AUSTRALIAN ACADEMY OF SCIENCE

NEWSLETTER

September–December 2000 www.science.org.au Number 48

Chance to change

The Academy of Science has strongly supported the analysis and recommendations of the Commonwealth's Chief Scientist, Dr Robin Batterham, in his discussion paper on Australia's science, technology and engineering capacity.

The discussion paper, entitled *The Chance to Change*, was released in August and recommended more basic science scholarships and a big increase in research funding and facilities. Dr Batterham observed that Australia was not keeping pace with the investments made in knowledge by comparable countries – in areas such as business research and development, patenting activity and public spending on education.

The President of the Academy, Professor Brian Anderson, said that the Chief Scientist had provided the Federal Government with a stark image of the contrast between the advanced economies and trends in Australia. He said that the review documented convincingly the links between producing new knowledge and creating new wealth.

'A knowledge economy needs a knowledge base, and the Chief Scientist's proposals provide us with some highly effective steps we can take to boost our knowledge base in science education, research, development and commercialisation of technology.'

Specific proposals

The Academy has responded to the discussion paper, and the recommendations of the Innovation Summit Working Group (see page 2), with some specific proposals. A whole-of-government approach will be needed to implement recommendations costing $2.5 billion over five years and involving four departments.

The contribution of industry will need to be significant. The shortfall in industrial investment in research and development since 1995 illustrates the urgency of the case put forward by the Chief Scientist.

A strong science base is needed to support the economy. Australia has a trade deficit of about $12 billion per year in information technology and $6 billion in chemicals. Enormous opportunities exist in both of these areas.

Professor Anderson strongly endorsed the discussion paper's statement that 'we must nurture our research capabilities in the 'enabling' sciences of physics, chemistry and mathematics'. There were serious weaknesses in these sciences due to current higher education funding policies. He said, 'Our universities are rapidly losing their ability to provide essential education and research in these critical areas.'

Need for science scholarships

The Academy supports proposals to provide scholarships for university students in the enabling sciences and for those combining science and education qualifications. It also supports an increase in the number of postdoctoral fellowships in science and technology.

In distributing scholarships, fellowships and research infrastructure grants to universities, the Academy argued that more weight should be given to the quality of research and teaching. A research assessment exercise could gauge the underlying quality of Australian science research.

Plurality of funding

The Academy believes that Australia must retain a pluralistic science funding system, with funds coming from the Australian Research Council, the National Health and Medical Research Council, government science agencies, university institutes, state museums and libraries, and private institutes. This plurality helps give a broader perspective on what research is important.

The Academy also supports the expansion of the Cooperative Research Centre program to take in small and medium-sized enterprises.

Professor Anderson said, 'The government can now proceed with confidence to formulate its promised plan for addressing the deficiencies that are acknowledged to exist in our research base.

Professor Brian Anderson

'The Academy, and the research community generally, stand ready to work with government, industry and the community to make the historical transition to a society in which prosperity can increase sustainably, with well paid, rewarding jobs, and resources to address our urgent social and environmental goals.'

Support from physicists

The Academy's National Committee for Physics has also supported the Chief Scientist's discussion paper. In a letter to the Prime Minister, the Chair of the Committee, Professor Anthony Thomas, said, 'In order for Australian business to be internationally competitive it is vital that there be a continuing source of new ideas. One never knows where the crucial new ideas will originate. The World Wide Web came from high energy physics; general relativity is crucial to global positioning technology.'

He noted the decline of staffing in university physics departments and the need to increase success rates for Australian Research Council grants. He also supported proposals to improve science education in schools.

Office-bearers of the Academy

President
Professor Brian Anderson

Secretary (Physical Sciences)
Professor Bruce McKellar

Secretary (Biological Sciences)
Professor John Young

Secretary (Science Policy)
Professor John White

Foreign Secretary
Professor Kurt Lambeck

Treasurer
Professor Athel Beckwith

Telephone numbers

Executive Secretary	(02) 6247 5777
Publications	(02) 6247 5385
Awards	(02) 6247 5777
Finance	(02) 6249 1362
Fellowship administration	(02) 6247 5777
National Committees	(02) 6247 3966
International programs	(02) 6247 3966
Library	(02) 6247 9024
Australian Foundation for Science	(02) 6247 5777
Facsimile	(02) 6257 4620
Email	**aas@science.org.au**

This newsletter is available on the Academy's web site, **www.science.org.au/academy/newslett/newslett.htm**.

Published by the Australian Academy of Science, GPO Box 783, Canberra ACT 2601.

Honorary editor: Professor Neville Fletcher FAA; production by Green Words & Images, Canberra. Other assistance: members of Academy committees and Academy staff.

Printed by McPherson's Printing Group, Melbourne.

ISSN 1031-9204
Print Post Approved PP 255003/00025

Innovation ideas endorsed

The Academy of Science and the Academy of Technological Sciences and Engineering have endorsed the recommendations of the Innovation Summit Implementation Group in their report, *Innovation – unlocking the future*.

