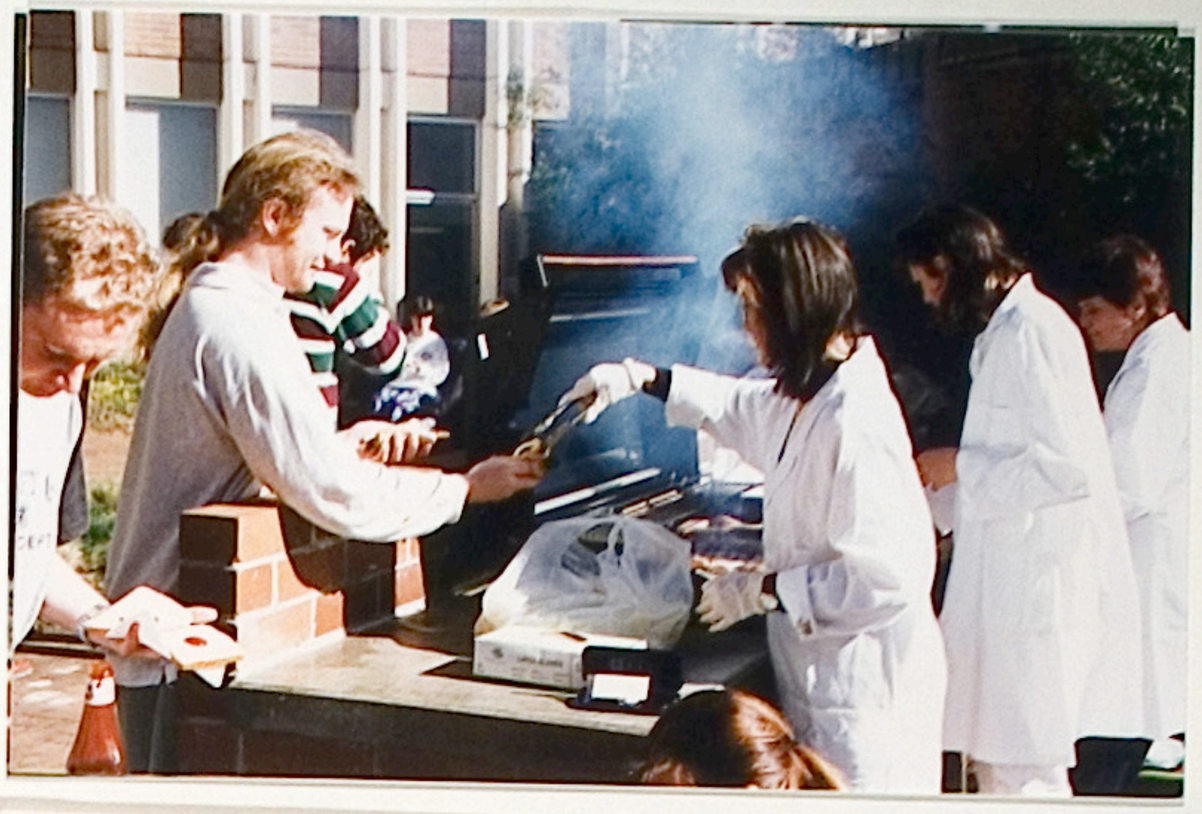
Last month, Queanbeyan resident Ron Bannerman, a security officer at Australian National University's Research School of Chemistry, decided he wanted to do his bit for kids with cancer.

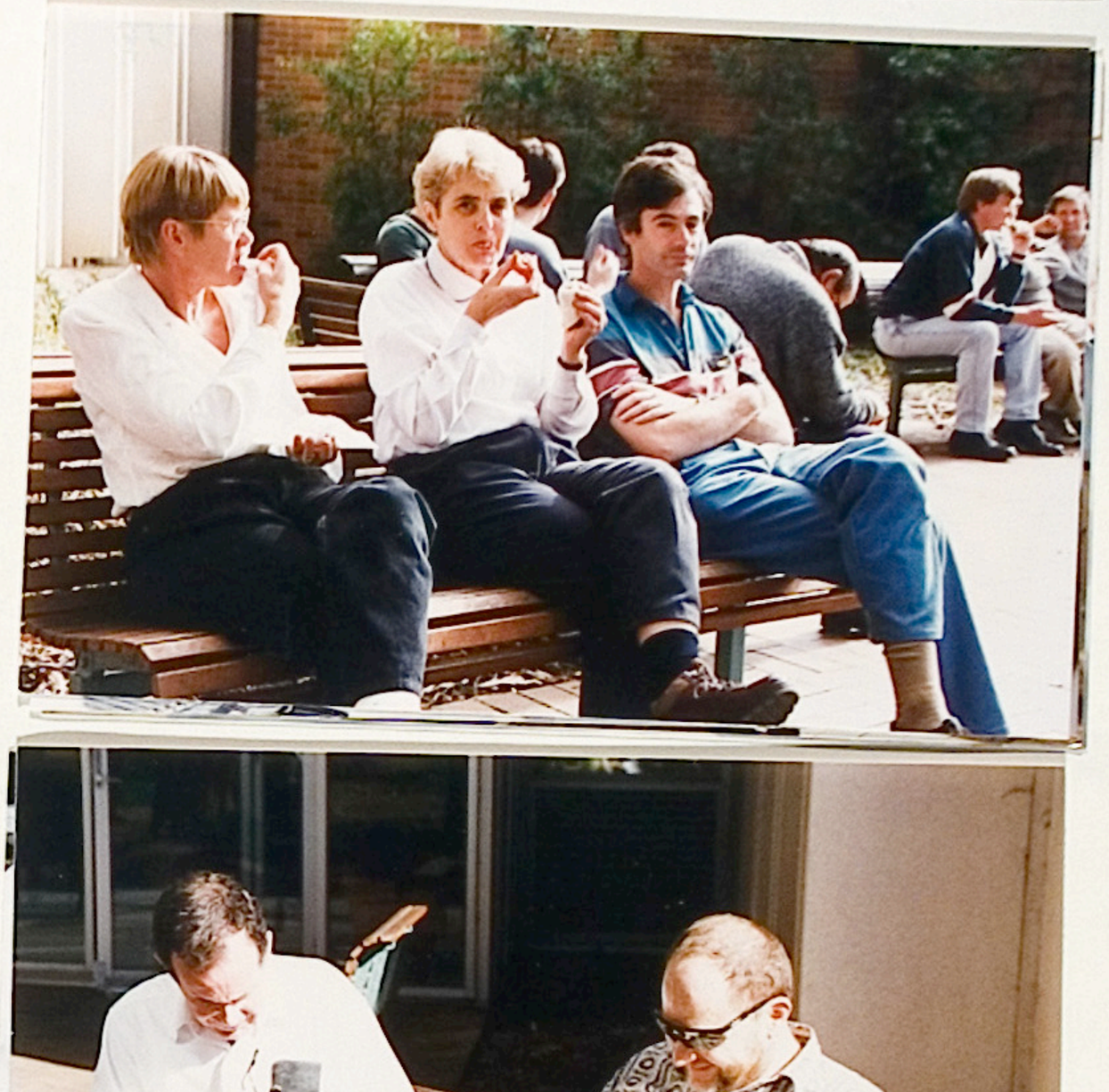
He sent out a challenge to students and staff of the school, promising to go under the razor if they could sponsor him enough money.

Naturally, the kind-hearted staff and students came through with the goods, while two chemistry teachers agreed to give up some of their facial hair in a bid to raise even more money.

The much anticipated head and face shave took place on May 19, with staff and students raising more than $1050 for the Queanbeyan-based ACT Eden Monaro Cancer Support Group.

We hope Mr Bannerman has an endless supply of woollen beanies for those forthcoming winter nights!





1998

May 1998
Money Raising
for Cancer

1997
Xmas Party



8







May 1998
Money Raising
for Cancer

1997
Xmas Party

1998 CHRISTMAS PARTY

Farwell to Margot Anderson

Thankyou to Peta Simmonds + Carol Jacob - Social Club

US-based scientists come out on top in Nobel prizes

THREE quantum physicists and two quantum chemists won Nobel prizes last week for discoveries about the building blocks of matter.

The awards confirmed the dominance of American science — all work at institutions in the US.

US physicists Robert Laughlin and Daniel Tsui and German scientist Horst Stoermer shared the 1998 Nobel prize in physics.

Austrian-born Walter Kohn and Briton John Pople shared the 1998 Nobel prize in chemistry.

The two prizes, awarded by the Royal Swedish Academy of Sciences, were each worth 7.6 million crowns ($1.56 million).