The Presidents of the two Academies, Professor Brian Anderson and Mr Tim Besley, in a joint statement said that the group's proposals offer a way forward for governments, universities and industry, highlighting the need for cultural change. 'We need to embrace innovation whole-heartedly as a nation,' they said.

The implementation group's proposals aim to strengthen the COMET and BITS schemes, which support innovation in industry, increase the research and development tax concession for industry, increase grant funds available through the Australian Research Council and rebuild research infrastructure.

The Presidents of the Academies said that the proposals would provide an enormous boost for risk-taking innovation and encourage creative basic researchers. They said, 'The government has been rewarded for its initiatives in innovation policy, and its wide-ranging consultation, with a cogent and well developed set of policies.' The next step required is endorsement of the group's proposals, and the earlier proposals by the Chief Scientist, Dr Robin Batterham, by the Federal Government.

Professor Anderson praised the role of the Minister for Industry, Science and Resources, Senator Nick Minchin. 'He has consulted widely and openly, especially through the Innovation Summit process. As a result of the inclusive process the Minister has used, I believe that the group's proposals will find strong support in all sectors.'

Space research

The Academy's National Committee for Space Science has published its biennial survey of space-related research in Australia, *Australian space research 1998–2000*. The report is sent to the Committee on Space Research of the World Council on Science. The committee's latest scientific assembly was held in Warsaw in July.

Contributions came from a wide range of institutions active in space research: CSIRO, universities, government agencies (the Australian Antarctic Division and the Ionospheric Prediction Service) and industry (British Aerospace and DSpace). The research fields cover earth observation (remote sensing), solar-terrestrial physics, upper atmosphere physics, climate and weather modelling, space astronomy and space communications.

The compiler of the report is the Chairman of the National Committee on Space Science, Professor P L Dyson.

The complete report is available in Acrobat format from the Academy's website at **www.science.org.au/academy/media/cospar2000.pdf.**

Forthcoming events

- *Every eight seconds: AIDS revisited*, symposium, Canberra, 29 and 30 November 2000 – see page 11 or **www.naf.org.au/aids.htm**.

New topics on *Nova*

- Fatal impact – the physics of speeding cars
- Hydatids – when a dog is not man's best friend

Nova: Science in the news is at **www.science.org.au/nova**.

Basser Library

Anyone wishing to use the Basser Library should contact the librarian, Rosanne Walker, telephone (02) 6247 9024 or email **rosanne.walker@science.org.au**.

Gifts to the Academy

If you would like to make a gift or a bequest to the Academy of Science or the Australian Foundation for Science, please contact the Executive Secretary or the Development Officer, telephone (02) 6247 5777 or email **es@science.org.au**.

Oliphant commemoration

A public commemoration of the life of the great Australian physicist and founding President of the Academy of Science, Sir Mark Oliphant (1901–2000), was held in the Great Hall of University House at the Australian National University on 25 August.

The commemoration was organised by the Academy and the university and attended by Sir Mark's former colleagues, friends, students and others who appreciated his contributions to science and Australian life.

Speakers were the Governor-General, Sir William Deane, the President of the Academy, Professor Brian Anderson, the Chancellor of ANU, Professor Peter Baume, the Director of the Research School of Physical Sciences and Engineering at ANU, Professor Erich Weigold, and Sir Mark's grandson, Michael Wilson. There were musical interludes from the Canberra School of Music.

Excerpts from some of the speeches are reproduced below. Complete versions of the speeches are available from the Academy's website at **www.science.org.au/oliphant.htm**.

Sir Mark Oliphant's grandson, Michael Wilson, addressing the Oliphant commemoration at University House in Canberra. Beside him are, from left, Professor Brian Anderson, Lady Deane and Professor Peter Baume.

Contribution to national life

Sir William Deane, Governor-General of Australia

Marcus Laurence Elwin Oliphant – as he was christened – was born in the Adelaide suburb of Kent Town on the 8th October in the first year of our nation's Federation, 1901.

From an early age Mark Oliphant had a wonderful talent. He first displayed it in his school laboratories where he made electric coils, meters, filters, pumps and glassware and in home experiments, sometimes with spectacularly unexpected results.

It later shone through the discoveries and achievements at the Cavendish Laboratory with Rutherford, at Birmingham and at Berkeley, which established him as one of the great physicists of our age: the splitting of the atom; the discovery of new forms of hydrogen and helium; the development of microwave radar; the Manhattan Project. One does not have to be an expert to comprehend his quite remarkable ability to envisage an experiment for which no precedent or laboratory existed and then to design and build the equipment necessary to conduct it.

In an international context, Sir Mark's achievements as a physicist, including his contributions to scientific knowledge and to the allied victory in the second world war, provide the firm foundation of his fame. We all share in the world's debt to him for them. But we Australians also owe him a much wider debt for the contribution which he made to our country, our standards, our decency and our lives.

And probably more than anyone else in our history, he played an extraordinarily effective role in encouraging the study of science and the recognition of science as a career for the young.

Over the last half century and more, Mark Oliphant's great standing in our community and the public trust which he enjoyed enabled him to play an influential role in raising public awareness and understanding of important – and some not so important – issues. Even when one disagreed with his strongly expressed views, his contributions to public debate were always transparently honest and invariably stimulating and challenging.

On many subjects which we now see as being of transcending importance to our national well-being and decency, his was a vitally important and fearless voice: on the evils of racism, on multiculturalism, on Aboriginal disadvantage and land rights, on the evils of totalitarianism, on the dangers of nuclear proliferation and the obscenity of war, on the critical importance of the environment and conservation. Those who have come after him in relation to those or other great issues are deeply indebted to him for the guidance and the leadership that he gave. Sometimes, the fact that he was there was as important as what he said. And the fact that he was there will long remain after he is gone from us.

Mark Oliphant died peacefully in this city, after a short illness, on the 14th of July. His life stretched from the first to the last years of the first century of the nation to which he contributed so mightily.

There are many lessons which Sir Mark taught his fellow Australians during his life. There are many messages he left us on his death. I conclude this inadequate tribute with what seems to me to be perhaps the most important of them. 'I like to believe', he wrote, 'that our Australian breed of civilisation is deep enough, and unselfish enough, to generate care for people as a whole'.

Contribution to Australian science

Professor Brian Anderson, President of the Australian Academy of Science

One of Mark Oliphant's most outstanding and durable achievements was the creation of the Australian Academy of Science in 1954. The *Economist* magazine, in its obituary of Sir Mark Oliphant, named it as one of two world-class institutions he

continued on page 4

Oliphant commemoration

continued from page 3

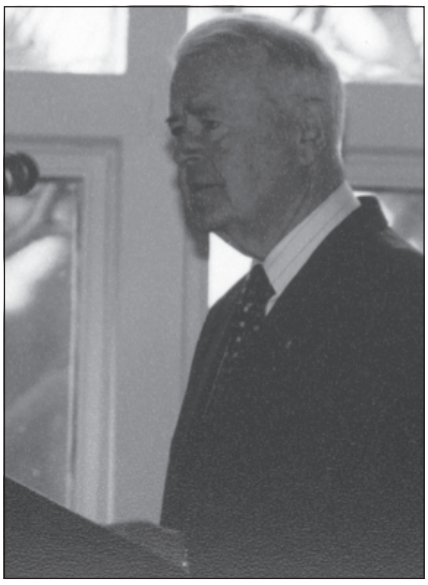
founded – the other being the Research School of Physical Sciences at the Australian National University.

In 1951 Oliphant organised a seminar on 'Science in Australia'. In its final session the seminar discussed ways of bringing scientists together and of forming a national centre for Australian science. Oliphant pointed out that most countries had national academies as a means of expressing and maintaining a coherent scientific outlook. He argued that the seminar should consider the creation of an academy. The response was favourable.

Late in 1951, Oliphant and Sir David Rivett, a former Chairman of CSIR, went to see the Prime Minister, Robert Menzies, who strongly supported the kind of academy envisaged, and he promised to help get a Royal Charter. A meeting of the Fellows of the Royal Society and other eminent scientists in Canberra in July 1952 worked out the details of the establishment and membership of the academy.

In November 1953 these 23 Foundation Fellows elected a provisional Council with Mark Oliphant as President. On 16 February 1954, the members of the provisional Council went to Government House in Canberra where the Queen handed Oliphant the Charter of the Academy.

Oliphant initiated fundraising for an Academy building by approaching the heads of two mining companies, who were then Fellows of the Academy. He never forgot receiving a cheque for £25 000 from BHP. The innovative dome was completed in 1959, within four years of the Academy's foundation. For that time, and even by today's standards, the project showed great vision and courage in its scale and design.



The Governor-General, Sir William Deane

Oliphant's personal relationships with Robert Menzies and ministers ensured continuing financial support for the Academy in particular and for research in general. He emphasised the need for more funds for the State universities, whose research infrastructure had run down.

Mark Oliphant's science

Professor Erich Weigold, Director, Research School of Physical Sciences and Engineering, Australian National University

Sir Mark was greatly stimulated by a visit to Adelaide in 1925 by New Zealand-born Ernest Rutherford, then Director of the Cavendish Laboratory in Cambridge. After Lord Rutherford's visit, Sir Mark was determined to work in his laboratory, an aim he achieved when he won an 1851 Exhibition Scholarship. He arrived at Cambridge in 1927.

Sir Mark's greatest personal triumphs in science came in the 1930s when his friendship with Lord Rutherford was at its height and when, with the departure of James Chadwick, he became assistant director of the laboratory – then the world's leading centre for experimental nuclear physics.

The simplest atom is hydrogen, which consists of a heavy positively charged nucleus called a proton and an electron. In 1932, Cockroft and Walton discovered that protons, when accelerated by several hundred thousand volts, would cause the disintegration of light nuclei such as lithium and boron with the release of large amounts of energy. Sir Mark was diverted from his previous work by the enthusiastic desire to have a hand himself in this important new field.

He set to work to build an apparatus capable of accelerating much larger numbers of protons than the accelerator of Cockroft and Walton. In doing so he developed an intense source of protons which was adopted as a standard component of such accelerators. With this apparatus, in 1933, Oliphant and Rutherford studied the disintegration of lighter elements by high-speed protons.