Laughlin, Tsui and Stoermer won for their work on how electrons behave in magnetic fields, a branch of particle physics that has already yielded a rich crop of Nobel prizes.

Their discoveries in quantum mechanics — the rules by which minute particles such as electrons move — were significant for the miniaturisation of electronic products.

"This discovery could be a breakthrough in the barrier that limits the smallness of computers, televisions and mobile phones," said Anders Barany, associate professor of theoretical atomic physics at Stockholm University.

"This could be the micro-electronics of the next century."

Laughlin, a professor at Stanford University, said their discovery probably did not have a practical application that would produce a new gadget, "but the main utility for a discovery is in a sense a knowledge base for discovering bigger things like what happens in the universe".

Kohn and Pople, described by the academy as the two most prominent figures in the enormous theoretical and computational developments that were revolutionising chemistry in the final years of the century, made it possible to model new chemicals in a computer as an alternative to chemical experiments.

Kohn's theoretical work formed the basis for simplifying the mathematics in descriptions of the bonding of atoms, a vital precondition for many of today's calculations, the academy said.

Pople, a leading figure in using the computer for chemistry, developed the entire quantum-chemical methodology now used in various branches of chemistry.

Pople lectured in the Australian National University's research school of chemistry in 1982 and has been a visiting professor on nine occasions. He and the school's Professor Leo Radom are co-authors of some 50 publications.

The work that won the Nobel for chemistry has applications from pharmaceuticals — seeing how a new drug would work — to the environment.

The research areas honoured by the prizes are connected.

Astrid Graslund, professor of biophysics at Stockholm University, said: "[Kohn] is a physicist by profession and his theory has had fundamental importance also for the physics of condensed matter, which is precisely the field where the physics prize was given."

Stoermer, born in Frankfurt, is a professor at Columbia University. Tsui was born in Henan, China, and is at Princeton.

Kohn, born in Vienna, works at the department of physics at the University of California Santa Barbara, where he headed the Institute of Theoretical Physics from 1979 to 1984.

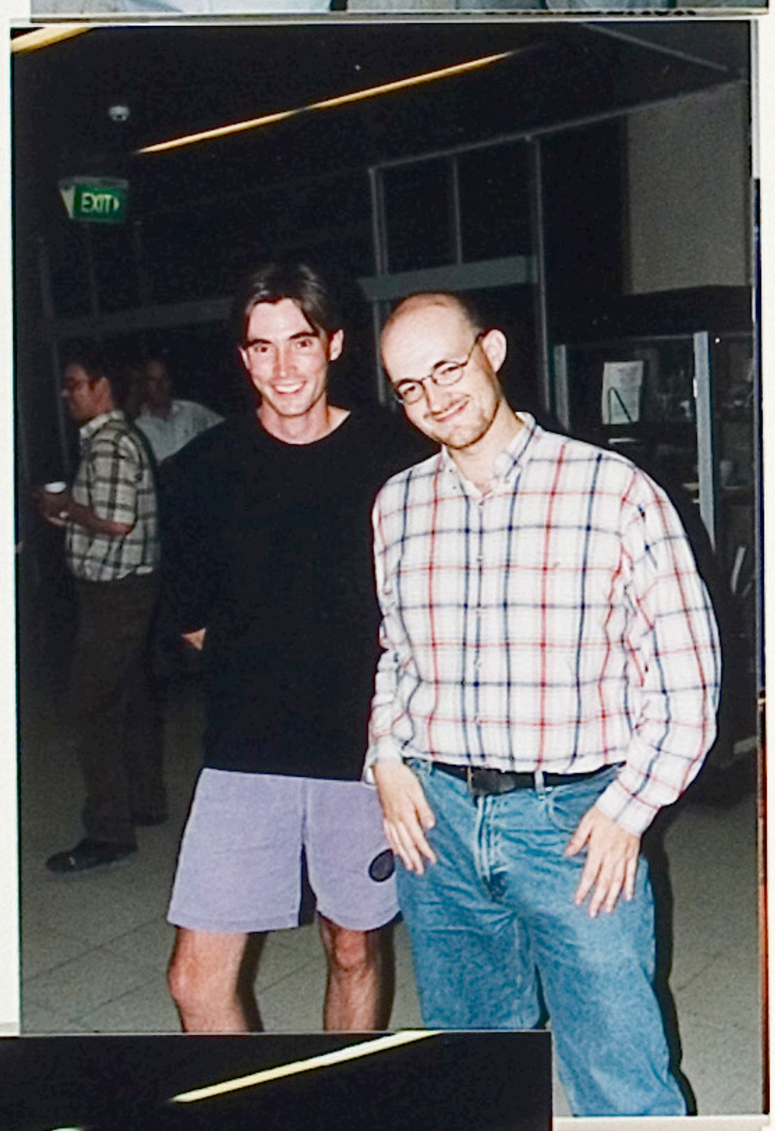
The English-born Pople, who is also a physicist, has been professor of chemistry at Northwestern University in Chicago since 1986.

❑ Reuters

1999 BIRCH LECTURE

PROFESSOR HUBERT SCHMIDBAUR

1999 BIRCH LECTURE



ANU REPORTER
10 MARCH 1999

World renowned research centre at crossroads

Chemistry is a creative discipline that touches everyone in their daily lives. Everything we see and touch in our daily activities is made of chemicals. We wear them; eat them; in fact we are chemicals. Chemistry is more than the study of how to create these molecules, it also concerns the properties of these molecules. There can be little general interest in a virtuoso synthesis of a compound if that compound has properties that are mundane or of no possible interest.

The mission of the Research School of Chemistry (RSC) is to conduct research and research training in chemistry at the highest international standard. The School, founded in 1967, has established itself as one of the world's leading centres for chemical research. In 1992, the US magazine *Science Watch* ranked ANU 45th in the world on the basis of citations per paper in chemistry. In the same year, RSC was ranked 8th in the world for organic chemistry, and 24th in the world for physical chemistry. For six months during 1998, the most highly cited chemistry paper worldwide was written by two members of RSC. Although one can argue interminably about the precise meaning of citation data such as these, it is clear that chemical research carried out at the ANU is having an international impact.

The orderly development and planning of School activities has recently been upset by government funding cutbacks (appoximately 12 per cent over three years) and inadequate supplementation of both cost of living rises and the depreciation of the Australian dollar. While the recurrent RSC expenditure has apparently risen year by year from $5.5 million in 1981 to $11 million in 1998, in fact when expressed in constant 1990 Australian dollars, the RSC budget has shrunk from some $11.3 million in 1980 to $9.7 million in 1997 — a decline of 16%. This decrease in real funding has been exacerbated by the depreciation of the Australian dollar against major foreign currencies — it is only worth 55 per cent of its 1981 value in US dollar terms.

Under the pressure of reduced recurrent funding, the School has made vigorous and successful efforts to increase the level of support from non-recurrent external sources. Although corporate support of basic research can augment government funding, it should never be a substitute for government funding. As US Congressman Vernon J. Ehlers said in a congressional address on 22 April 1998; "While it is clear that [in the US] industry does fund a substantial amount of basic research, and that the federal government should continue to fund research of a more applied nature, because the results of industrial basic research are almost always proprietary, the federal government has an irreplaceable role to play in generating new knowledge that is available for widespread dissemination". This generation of new public knowledge is one of the core missions of universities in western society.

The Research School of Chemistry, the ANU and university research throughout Australia is at a crossroads. We have just managed to absorb the last round of unfunded salary rises and cutbacks — in the process reducing staff numbers proportionately. If there is another round of cost cutting similar in magnitude to the last, tertiary research will suffer disastrous, long-term damage. The tragedy is that those in power do not seem to even vaguely understand the gravity of the situation that they have created.

Professor Denis J Evans
Dean, Research School of Chemistry

New PhD study may aid asthma sufferers

Studies by a PhD student at RSC have identified a number of enzyme inhibitors which could help sufferers of asthma and hypertension.

Ms Ling Xia, currently completing her doctorate under Dr Chris Easton in the Biochemical Reactions and Molecular Recognition Group at RSC, is looking at ways of inhibiting enzymes involved in fatty acid metabolism.

In particular, she is examining the processes where fatty acids are converted into moderators of physiological activities.

"Fatty acids metabolites such as prostagladins and leukotrienes can cause physiological responses like hypertension, asthma and allergic response," Dr Easton said.

"But at the same time they also have important biological functions."

"The initial enzymes involved in the synthesis of these metabolites are called lipoxygenases," Dr Easton said.

"Altogether there are six lipoxygenases. The idea is to selectively inhibit just one of them, because one will be associated with a particular disorder."

Ms Xia designed, synthesised and tested 15 compounds, and found three to be quite good and selective inhibitors of three specific lipoxygenases associated with asthma, hypertension and the control of metabolic rates.

This research is part of an ongoing project looking at various aspects of lipid metabolism in collaboration with the Adelaide Medical Centre for Women and Children.

"Indications are that these compounds are also effective in preclinical assays," Dr Easton said.

TERESA BELCHER

Researchers seek to discover secrets of plant photosynthesis

BY TERESA BELCHER

A group of four researchers from the ANU is working to unveil the mystery behind the structure and function of Photosystem II, the pigment/protein complex central to the operation of green plant photosynthesis.

Dr Elmars Krausz of the Research School of Chemistry, Dr Tom Wydrzynski of the Research School of Biological Sciences and Drs Ron Pace and Gad Fischer from the Chemistry Department in the Faculty of Science recently received an ARC Grant to undertake "Multispec-troscopic Studies of Photosystem II".

Photosystem II is the oxygen-evolving site of a plant. "The grant has been awarded to use a variety of spectroscopic techniques to investigate the fundamental reaction — the catalytic formation of oxygen from water," said Dr Pace. "To understand how this system works has been described as one of the great remaining challenges in modern-day biophysics."

"This research provides an unique opportunity for ANU to pursue an area of study on this very important enzyme in which we have a jump on the rest of the world. This is due to the successful preliminary work we have done here and also because of the unique sensitivity of the instrumentation which we are using," Dr Pace said.

A recent two-day meeting in Sweden sponsored by the Nobel Foundation, and attended by Dr Pace, identified what is currently understood about Photosystem II and what experiments need to be undertaken to further the knowledge.

"Certainly one of the things that came out of that meeting was the necessity to use a multi-spectroscopic approach," Dr Pace said.

Work will soon begin here on investigations using a newly applied spectroscopic probe — Magnetic Circular Dichroism (MCD). "This will enable us to more precisely investigate the oxygen-evolving centre and its structural organisation. The centre contains a cluster of four manganese atoms and the way in which the chemistry goes on through these manganese atoms is essential to all mammalian life on the planet, for without it we wouldn't be here — we wouldn't have anything to breathe," Dr Krausz said.

Photo: Neal McCracken, ANU Photography

Plant science: Dr Ron Pace (left), Mr Keith Jackman (Senior Technical Officer), Dr Elmars Krausz, Dr Gad Fischer and Dr Tom Wydrzynski stand by the Circular Dichroism Spectrometer.

Photosystem II splits water by a four-step process using light energy from the sun. Each photon of light creates an electron which is then stored in the manganese-containing protein. Once four electrons are accumulated, a catalytic reaction occurs and two water molecules are oxidised to form a molecule of oxygen and four H+ (protons).

"This process involves very highly energetic intermediates that would normally destroy its biological surroundings," Dr Krausz said. "It's like lighting fire in a wicker basket without burning the basket, but plants have solved this problem."

"Investigation into this process also has enormous practical application. If one can find out how to couple the light-driven oxidation of water to hydrogen gas (H2) formation, then there is a massive potential for its use as an energy source," Dr Wydrzynski said. "The burning of hydrogen creates no pollution; since it regenerates back again into water — it is the perfect fuel".

"If you discover that one, you could be richer than Bill Gates," Dr Krausz said.

FACT FILE

Staff and Students
282 people

Research Groups

Inorganic :
- Organotransition Metal Chemistry
- Coordination Chemistry, Kinetics and Mechanism
- Coordination Chemistry and Inorganic Electrochemistry
- New Silicate Materials
- Inorganic Stereochemistry and Asymmetric Synthesis
- Solid State Inorganic Chemistry

Organic and Biological:
- Synthesis and Mechanism
- Synthetic and Bio-organic Chemistry
- Protein Synthesis and Evolution
- Biochemical Reactions and Molecular Recognition
- Nuclear Magnetic Resonance
- Mass Spectrometry
- Organic Synthesis
- Protein Crystallography and Engineering
- Bio-Organic Chemistry
- Biomolecular Simulations and Calculations

Physical and Theoretical:
- Photophysics and Magnetic Resonance
- Theoretical Chemical Physics
- Liquid State Chemical Physics
- Laser and Optical Spectroscopy
- Theoretical Organic Chemistry
- Polymer Chemistry
- Disordered Materials
- Solid State Molecular Science

Groundbreaking study reveals structure of growth factor

By Teresa Belcher

The structure of an unusually active form of Insulin-like Growth Factor I (IGF-I) has recently been determined through groundbreaking research by members of the Research School of Chemistry (RSC).

Leanne Laajoki, a PhD student at RSC, and Dr Max Keniry, Head of the Nuclear Magnetic Resonance (NMR) facility at the ANU are undertaking collaborative research with Dr John Carver of the University of Wollongong and the Cooperative Research Centre for Tissue Growth and Repair to determine the structure of Long-[Arg^3]-IGF-I.

"This research will enhance the already enormous industrial and medical application of these growth factors," Dr Keniry said.

"Knowledge of the structure may lead to the design of new molecules for use in medical applications and biotechnology."

IGFs are a group of proteins that promote cell growth and differentiation. They are single chain polypeptides exhibiting a high degree of sequence similarity with insulin and are found in plasma and most biological fluids.

The structure of Long-[Arg^3]-IGF-I was determined by Nuclear Magnetic Resonance (NMR) techniques.

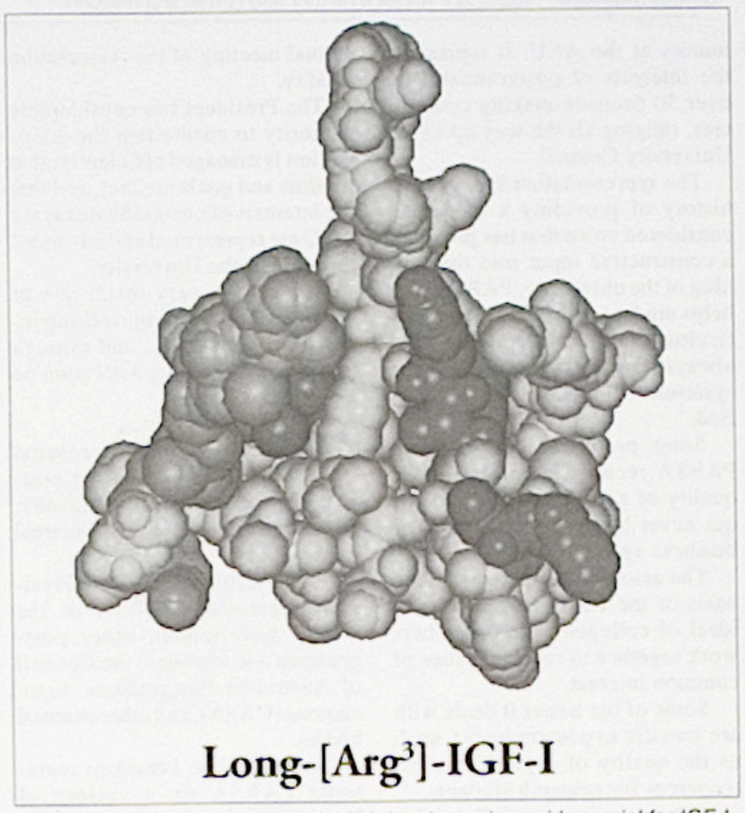
Two- and three-dimensional maps of the characteristic radio frequencies of individual nuclei within the molecule were created by using the high field NMR spectrometer at the University's NMR facility.

A superconducting magnet creates a strong external magnetic field into which the sample is placed and the associated console generates radio frequencies which are absorbed by the nuclei and recorded as peaks.

"The generated peaks are analysed to extract the internuclear distances between protons in the macromolecule," Dr Keniry said.

"All protons have unique characteristic frequencies, and by using sophisticated mathematical techniques such as distance geometry and torsion angle molecular dynamics, a model of the structure can be generated."

"This molecular model will help us to understand the basis for the biological nature of its activity and deduce why it is more active," Dr Keniry said.



A model of an IGF-I analogue highlighting the amino acids crucial for IGF-I receptor binding.

ANU chemistry paper was 'world's most-cited' in 1998

A paper by ANU scientists in the Research School of Chemistry achieved the honour of being the world's most highly cited chemistry paper in 1998.

The publication, by Dr Tony Scott and Professor Leo Radom, achieved the number one rating in the US journal *Science Watch*. Each issue of the bi-monthly journal presents a "What's Hot in Chemistry" list, detailing the 10 papers most highly cited during a preceding two-month period.