More important experiments were made possible by the discovery of deuterium, which is heavy hydrogen twice as heavy as ordinary hydrogen, and by the gift to Lord Rutherford by Professor G N Lewis of a small quantity of 'heavy water'. Heavy water contains deuterium rather than ordinary hydrogen as a constituent. Using deuterium nuclei (deuterons) as projectiles, Sir Mark and Lord Rutherford discovered important new transmutations.

Most importantly Sir Mark showed that deuterons could interact with each other to produce a third form of hydrogen, this one three times heavier than ordinary hydrogen, to which the name 'tritium' was given. This was the first example of fusion, producing heavier nuclei from two lighter ones. In the same way Sir Mark discovered helium-3, a light form of helium.

At Birmingham University, Sir Mark's laboratory was responsible for one of the most important scientific inventions of the war – the cavity magnetron. Developed under Sir Mark's direction, it produced high-power centimetre-wavelength radiation. This invention transformed radar. It made possible the development of equipment that enabled narrow beams of radio waves to be produced. Transmitted in pulses of concentrated power, these radio waves could seek out ships, submarines and aircraft.

After the war, a new national research university was being planned in Canberra. Sir Mark accepted a post as Director of the Research School of Physical Sciences. He returned to his native Australia in 1950.

He began a broad and dynamic program in the physical sciences, expanding the work of his research school to include astronomy, mathematics and geophysics, as well as broad areas of physics. The school became a major centre of Australian research and postgraduate training, and gave birth to new research schools in earth sciences, information sciences and engineering, astronomy and astrophysics, and mathematical sciences.

Evidence for nutritional guidelines

The Academy's National Committee for Nutrition invited nine Australian experts with a range of specialties to join the committee in a workshop on 4 August 2000 at the Academy to discuss how evidence-based medicine and the National Health and Medical Research Council's levels of evidence can be applied in interpreting and designing human nutrition research.

The NHRMC rightly puts randomised controlled trials at the highest level of evidence, but these levels are intended primarily for evaluation of pharmaceuticals and clinical procedures. Nutrition scientists must use the best evidence available and appropriate, but only some of this can be randomised controlled trials. Diets and dietary change are much more complex than taking a single drug; compliance is more uncertain. Dietary trials need more staff but they cannot expect the funding that is available for drug companies' trials.

Most controlled trials of dietary change have looked at the effect on an intermediate end point, like blood cholesterols, blood sugar or blood pressure, and randomisation is not the only criterion of quality in such trials. Trials with disease incidence or mortality as end points have to be randomised. In the nutritional area these have usually tested one or two nutritional supplements or single foods. Some of these have given results that were not expected from other levels of evidence, such as the lack of benefit of beta-carotene against cancer or of vitamin E against heart disease.

These surprises were discussed at the workshop. In some cases a randomised controlled trial can be misleading, for example, if other active drugs are given at the same time in a secondary prevention trial, or if a nutrient's preventive action is at an early (mutation), not a late (promotion) stage of cancer development.

Of the studies in observation epidemiology, cohort (prospective) studies are likely to be more reliable for nutrition than case-control studies. But these studies depend on estimates of food intakes of large numbers of subjects. There is no perfect method for doing this: people tend to under-report what they eat, some more than others; the questionnaire may not be precise and food habits can change. Nutrients in foods differ in bioavailability. A few objective biomechanical markers are available (for example, urine sodium, serum folate) but there is a real need for more. Interpretation of cohort studies can be difficult because of confounding factors. Those who eat more (or less) of a particular food may have a healthier lifestyle in other ways.

For practical nutritionists, our present nutritional prescriptions (though provisional) are based on stronger evidence than our evidence about how to persuade people to eat and continue with a healthier diet, for example, for weight reduction.

In a search for more reliable quantitative evidence we should not lose sight of the value of qualitative research, of animal experiments, of paradigms in nutrition and of the wisdom of (good) expert committees.

Dietary guidelines published by the NHRMC, notably the latest, Dietary Guidelines for Older Australians (1999), originated in an expert committee and were scrutinised to check that they were evidence-based. As well as consistency with the science they had to be conservative – unlikely to cause harm – and avoid unnecessary change from previous Department of Health advice. They also had to undergo two rounds of public consultation and be edited for clarity of language.

A full report of the workshop will be published. For a copy, email Trish Nicholls at **nr@science.org.au**.

Professor Stewart Truswell
Chair, National Committee for Nutrition

Major research facilities need funds

The Chief Scientist, Dr Robin Batterham, in his discussion paper on Australia's science capability, *The Chance to Change* (see page 1), recommended that the Commonwealth Government establish a major research facilities program. The report from the Innovation Summit Implementation Group backed the proposal.

The Academy strongly supports the recommendation for a national commitment to a competitive major research facilities program, with participation by states, territories, universities, government research agencies and commercial interests.

However, Dr Batterham's discussion paper recommended that the Commonwealth fund only 50 per cent of the cost of new facilities, with the remainder coming from other governments, research organisations and business.