The paper, "Harmonic Vibrational Frequencies: An Evaluation of Hartree-Fock, Moller-Plesset, Quadratic Configuration Interaction, Density Functional Theory, and Semiempirical Scale Factors" was published in the *Journal of Physical Chemistry* in 1996. It entered the *Science Watch* list in late 1997 in the number four position, reaching number one by March/April 1998 and maintaining the top position until November/December when it fell to number two.

"The paper is heavily cited because it is very useful in a practical sense," Prof Radom said. "There are now many people working in the area of computational quantum chemistry and they would make use of this paper rather than having to do the research themselves."

Harmonic vibrational frequencies describe how molecules vibrate. This information can then be used to calculate fundamental properties of molecules such as their thermodynamic properties. Prof Radom's group uses computers to predict the vibrational frequencies and thermodynamic properties of molecules.

"Our more general aim is to do chemistry with a computer instead of in the laboratory," Prof Radom said. "This means that we can predict properties of molecules rather than having to measure them."

Prof Radom said that the use of computers could make laboratory work more cost-effective by identifying suitable experiments and eliminating others. This will lead to the efficient design of new pharmaceutical products and other chemicals.

The field of computational quantum chemistry also received major recognition in 1998 with the awarding of the Nobel Prize in Chemistry to Professor John Pople, a long-term associate of the Research School of Chemistry.

"Prof Pople was one of the pioneers in this area, and has been my mentor and colleague for many years," said Prof Radom.

Teresa Belcher

Photo supplied by Prof Leo Radom

Nobel company: Professor Leo Radom (left) with 1998 Nobel Prize for Chemistry winner Professor John Pople at a function in Geneva.

THE AUSTRALIAN NATIONAL UNIVERSITY

FACULTY OF SCIENCE

Review of the Department of Physics and Theoretical Physics

The Vice Chancellor has approved a review of the Department of Physics and Theoretical Physics in the Faculty of Science.

The review is to take place on **29 and 30 March 1999**. The Review Committee, has the following terms of reference:

a) to assess the quality of the department's record in teaching, research, and other contributions to the faculty, the University, and the wider community over the period since the last review;
b) to explore and comment upon the department's understanding of its range, style and objectives and how well that fits with other areas in the faculty and with those aspects of the faculty's strategic planning which are relevant to the review;
c) to provide advice on:
whether the department should continue, and if so whether it should continue in its current form;
whether there are changes that should be made in the direction of the department;
whether there are other changes that should be made in order to increase the effectiveness of the department.

Persons wishing to make submissions to the Review Committee may do so in writing to the Secretary of the Committee, Ms Jan O'Connor, Faculty Secretary, Science, or by email to: jan.oconnor@anu.edu.au, or by fax: (02) 6249 0102.

The deadline for submissions is Monday 22 March 1999.

Submissions will be treated confidentially during the review process but respondents should be aware that after the release of the review report, submissions, including the names of the authors of the submissions, may be made available on request to interested persons.

Research methods win peer approval

ANU researchers investigating non-conventional methods to identify protein structure faired well at a recent conference comparing methods.

The Protein Calculation Group in the Research School of Chemistry, headed by Dr Andrew Torda, and collaborators including Dr Thomas Huber from the Supercomputer Facility, IT Services, have been working on a program and methods to determine the "most likely" structure for proteins.

The conference, Critical Assessment of Techniques for Protein Structure Prediction (CASP3), held last December at Asilomar, California in the United States, involved nearly 50 groups from throughout the world comparing techniques and results.

An objective assessment revealed that Dr Torda's group performed fairly well.

"Almost everyone who is dabbling with protein structure has got programs which attempt to do this. However, none of the programs or methods (including ours) really work very well," Dr Torda said.

"If you are going to do anything with a protein you really almost always need to have its structure. The trouble is, it is so expensive and slow to go and determine a protein structure. It would be terrific if you could predict the protein structure just based on sequence," Dr Torda said.

The demand for prediction methods is being fuelled by biotechnology companies working in DNA sequencing.

"At the moment there is a massive amount of effort going into determining protein structures by Nuclear Magnetic Resonance (NMR) and crystallography."

Workers with Dr Torda began developing methods that would allow things such as force fields to be built automatically. "By 1995 we applied these force-field building methods to build functions which would help us find protein structures without being bound by the ideas of real physical energies," Dr Torda said.

Proteins, essential to all living organisms, have extremely complex structures. They are built from amino acids and joined in a sequence to form a polypeptide chain. The polypeptide chains twist and turn in a variety of shapes and can also interact, bundle and bond with each other.

There are endless applications for protein structures. For example, structures solved in Melbourne were used to design the influenza drugs in the news last year. Similarly, understanding protein function assists in the use of these molecules as industrial catalysts or in biosensors.

Teresa Belcher

Chemistry head warns of decline in basic research

By Julia Veitch

The Dean of the ANU's Research School of Chemistry (RSC) has warned that tertiary education and research in the country is in crisis.

Professor Denis Evans presented figures to last month's ANU Council meeting that showed staff numbers in the key disciplines of physics, chemistry and mathematics had fallen by almost one-third in all Australian universities over the past five years.

He told Council that the situation was desperate, not just for ANU. He said he was not making apologies for the RSC performance, which had been good by standard measures.

"In 1992 Science Watch rated us in the top 50 chemistry departments worldwide. For six months in 1998 we had the most highly cited research paper in world chemical literature and also a Visiting Fellow associated with the RSC over 20 years, John Pople, was jointly awarded the Nobel Prize for chemistry," Prof Evans said.

But Prof Evans warned that there would be a lag period before the effect of cuts is seen. "The work described in our 1998 citation classic was carried out in 1995 under higher resource levels, so it looks as though world-class chemistry is done with lower support."

According to Prof Evans, the funding reductions result from combined causes: the 6 per cent government cuts across the university sector; the refusal of the federal government to make proper allowance for depreciation of the Australian dollar; and the government's refusal to fund pay increases to the university sector. These reductions have been exacerbated by a shift of the remaining funding by governments and universities from basic research to more applied areas. This trend seems destined to increase if the government's recent green paper on research funding is to be believed.

"Full-time continuing academic staff numbers in chemistry departments in nine major Australian universities declined from 231.4 staff in 1994 to 162 in 1999," Prof Evans said.

Prof Evans said the heads of chemistry in the Universities of Melbourne and Sydney and the University of New South Wales had told him that they were finding it difficult to cover the spectrum of chemistry teaching for undergraduates.

"These problems traverse the entire Australian university sector," Prof Evans said. "Similar staffing cutbacks have occurred nationwide in mathematics and physics, the latter declining 16.5 per cent from 1994 to 1997. In mathematics, losses are 20 per cent..

"Increasing our level of external funding doesn't solve the problem. The proprietary nature of most corporate research is completely different in character to traditional university research. For example the fruits of commercial-in-confidence research are not available for public dissemination or even for departmental seminars. Corporate support of basic research can augment but not replace government funding, as the generation of new public knowledge is one of the core purposes of universities in developed societies.

"If cutbacks to basic university research are not reversed there will be long-term damage to the nation's intellectual infrastructure, without which a modern prosperous society is not possible. Our competitors in Asia and North America certainly understand this.

"I would like to see the AVCC, Business Council of Australia and the community push for a commitment to basic research and education," Prof Evans said.

VOL 30 NO:13 WED 1st SEPT 99

HIGHER EDUCATION

Depletion rate bodes ill for chemistry

PATRICK LAWNHAM

MORE staff losses are expected at top university chemistry departments as the Federal Government's funding cuts threaten the nation's "intellectual infrastructure", according to an Australian National University dean.

Professor Denis Evans, dean of the ANU research school of chemistry, said the trend seemed destined to continue under policies proposed in the Green Paper on research.

Similar staff cuts had occurred nationwide in physics and mathematics, said Professor Evans, whose school is rated as one of the world's leading chemistry institutions.

"No modern society is possible in the absence of [university] schools, somewhere in the nation, that are capable of teaching the broad, fundamental curriculums of chemistry, mathematics and physics," Professor Evans said.

"Tertiary education and research is in crisis across this nation."

A survey in 1998 showed a 20 per cent loss of full-time permanent academic positions at mathematical science departments at 26 tertiary institutions since 1995, or almost 129 jobs.

Physics departments at 20 institutions lost 16.5 per cent of full-time permanent staff in 1994-97 , or 51 jobs.

Professor Evans said cuts in full-time permanent staff levels, including researchers, had occurred at all high-ranking chemistry departments since 1994, ranging from 13 per cent at Monash University to 50 per cent at Macquarie University.

His own school had lost 20 per cent, and the ANU's undergraduate arm, The Faculties, had also lost 20 per cent of full-time chemistry academics.

Professor Evans has told the ANU council that the University of Sydney was projecting a further loss of more than 20 per cent in full-time chemistry staff during the next three or four years, after a 35 per cent loss since 1994.

The heads of the biggest remaining chemistry departments — at the universities of Melbourne, Sydney and NSW — were reporting difficulties in covering the entire discipline for undergraduate teaching, he said.

"One cannot imagine how the smaller departments can teach their subject."

Professor Evans said it took 16 years to train a competent university researcher — four years as an undergraduate, four for a PhD, four for postdoctoral research and four to establish a viable research program.

"Who will train the next generation of university teachers and researchers if the current generation of university professors is removed?" he said.

Chemistry departments were vigorously trying to increase external funding, and the ANU research school's industrial collaborations included one with pharmaceutical group SmithKline Beecham that involved new anti-infective agents.

But commercial in-confidence research was not available for teaching or public dissemination, while generation of new public knowledge was a core purpose of universities in western society.

Chemistry's decline

University	1991	1994	1999	decrease
UNSW		43	24	44%
Sydney		40	26	35%
Melbourne	33	30	25	16%
Monash	34	30	26	13%
Queensland	26	24	18	25%
ANU RSC		22.4	18	20%
Macquarie		16	8	50%
La Trobe	22	16	9	43%
ANU Faculties		10	8	20%
Adelaide/Flinders	20		11.6	42%
UNE	9	7	6	33%

Equivalent full-time continuing academic staff in chemistry departments

THE AUSTRALIAN NATIONAL UNIVERSITY

ANU Rep

First, to learn the nature of things

Birdbath algae may help malaria fight

By Julia Veitch

A group of ANU scientists has discovered compounds that may be used to develop drugs to fight malaria and cancer in algae from the birdbath at the Canberra home of one of the researchers.

The group, which includes Dr Geoff Smith and Professor Kiaran Kirk from the Faculty of Science's Division of Biochemistry and Molecular Biology (BaMBi) and Prof Rod Rickards from the Research School of Chemistry (RSC), identified the compounds from a cyanobacterium in algae from Dr Smith's birdbath.

"Cyanobacteria are sources of a variety of pharmacologically active chemicals with antibiotic, antiviral, antifungal, antibacterial, anti-algal and other bioactive properties. Research on them has been increasing over the past 10 years," Dr Smith said.

"My lab team and I screened 200 new strains of cyanobacteria collected from southeast Asia and Australia. We found 20 anti-algal strains of potential use in the development of herbicides."

Dr Smith's laboratory is close to that of Dr Kirk, whose group has had a long-standing interest in the physiology and biochemistry of the malaria parasite.

"Proximity of the Kirk and Smith laboratories led to discussions of the malaria parasite's evolutionary connection with algae and cyanobacteria," Dr Smith said. "For example, the malaria parasite has, like plant cells, a sub-cellular structure called a plastid which probably evolved from an alga or cyanobacterium. We therefore decided to test the 20 strains for their effect on malaria parasites."

The malaria parasite is a single-celled organism that invades the red blood cells of its host. Each year as many as 250 million people are infected by the parasite, with around 2 million people dying from the disease.

"There is an urgent need to develop new anti-malarials as there is increasing resistance by the parasite to treatments presently in use," said Prof Kirk. "The general aim of our work in this area is to obtain detailed knowledge of the physiological and biochemical processes that are important to the parasite, so that we might target these with new drugs."

"When we tested the 20 cyanobacteria that Geoff's group had shown to have anti-algal activity, we found that two of the strains contained substances that were extremely effective at killing the malaria parasite, more so than widely used anti-malarials such as chloroquine."

"We showed that the same substances were equally effective at killing human cancer cells," Prof Kirk said. "This makes it unlikely that they were targeting the plant-like features of the malaria parasite, but it does add another dimension to their potential uses."

The group faced with the difficult task of isolating and identifying the active substances called on Prof Rod Rickards and his colleagues from the RSC to help define their molecular structures.

"Determination of the exact molecular structures of the active components of the cyanobacteria was intricate and required the use of different techniques, including mass and nuclear magnetic resonance spectrometry and X-ray crystallography," said Prof Rickards.

"The structures are unique amongst natural products, so we've taken out a provisional patent on them. We now hope to generate interest from drug companies which are able to test the compounds on a variety of target cells," Dr Smith said.

The work was a cross-campus collaboration, involving both the Faculties and the Institute of Advanced Studies, and the researchers emphasised the effort was only possible because of the ANU's unique research environment with specialised but related areas.

The research group included Ms Jenny Rothschild and Dr Anthony Willis from the RSC, and Ms Nola de Chazal, Ms Julie Kirk and Dr Kevin Saliba from BaMBi.

Dr Smith said their project was the sort that was difficult to "sell" for external funding as the outcomes were entirely unpredicted.

The work is to be published in the international journal *Tetrahedron*.

21st October 1999

ANTIPODES Ian Lowe looks at science policy

Basic overhaul needed

RESEARCHERS are on the march over the state of basic science in Australia.

A new report by a parliamentary committee poses serious questions about the future of research. And recent figures showing the effects of budget cuts on science in universities reinforce the committee's concerns. Now the scientists themselves are planning to descend on Parliament to voice their anxiety.

The report, entitled *The Effect of Certain Public Policy Changes on Australia's R&D*, was released late last month by the House of Representatives Standing Committee on Industry, Science and Resources. Given a majority of Government members on the committee it was no surprise it concluded that recent public policy reforms had brought economic benefits to the nation. But the admission that there were "negative effects for R&D that need to be addressed" was astonishing.

The report identified, for example, a loss of a "critical mass" for research in industries such as electricity supply, where the former large public utilities have been broken up into smaller units. And it also decried the decline in business research expenditure since 1996 from what was even then a low base.

But the most serious problems are in basic science. "The competitive environment has meant a loss of clear responsibility for some important—but commercially unattractive—long-term and 'public good' R&D activities," the report said. And it recommended that the government discuss with universities the need for funding such research.

The committee's recommendation is not before time, judging from figures released by Denis Evans, dean of chemistry at the Australian National University (ANU) in Canberra. A study of 26 universities showed a 20 per cent loss of full-time lecturing positions in maths between 1995 and 1998. That's about 130 fewer mathematicians. Another survey, this time of physics departments in 20 universities showed a 16·5 per cent cut in three years. That's 50 fewer physicists. Reductions in chemistry range from 13 to 50 per cent, Evans says, with further cuts on the way. Even large departments, he said, are now finding it difficult to cover the whole field of chemistry at the undergraduate level.

Now the national science lobby group, the Federation of the Australian Scientific and Technological Societies (FASTS), is mobilising scientists. It has set Wednesday 24 November as the day for 150 scientists and technologists to meet their local members and senators. The message they will deliver, says FASTS president, Peter Cullen, is that R&D funding is an investment in the future.

The committee report has put some hard questions on the agenda for the National Innovation Summit next February. By then I hope that politicians will have got the message that basic research is at least as important to the future as business tax structures.

THE VICTORIAN election has put the issue of revitalising the Snowy River right back on the political agenda. The massive Snowy River hydro-electric and irrigation scheme has diverted about 99 per cent of the river's natural flow from East Gippsland to the Murray River. Now environmentalists are calling for Snowy River flows to be restored to about 30 per cent of what they were—a figure they believe would restore the river's natural ecosystem. But every litre diverted back to the Snowy reduces the potential to generate clean power and irrigate crops. The Snowy River scheme is administered jointly by New South Wales and Victoria—but it is mainly NSW that would miss out on irrigation water if more flowed down Victoria's Snowy River.

Last year, a commission chaired by former NSW government minister Robert Webster struck a compromise, recommending that 15 per cent of the natural flow be restored. Now, an independent politician, Craig Ingram, has won the seat of Gippsland East in the Victorian parliament on a platform of restoring the flow level to 28 per cent. With Independents holding the balance of power, Melbourne decision-makers are showing renewed interest in the Snowy.

ENIGMA 1050

Find the link

Richard England

I WAS trying to construct a chain of 2-digit and 3-digit perfect squares such that each square in the chain had at least two digits in common with each of its neighbours (or with its sole neighbour, if it was at either end of the chain). If a square had a repeated digit that digit only counted more than once in calculating the number of digits that the square had in common with another square if it also appeared more than once in the other square; so 121 had only one digit in common with 100, but 100 had two in common with 400.