In a response to the discussion paper, the Academy stated that the expectation that the Commonwealth would fund only 50 per cent of capital costs is unrealistic, especially for expensive facilities. The Secretary (Science Policy), Professor John White, wrote, 'State governments do not have a good track record in supporting major research facilities. For instance, for the existing 36 core research facilities, states, territories and local government contribute only 2 per cent of operational funds.

'The particular position of the Australian Capital Territory should be considered. The ACT Government has a small revenue base, with limited capacity to contribute to research facilities. However, the ACT has a concentration of research activity, with research and development accounting for 5.6 per cent of the ACT gross domestic product (in 1997–98), compared with 1.6 per cent of national GDP.'

The Academy also believes that Commonwealth contributions should be new money, not funds already directed to universities and government research agencies.

The Commonwealth Government's Coordinating Committee on Science and Technology proposed that the major facilities program would require $60 million for capital costs. The Academy pointed out that this is less than the annual depreciation value of existing facilities. In the last round of proposals, in 1995, scientists proposed 35 facilities costing $370 million altogether.

The Academy is convinced that the national program should also contribute to operating costs.

Lloyd Rees Lecture on the process of discovery

Dr Peter Colman, Director of the Biomolecular Research Institute in Parkville, delivered the fifth Lloyd Rees Lecture on New drugs for influenza and other things – the role of physics, chemistry, biology and business *on 14 September 2000 in Melbourne. The Lecture is held every two years by the Academy to commemorate the life and work of Dr A L G Rees, who was Chief of the CSIRO Division of Chemical Physics from 1958 to 1978. The following is a shortened version of the lecture.*

Dr Peter Colman, right, with Professor Sandy Mathieson and Lois Mathieson after the Rees Lecture.

Chemistry, physics, biology and industry were all passions, it seems, of Lloyd Rees, but one suspects from Alan Walsh and John Willis's memoir of Lloyd that he was equally passionate about removing the traditional barriers between these disciplines, which are equally barriers to the progress of science and which I regret remain in much of Australia's scientific effort today. But I want to draw an even deeper tie to Lloyd Rees, because he was fundamental in introducing to Australian science the two great diffraction techniques, using x-rays and electrons, the first of which was pioneered in Australia by Sandy Mathieson and which is at the heart of the talk I want to give today.

I want to wrap today's talk between the covers of a book by David Landes, *The Wealth and Poverty of Nations*, and to start with a lovely little chapter, 'The Invention of the Invention', in which Landes describes the degree to which technical innovation flourished during the Middle Ages. He talks about the waterwheel, the mechanical clock, printing, gunpowder, and for today's talk he mentions also the eyeglass, which as best as we can ascertain is a discovery of around the year 1300, in Pisa, and which rapidly led to the use of spectacles. This invention enabled the useful lifetime of a skilled workman to be effectively doubled.

The eyeglass that I want to talk about in introducing today's subject is the modern-day monster, the synchrotron, such as the facility on the outskirts of Chicago. This allows scientists to study at atomic resolution the structure of matter. Let me show you what the other subject of the talk, influenza viruses, what these molecules look like as seen through an electron microscope and what one is able to achieve if one strips from the surface of these viruses, using enzymes, crystals of the spike-like structures that are protein molecules. When x-rays from a synchrotron are passed through one of these crystals, one gets a pattern of black spots, from whose intensities and positions one can reconstruct an image with a magnification of approximately 100 million times. This has allowed us to determine the atomic structure of one of those spikes on the surface of the influenza virus.

If one looks at the structures of all of the known influenza viruses that are out there in the world, you see a pattern of integrated variation which covers almost the entire surface of one of these spikes on the surface of the influenza virus. The part that does not change is a part which we recognised might be exploitable in terms of making drugs for influenza which would have a very interesting property, and that is that they should work against all strains afforded, because this part of the molecule is an invariant feature.

In 1983, when we published this structure, it was also the 50th anniversary of the discovery of influenza viruses. So at the end of 1983 I found myself in London giving a talk about this work at this 50th birthday party and at the end of my presentation I said I believed that we could use the information that we had discovered to lead us towards new drugs for influenza. This remark attracted the interest of the Research Director of Glaxo in the UK. And during all of 1984, CSIRO, through its commercial office, tried to work out an agreement between Glaxo and the laboratory in Parkville. The key element in Glaxo's decision not to pursue such an agreement was the work of two Austrian chemists, Meindl and Tuppy, who in 1969 had made the molecule Neu5Ac2en. They made it as a non-selective inhibitor of neuraminidases,

whether they be of viral, bacterial or even mammalian origin. They had hoped, of course, that these compounds might be effective anti-influenza agents. But it was the failure of chemists during the 1970s to show that this particular molecule and closely related molecules would work in animals that really came back to bite us when we were trying to encourage Glaxo that for a modest investment they really could have all the rights to this work. So we shouldn't have been surprised when the negotiations were called off.