I found that I could construct three totally different chains each consisting of at least five squares; and I made each of these chains as long as possible, consistent with the stipulation that no square should be used more than once. But I could not link these chains into a single long chain until I used one particular 4-digit square as the means of linking one end of my first chain to one end of my second chain and also the other end of my second chain to one end of my third chain. In each place where it was used, this 4-digit square had at least two digits in common with each of its chain neighbours. (1) Identify this 4-digit square. (2) Which were the squares at opposite ends of the single long chain?

A £15 book token will be awarded to the sender of the first correct answer opened on Thursday 4 November. The Editor's decision is final. Please send entries to Enigma 1050* New Scientist, *151 Wardour Street, London W1V 4BN, or by e-mail to enigma@new scientist.com (please give your postal address). The winner of Enigma 1043 is Adrian Somerfield of Dublin.

Answer to 1043, Grandad

Grandad would have been 107 in 1999

Depletion rate bodes ill for chemistry

PATRICK LAWNHAM

MORE staff losses are expected at top university chemistry departments as the Federal Government's funding cuts threaten the nation's "intellectual infrastructure", according to an Australian National University dean.

Professor Denis Evans, dean of the ANU research school of chemistry, said the trend seemed destined to continue under policies proposed in the Green Paper on research.

Similar staff cuts had occurred nationwide in physics and mathematics, said Professor Evans, whose school is rated as one of the world's leading chemistry institutions.

"No modern society is possible in the absence of [university] schools, somewhere in the nation, that are capable of teaching the broad, fundamental curriculums of chemistry, mathematics and physics," Professor Evans said.

"Tertiary education and research is in crisis across this nation."

A survey in 1998 showed a 20 per cent loss of full-time permanent academic positions at mathematical science departments at 26 tertiary institutions since 1995, or almost 129 jobs.

Physics departments at 20 institutions lost 16.5 per cent of full-time permanent staff in 1994-97, or 51 jobs.

Professor Evans said cuts in full-time permanent staff levels, including researchers, had occurred at all high-ranking chemistry departments since 1994, ranging from 13 per cent at Monash University to 50 per cent at Macquarie University.

His own school had lost 20 per cent, and the ANU's undergraduate arm, The Faculties, had also lost 20 per cent of full-time chemistry academics.

Professor Evans has told the ANU council that the University of Sydney was projecting a further loss of more than 20 per cent in full-time chemistry staff during the next three or four years, after a 35 per cent loss since 1994.

The heads of the biggest remaining chemistry departments — at the universities of Melbourne, Sydney and NSW — were reporting difficulties in covering the entire discipline for undergraduate teaching, he said.

"One cannot imagine how the smaller departments can teach their subject."

Professor Evans said it took 16 years to train a competent university researcher — four years as an undergraduate, four for a PhD, four for post-doctoral research and four to establish a viable research program.

"Who will train the next generation of university teachers and researchers if the current generation of university professors is removed?" he said.

Chemistry departments were vigorously trying to increase external funding, and the ANU research school's industrial collaborations included one with pharmaceutical group SmithKline Beecham that involved new anti-infective agents.

But commercial in-confidence research was not available for teaching or public dissemination, while generation of new public knowledge was a core purpose of universities in western society.

Chemistry's decline

University	1991	1994
UNSW		43
Sydney		40
Melbourne	33	30
Monash	34	30
Queensland	26	24
ANU RSC		22.4
Macquarie		16
La Trobe	22	16
ANU Faculties		10
Adelaide/Flinders	20	
UNE	9	7

Equivalent full-time continuing academic staff in ch

THE AUSTRALIAN NATIONAL UNIVERSITY

ANU Reporter

First, to learn the nature of things

Volume 30 No.14 Wednesday 15 September 1999

Birdbath algae may help malaria fight

By Julia Veitch

A group of ANU scientists has discovered compounds that may be used to develop drugs to fight malaria and cancer in algae from the birdbath at the Canberra home of one of the researchers.

The group, which includes Dr Geoff Smith and Professor Kiaran Kirk from the Faculty of Science's Division of Biochemistry and Molecular Biology (BaMBi) and Prof Rod Rickards from the Research School of Chemistry (RSC), identified the compounds from a cyanobacterium in algae from Dr Smith's birdbath.

"Cyanobacteria are sources of a variety of pharmacologically active chemicals with antibiotic, antiviral, antifungal, antibacterial, anti-algal and other bioactive properties. Research on them has been increasing over the past 10 years," Dr Smith said.

"My lab team and I screened 200 new strains of cyanobacteria collected from southeast Asia and Australia. We found 20 anti-algal strains of potential use in the development of herbicides."

Dr Smith's laboratory is close to that of Dr Kirk, whose group has had a long-standing interest in the physiology and biochemistry of the malaria parasite.

"Proximity of the Kirk and Smith laboratories led to discussions of the malaria parasite's evolutionary connection with algae and cyanobacteria," Dr Smith said. "For example, the malaria parasite has, like plant cells, a sub-cellular structure called a plastid which probably evolved from an alga or cyanobacterium. We therefore decided to test the 20 strains for their effect on malaria parasites."

The malaria parasite is a single-celled organism that invades the red blood cells of its host. Each year as many as 250 million people are infected by the parasite, with around 2 million people dying from the disease.

"There is an urgent need to develop new anti-malarials as there is increasing resistance by the parasite to treatments presently in use," said Prof Kirk. "The general aim of our work in this area is to obtain detailed knowledge of the physiological and biochemical processes that are important to the parasite, so that we might target these with new drugs."

"When we tested the 20 cyanobacteria that Geoff's group had shown to have anti-algal activity, we found that two of the strains contained substances that were extremely effective at killing the malaria parasite, more so than widely used anti-malarials such as chloroquine."

"We showed that the same substances were equally effective at killing human cancer cells," Prof Kirk said. "This makes it unlikely that they were targeting the plant-like features of the malaria parasite, but it does add another dimension to their potential uses."

The group faced with the difficult task of isolating and identifying the active substances called on Prof Rod Rickards and his colleagues from the RSC to help define their molecular structures.

"Determination of the exact molecular structures of the active components of the cyanobacteria was intricate and required the use of different techniques, including mass and nuclear magnetic resonance spectrometry and X-ray crystallography," said Prof Rickards.

"The structures are unique amongst natural products, so we've taken out a provisional patent on them. We now hope to generate interest from drug companies which are able to test the compounds on a variety of target cells," Dr Smith said.

The work was a cross-campus collaboration, involving both the Faculties and the Institute of Advanced Studies, and the researchers emphasised the effort was only possible because of the ANU's unique research environment with specialised but related areas.

The research group included Ms Jenny Rothschild and Dr Anthony Willis from the RSC, and Ms Nola de Chazal, Ms Julie Kirk and Dr Kevin Saliba from BaMBi.

Dr Smith said their project was the sort that was difficult to "sell" for external funding as the outcomes were entirely unpredicted.

The work is to be published in the international journal *Tetrahedron*.