Also during 1984, my colleague Peter Tulloch had introduced our laboratory to a young entrepreneur by the name of Mark Crossling, who had set up a little company in Melbourne called Biota. Although he had a very clear vision about establishing an agricultural biotech company, he shifted direction when he heard Glaxo had lost interest in our flu project. He rewrote his business plan and during 1985 Biota was born, as was the agreement between CSIRO and Biota to support the work. Biota floated at the end of 1985 and raised $3 million on the stock exchange. In the late 1980s there were two take-over attempts for Biota, during the second one of which its share price got as low as six cents. Biota was clearly very fast running out of cash, and it was desperation stakes for the science to deliver a compound. Two grants from the Industry Research and Development Board saved the day.

It was during 1988 that my colleagues, principally Jose Varghese and I, started to come up with the necessary degree of clarity about the structure to enable two key individuals, Wen-Yang Wu and Mark von Itzstein, to really focus their chemistry in a way that had not been possible before. Jose's picture showed in its fine atomic detail all of the interactions between the natural substrate and the enzyme pocket, and there is a beautiful degree of fit between the natural ligand, everywhere except in one region. The 4-hydroxyl of Meindl and Tuppy's compound projects into a pocket of the enzyme, which has water molecules in it and a couple of negatively charged groups. This was the observation that led Wu and von Itzstein to propose that replacing this hydroxyl with ammonium or guanidinium functionalities might lead to improved fit. And making that one minor change improves the potency of this molecule by 10 000 times, that is to say, that if you need a given concentration to inhibit the enzyme with the molecule Neu5Ac2en, you need only one ten-thousandth of the concentration of the molecule zanamivir (the guanidinium derivative of Neu5Ac2en) to get the same degree of inhibition. Zanamivir, of course, is the active ingredient in what we now know as Relenza.

Biota were not only out of cash, but being a little company they had none of the resources needed to carry out a drug development program. And they needed a big partner to help them do that. Glaxo ultimately bought this work in 1990 from Biota with a significant royalty associated with it. One of the things Glaxo could provide to Biota were animal models in the form of ferrets. The ferrets develop a normal increase in body temperature on day three after infection, but animals on the drug showed no symptoms and in other studies these animals also showed the level of virus that could grow in them was heavily reduced by the presence of the drug. This result led us to the bold conclusion that we might have actually made something more than just a neuraminidase inhibitor and that the compound might indeed be a drug for influenza.

Drug companies and chemists like to protect their intellectual property by describing a chemical entity and its uses, and Glaxo sought protection, with Biota, for this compound that had been designed and synthesised in Melbourne. But I have always believed that we made a bigger discovery than this. We actually discovered that anything that you put into this pocket could be a drug. That discovery has enabled a competitor compound to be marketed alongside Relenza today, but it was not, in itself, protected by patent.

Finally, I want to go back to the *The Invention of the Invention*. When Landes writes about these four or five inventions from the Middle Ages, an age in which he said the invention was invented, it is noticeable that there is no recipe. It just says that, well, the eyeglass was invented, the waterwheel was invented, and so on. So it seems to have some harmony with the words Alan Walsh and John Willis wrote in their memoir of Lloyd Rees: 'the important applications of fundamental work are in quite unexpected areas'.

One of the things which gets in the way always, it seems to me and it seemed to Landes, is dogma. And he tells a very nice story about the Portuguese and the navigational supremacy that they had in the 1480s. At that time they had worked out tables for measuring latitude based on the declination of the sun at different seasons, and they had used these tables to navigate their way all the way to the southern tip of Africa, which they knew long before Columbus found the New World. But that navigational supremacy that they had grew out of a 15th century society which was tolerant, which allowed Jewish and Muslim mathematicians to work together, and in which scientific endeavour flourished. This supremacy was lost when the Iberian Inquisitions of the 16th century robbed their society of independent thinkers.

By 1520 there were no astronomers in Portugal because they had all been labelled Jewish and thrown out. The people who left in those early years didn't only take their knowledge and their commercial knowhow, but here is a nice turn of phrase from Landes: 'they also took those immeasurable qualities of curiosity and dissent that are a leaven of thought'.

I think dogma still dogs us today. One of the dogmas we fight constantly is that which says or claims to know how scientific discoveries are made. John Polanyi, the Nobel Laureate chemist, gave a lovely talk in Melbourne a few years ago, which he entitled: 'How discoveries are made and does it matter?' And he answered this in his opening sentence when he said: 'We don't know how scientific discoveries are made and, yes, it does matter, because some people think they do.' Intolerance, ignorance and even superstition remain as enemies of progress, and Landes sums all this up so beautifully in the closing words of his book: 'The one lesson that emerges is the need to keep trying: no miracles; no perfection; no millennium; no apocalypse. We must cultivate sceptical faith; avoid dogma; listen and watch well; try to clarify and define ends the better to choose the means.'

Science policy and collaboration with Korea

Korean science and technology policy has passed through a number of phases, related to the progress of that country's industrialisation. These are described in a recent report by the Australian Academies of Science, and Technological Sciences and Engineering, and contrast with policies pursued in Australia.

In the 1960s, when the main goal for industry was import substitution, Korea's science and technology strategy was to build technical education and import foreign technology.

In the 1970s research institutions were established to further education, adapt imported technology and conduct research for particular industries. In the 1980s industrial policy sought comparative advantage and private industries began to establish their own laboratories.