RSC glassblower wins award

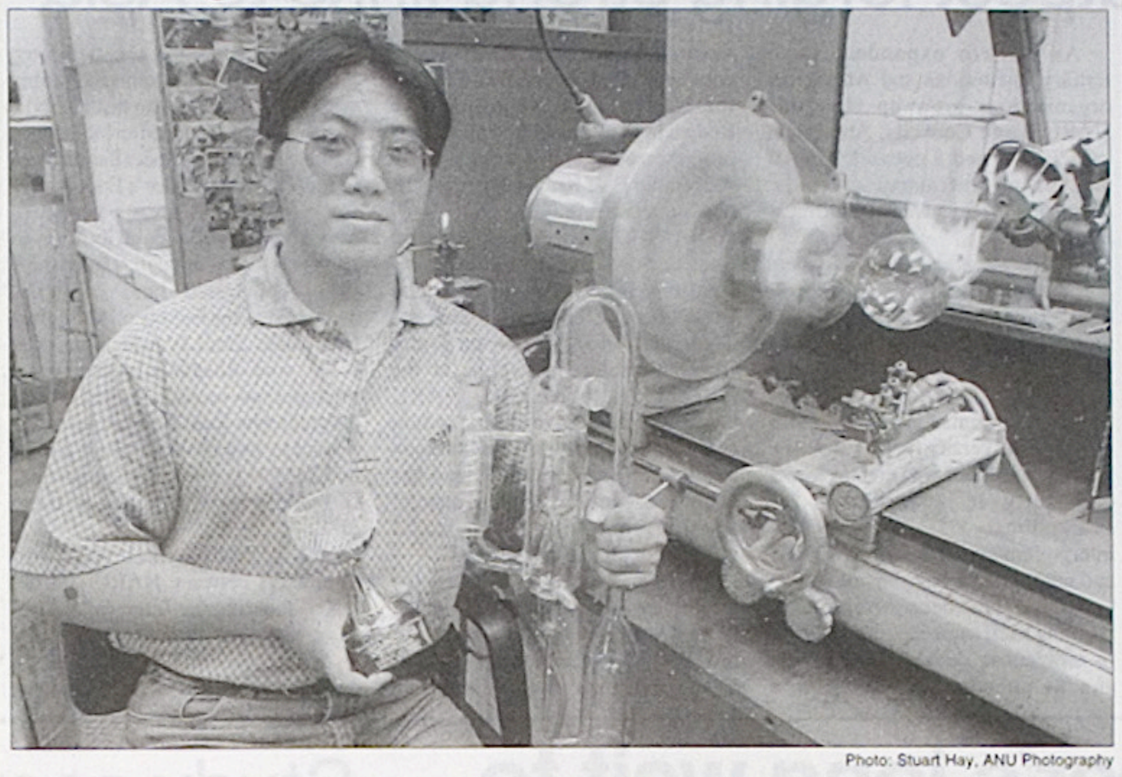


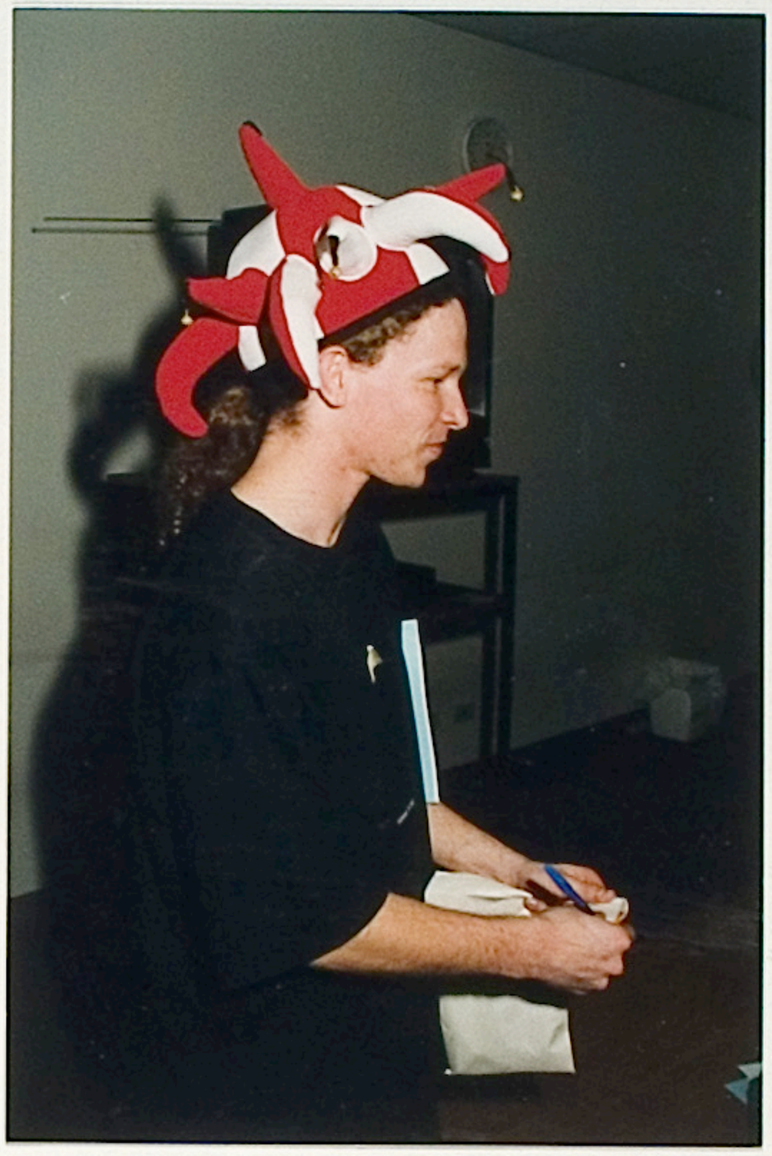
Photo: Stuart Hay, ANU Photography

Paul Siu (above), trainee scientific glassblower in the Research School of Chemistry (RSC), received a Certificate of Merit when he, and colleague Chris Tomkins, attended the 4th Australasian Scientific Glassblowing Symposium in Wellington, New Zealand last month. Mr Siu was awarded the certificate for a glass diffusion pump he constructed in the RSC glass workshop. He has been training as a scientific glassblower under Mr Hans Adler since January 1997. The symposia, held biennially in Australia and New Zealand, are organised by the Scientific Glassblowing Association of Australia and the New Zealand Society of Scientific Glassblowers, and attract scientific glassblowers from as far afield as UK, USA, Japan and Malaysia.

ANU REPORTER VOL 30 NO: 17 WED 17TH NOV 1999

decrease
44%
35%
16%
13%
25%
20%
50%
43%
20%
42%
33%
partments

MELBOURNE CUP DAY 1999



Edited by SIMON GROSE E-mail: simon.gr

Seeking balance in higher-education visi

JOHN WHITE examines some of the issues behind a 'blueprint' for universities and its potential effects on research and innovation.

THE RECENT government White Paper on Higher Education Research is a "blueprint" which could set the university scene in Australia for 10 or more years. It has been labelled "too late, too simplistic" by the Academy of Science. Is it good enough?

Next week, Australia's most important Innovation Summit will meet in Melbourne. Will it be able to help show a way forward for the nation's universities, our largest research and innovation contributors?

Since they became subject to an industrial award in 1991, the universities may not have quite become mere factories for graduate production, but something vital has been lost. Their research agendas have suffered almost random attrition because of short-sighted and simplistic policy and, in the struggle for survival as education businesses, the academic cultures of learning for its own sake and interdisciplinary respect have been weakened.

Paradoxically, these may be values that Australia should be striving to safeguard in the 21st century.

In accounting terms, the higher-education system has shown its productivity as a national income and wealth generator. There is a demonstrable return on funds invested. For government expenditure on higher education of nearly $5 billion a year, about $3 billion a year returns in the form of income tax from academics ($1 billion), student HECS repayments ($1 billion) and student fees ($1 billion). Surely a good return.

The current malaise in Australia's universities has been obvious for some time, if not officially recognised by government. Three years of costly inquiry and draft reports later, the recently issued white paper, though containing good reforms for the Australian Research Council, for example, is a disappointment. Unlike its Green predecessor, it leaves much important detail unresolved. Australian universities can only hope that some remediation of this will occur in the implementation processes, with consultation.

Three serious concerns that should be addressed at the summit, by the Chief Scientist's review of the Australian science base, and ultimately by government, are:

- The lack of additional funding for research and research infrastructure to balance what was promised last year on the medical side. In the international innovation context, a strategic loss of research balance in Australia should be unthinkable.
- A failure to propose real quality measures of research output to guide research funding — moving the deck chairs does not assist the engines.
- The "linkage" proposals are overemphasised. Applied research will always need a strong, well-funded science base underpinning it.

The following are some suggestions for the way ahead, based on recent submissions from the Australian Academy of Science and a plea for some balancing policy on teaching quality.

Quality first

Subsequent to the doubling of the number of universities since 1988, we now have too many universities attempting to do research and research training "across the board" at the highest international level. The number of Australian higher-degree research student enrolments almost doubled between 1989 and 1998.

The growth was strongest in the humanities and social sciences. Our higher- education sector appears to have been drawn into a race for research degree enrolments by the

funding formulae of the past 10 years. The new formulae of the recent white paper, with their weak quality component, will make the situation worse.

Is this to say that we should abandon the vision of the unified national tertiary education system which allows Australia to lead the world in access by young people to higher studies? Certainly not. Instead, quality of research (and eventually teaching), measured impartially and against the highest standards, must be used to reward excellence in however small a university it is found.

The Academy of Science, the Australian Research Council, the Joint Academies' Forum and many others have suggested a robust research assessment process, simpler than those in other major OECD countries, but where quality of outputs is rigorously measured. This process would be limited in time by a "sunset clause" allowing the universities to then largely "take over".

This process could be implemented by strengthening the independent body foreshadowed in the white paper. A research assessment exercise, with broad enough quality indicators and impartial nation-wide standards, could produce a sustainable growth of diversity in the research roles of higher-education institutions.

Innovation system

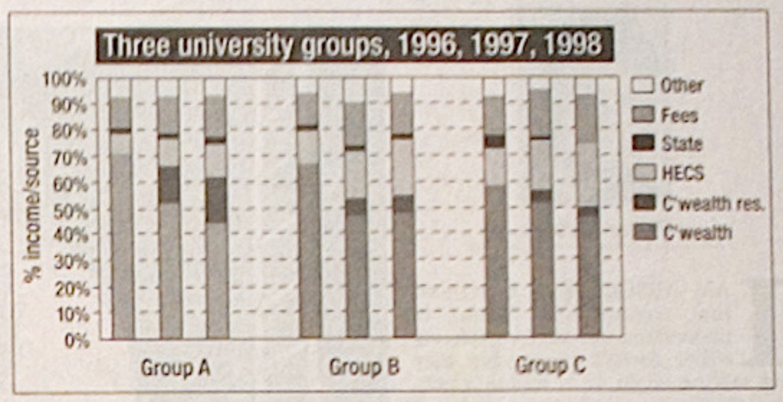
One of the great research performers of the country, the Institute of Advanced Studies at the ANU, is briefly mentioned in the white paper, but with a great lack of understanding of its history of achievements and its potential to invigorate the innovation system.

Though a recognised world leader in many fields, it has had no substantial supplement to its funding since 1990. Despite the excellent report of a comprehensive international review in 1995, it has had to mirror all other universities with large staff cuts to ensure that its research remains focused and internationally competitive. For such a generator of innovation, the white paper has produced only grudging entry to national funding sources on the same basis as other universities.

The price for being allowed to compete is high — a cut of 20 per cent of its research budget and, much more important, the probable sacrifice of its independent "long-term" research philosophy unless further staff cuts are made to redeploy money. An element of the plurality of Australia's research agenda is at stake as well as the future of the national research facilities sited at ANU.

Financial stress

Personal inquiries to a number of universities around the country indicated how much things have changed even since 1996. Anecdotally, Commonwealth direct funding for some was down 30 per cent and HECS contributions up by 50 per cent on their 1996 values to 1998. Analysis of DETYA statistics bears this out and shows that the financial stresses have already precipitated diversity — but how random and at what cost? The graph shows the income from various sources for three representative groups of universities for 1996-98.



GROUP A: Melbourne, Sydney, ANU, Western Australia and UNSW. **GROUP B:** mostly "pre-Dawkins" universities, Newcastle, UTS, Griffith, Latrobe, Wollongong and Tasmania. **GROUP C:** Canberra, Curtin, Charles Sturt, QUT, Central Q and Western Sydney.

The proportion of Commonwealth direct funding has fallen for each group while the fraction of income from HECS and student fees has increased strongly across the system. "Market forces" are biting, but hidden behind the data are mergers of discipline areas and, probably unexpected, losses of scientific research capacity even in some of our greatest institutions.

School student perceptions about job opportunities drive these "forces" strongly — and for the enabling sciences of mathematics, physics and chemistry, the negativeness of these perceptions is a deep-seated problem. At present the close gearing of university finance to undergraduate student numbers is a prescription for haphazard change in the nation's research capability.

To complement the research policy outlined in the white paper, strong and comprehensive policy to encourage and reward teaching quality is needed to balance the university funding model. This policy need not divide the university system. With new money and astute incentives, Australia could re-energise its broad higher-education sector and get the "best of both worlds" as in some parts of the United States. One attractive model there is the "liberal arts college". Renowned excellence in undergraduate instruction is a clear goal for these colleges, there are very few PhD programs, but research thrives in a few centres of excellence in many places.

Industry links

More "linkage", rather than research quality assessment, seems to be the white paper's "panacea" which will lead simultaneously to industrial innovation and a smooth diversification of the higher-education system. Clearly, closer links between universities and industry are valuable to the nation.

But the greatly enhanced emphasis on linkage in the white paper is too central to the funding formulae. It risks further destruction of Austra-

lia's aca
focus on
rience o
that a si
ing form
and medi
osity-dri
intense
"blue-sky
lian Res
each yea

The s
linked
through
Centres,
and the
partmen
Resourc
many p
to indus
add to t
try is g
versities
the Gov
tax law,
to make

The g
most va
worldwi
heritage
ket and
that wa
led the
access t
devise
cellenc
search

Our
depends
fettered
by the
Univers
gardens
toon. T
as the

Profe
Physic
the A
Chem
Secret
of Sc
E-mail

CONFERRING OF DEGREES AUTUMN 2000

More than 1,000 students took part in the ANU's Autumn Conferring of Degrees just before Easter.

The Faculties of Economics and Commerce and Engineering and Information Technology and the Research School of Social Sciences comprised the first of four graduation sessions on Wednesday morning, with ANU Vice-Chancellor Professor Deane Terrell addressing the gathering.

Professor Terrell wished students the best for the future. "The University is proud of you and I have every confidence that each of you will bring great credit to your alma mater as you progress in your respective careers."

Author, broadcaster and film maker, Philip Adams, addressed the Faculty of Arts' conferring ceremony on Wednesday afternoon.

Graduands from The Faculties of Asian Studies and Law, the Asia Pacific School of Economics and Management and the Research School of Pacific and Asian Studies were conferred on Thursday morning and addressed by the Director of the ANU's Centre for International and Public Law, Professor Hilary Charlesworth.

The final conferring session, on Thursday afternoon was for graduands from the Faculty of Science; John Curtin School of Medical Research; the Research Schools of Astronomy and Astrophysics, Biological Sciences, Chemistry, Earth Sciences, Information Sciences and Engineering, Physical Sciences and Engineering; School of Mathematical Sciences; Centre for Resource and Environmental Studies and the National Centre for Epidemiology and Population Health.

Among the graduates, James Kakare Morauta, the son of Papua New Guinea Prime Minister Sir Mekere Morauta, was awarded his second university medal in a Bachelor of Laws degree with honours. Bachelor of Arts (Honours) graduate Matthew Tinning received the Tillyard Prize, awarded annually to the honours student whose personal qualities and contributions to university life are judged to be the most outstanding.

Annual awards were also presented to teaching staff at the ANU. Professor Russell Craig from the Department of Commerce, Dr Michael Green from the Department of Engineering, Dr Ian Holloway from the Faculty of Law and Professor Bill Jenner from the China and Korea Centre were all acknowledged for their contribution with the Vice-Chancellor's Awards for Excellence in Teaching.

One of the convocation representatives on, and longest-serving members of, the ANU Council, David Solomon, was awarded a Doctor of Letters based on an assessment of his published works.

Ms Julie Gorrell, executive and liaison officer for the Humanities Research Centre and the Centre for Cross-Cultural research received an Equity and Diversity Certificate for her "consistent and outstanding commitment to raising the profile of equity and diversity issues and ideas".

The first Clare Burton Award, made to an area of the university that has made the most outstanding contribution towards progress in equal opportunity or achieved significant success in the promotion of an environment where human diversity is valued, was awarded to the staff of the business office, store and mechanical workshop in the Research School of Chemistry.

Photo: Stuart Hay, ANU Photography

Top teachers: Winners of the Vice-Chancellor's Awards for Excellence in Teaching Dr Michael Green and Professor Russell Craig (above) and Dr Ian Holloway (right) with their certificates.

Photo: Bob Cooper, Coombs Photography

Photo: Darren Boyd, Coombs Photography

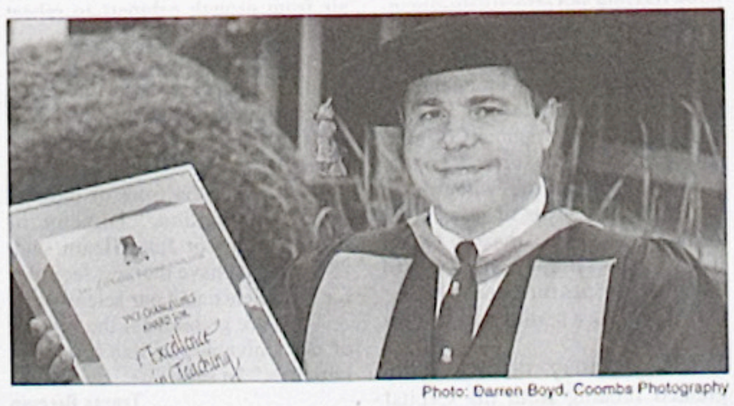


Photo: Darren Boyd, Coombs Photography

Top: Staff of the business office, store and workshop at the Research School of Chemistry with their Clare Burton Award for equity and diversity in the workplace. It was the first time the award, named in memory of Dr Clare Burton, has been given.
Above: ANU Chancellor Professor Peter Baume reads the citation for a Doctor of Letters for Convocation representative on the ANU Council, David Solomon. Dr Solomon received his degree based on his published works.