Since 1990 Korean policy has aimed to improve national competitiveness through national research projects, demand-oriented technology development, human resources development and the globalisation of research. A five-year plan for innovation was adopted in 1997.

The Korea Science and Engineering Foundation (KOSEF), which was established in 1977, funds research, education, industry links and international cooperation.

The President of the Korea Science and Engineering Foundation, Dr Chung-Duk Kim, centre, and other KOSEF officials with Thérèse Lewis, second from left, and Elizabeth Meier from the Australian Academies.

The Australian Academies of Science, and Technological Sciences and Engineering, and KOSEF have been collaborating in scientific workshops and exchanges since the signing of an agreement in 1992. Joint workshops have been held on water and wastewater treatment, advanced ceramics, light alloys, evolutionary computation, manufacturing technology, polymers, synchrotron research, environmental technology, biotechnology and deposition in the atmosphere. Many individual scientists have made short visits.

There have also been a number of official delegations from one country to the other. Following discussions in Australia about ways of improving cooperation with Korea, the Australian Academies took the opportunity of the light metals workshop in May (see report on this page) to meet Korean researchers and administrators and share ideas on science policy and cooperation.

The representatives of the Australian Academies, Thérèse Lewis and Elizabeth Meier, visited Korean universities and research institutes, discussing existing or potential collaboration with Australian scientists. A meeting with KOSEF staff negotiated a revised memorandum of understanding between the organisations and made further plans for links and exchanges.

A full report of the visit is available from the Academy's website at **www.science.org.au/internat**.

Schizophrenia symposium

The Academy of Science recently held a symposium called *Schizophrenia and other psychoses: translating research into policy and action*. The symposium, held in Canberra in October 2000, brought together policy makers, medical researchers, administrators, consumers and carers. They discussed research findings, public policy and service provision needs.

A summary of proceedings will be made available on the Academy's website (**www.science.org.au**) or from Trish Nicholls, email **nr@science.org.au**.

Light metal alloy workshop

Light metal alloys are important to both Australia and Korea. Australia is the world's biggest producer of raw materials for the production of aluminium and is also likely to become a major producer of magnesium. Australian manufacturers, particularly in the car industry, export growing quantities of aluminium components.

Korean manufacturing industry is increasing its use of light alloys, especially to reduce the weight of cars.

Both countries have excellent research into the structure, properties and processing of light alloys. Workshops in 1996 and 1997 have built good relationships between Australian and Korean researchers. Another joint workshop on light alloys was held in Cheju on 25 and 26 May 2000.

The workshop was organised by the Australian Academies of Science, and Technological Sciences and Engineering, and the Korea Science and Engineering Foundation. Funding came from the Technology Diffusion Program of the Commonwealth Department of Industry, Science and Resources.

The Australian delegation was headed by the Chief Executive Officer of the Cooperative Research Centre for Cast Metals Manufacturing at the University of Queensland, Professor Gordon Dunlop. It included young researchers and industry representatives from Comalco Aluminium, the Australian Magnesium Corporation and Nissan Castings.

The Korean group was led by the Director of the Centre for Advanced Aerospace Materials at the Pohang University of Science and Technology, Professor Nack Joon Kim. It included industry representatives from Hyundai and the Korea Automotive Technology Institute.

The presentations covered overviews and details of research, and applications to manufacturing. The industry representatives helped to focus discussion and steer collaboration towards industrially significant research.

The workshop ended with an extensive discussion of possible areas of collaboration. Draft project outlines are being considered. A single project, possibly in the area of magnesium alloys, is expected to result.

Exchanges for young researchers

Ten scientists have travelled to the USA and ten to Europe under the Academy's 2000 exchange program for young researchers. The scheme is supported by the Technology Diffusion Program of the Department of Industry, Science and Resources.

USA

Dr Craig Styan, of the Department of Zoology at the University of Melbourne, visited the Darling Marine Centre in Maine to study spawning in marine invertebrates.

Dr Xiu Song Zhao, of the Department of Chemical Engineering at the University of Queensland, visited Pennsylvania State University to study modification of the acidic properties of MCM-41 for catalytic applications.

Dr Irina Dedova, of the Muscle Research Unit at the University of Sydney, visited the University of Illinois to study the structure and function of skeletal myosin and actin.

Ms Louise Phillips, of the School of Botany at the University of Melbourne, visited the University of North Carolina at Chapel Hill to study molecular techniques to determine tribal classification in red algae.

Dr Harrison Weisinger, of the Department of Food Science at the Royal Melbourne Institute of Technology, went to the National Institute on Alcohol Abuse and Alcoholism in Maryland to study the effect of dietary omega-3 fatty acids on the retina.

Ms Sarah Jane Pethybridge, of the University of Tasmania, visited Washington State University at Prosser to study purification of the viruses infecting hops.

Mr Ben Hoffman, of CSIRO Tropical Ecosystems, visited New Mexico State University to study thermally controlled dominance hierarchies in ant communities.

Mr Craig Jin, of the Department of Physiology at the University of Sydney, visited the University of Maryland to study auditory sound localisation.

Dr James Whisstock, of the Department of Biochemistry and Molecular Biology at Monash University, visited the University of Massachusetts to study serine proteinase inhibitors.

Ms Lisa Kewley, of the Research School of Astronomy and Astrophysics at the Australian National University, went to Iowa State University to study the energy source of luminous infrared galaxies.

Europe

Dr Carmen Gaina, from the Division of Geology and Geophysics at the University of Sydney, visited the Institute of Geophysics in Paris to explore a new tectonic model for the evolution of the central Indian Ocean.

Mr Charles Warren, of the Department of Botany at the University of Western Australia, visited the French National Institute for Agronomical Research at Champenoux to find out about *Pinus pinaster*.

Mr Bradley Wilsmore, of the Department of Physiology at the Australian Institute of Sport, went to the Copenhagen Muscle Research Centre to study the mechanisms controlling muscle blood flow during exercise.

Ms Megan Munsie, of the Centre for Early Human Development at Monash University, visited the University of Cambridge to compare gene expression in cell lines of cloned embryos.

Mr Carl Reidsema, of the Department of Mechanical Engineering at the University of Newcastle, visited the University of Strathclyde in Scotland to study the development of blackboard systems in planning concurrent engineering design processes.

Ms Glynis Bailey, of the School of Psychology at the University of New South Wales, visited the University of York to study neural mechanisms of within-event learning.

Mr Phillip Isaac, of the Department of Mathematics at the University of Queensland, went to the University of London to study quasi Hopf algebras and quantum groups.

Dr Sharon Allen, of the Centre for Ore Deposit Research at the University of Tasmania, went to Germany to visit the GEOMAR Research Centre in Kiel and study the simulation of volcaniclastic gravity flows.

Mr Gregg Suaning, of the Graduate School of Biomedical Engineering at the University of New South Wales, visited Aalborg University in Denmark to study electronic vision for the blind and neuromotor control prosthesis for quadriplegia.

Dr Geordie Mark, of the Economic Geology Research Unit at James Cook University of North Queensland, visited the Swedish Museum of Natural History to study proterozoic iron oxide deposits.

Oxburgh visits

The Rector of the Imperial College of Science, Technology and Medicine in London, Lord (Ronald) Oxburgh, visited the Academy on 20 September. Lord Oxburgh is a Corresponding Member of the Academy. He is pictured signing the Academy's Charter book with his wife, Lady Oxburgh.

Forum on greenhouse gases

The Academy's National Science and Industry Forum recently held a meeting on Australia's obligations to reduce its contributions to greenhouse gases in the atmosphere. The forum, entitled *Greenhouse gases – meeting our bottom line*, was held in Melbourne in October 2000. Speakers included leaders from a variety of industries and from research organisations.

A report of the meeting will be made available on the Academy's website (**www.science.org.au**) or from Faye Nicholas, email **ac@science.org.au**.

The Australian Greenhouse Office sponsored the forum.

Exchanges to North America

Twenty-eight scientists will travel to North America during 2000 and 2001 as part of the Academy's international exchange program with North America. The program is funded by the International Science and Technology Networks element of the Department of Industry, Science and Resources.

Dr Kevin Williams, of the South Australian Research and Development Institute, will visit the International Maize and Wheat Improvement Centre in Mexico to study the mapping of genetic traits for drought tolerance and disease resistance in wheat.

Dr Michael Shats, of the Research School of Physical Sciences and Engineering at the Australian National University, will visit the University of Wisconsin-Madison to study comparative analysis of plasma confinement in stellarators.

Dr Alexander Cogle, of the Centre for Tropical Agriculture in Queensland, will visit Michigan State University to study action in catchments.

Dr Martin Hand, of the Department of Geology and Geophysics at the University of Adelaide, will visit Dalhousie University in Canada to study metamorphosis in high-temperature, low-pressure orogenic belts.

Dr Robert Robson, of the School of Computing, Mathematics and Physics at James Cook University of North Queensland, will visit Chatham College in Pittsburgh to study the kinetic theory of electron swarms in molecular gases.

Dr Murray Batchelor, of the Department of Mathematics at the Australian National University, will visit Florida Atlantic University to study solvable models in statistical mechanics and pattern formation.

Dr David Miller, of the Department of Biochemistry and Molecular Biology at James Cook University, will visit the University of Colorado Health Sciences Centre to study mitochondrial RNA uptake in a model lower animal.

Dr Frank Seebacher, of the Department of Zoology at the University of Queensland, will visit the Centre for Reproduction of Endangered Species in San Diego to study patterns of body temperature in reptiles.

Dr Evans Lagudah, of CSIRO Plant Industry, will visit DuPont Agriculture Products in Delaware to study gene organisation and distribution in wheat.

Dr Gang-Ding Peng, of the Optical Communications Group at the University of New South Wales, will visit the NEC Research Institute in New Jersey to study the interconnection of polymer optical fibre networks.

Dr Annette George, of the Department of Geology and Geophysics at the University of Western Australia, will visit the University of Manitoba to study Devonian reef complexes in western Canada.

Dr Besim Ben-Nissan, of the Department of Chemistry, Materials and Forensic Science at the University of Technology, Sydney, will visit the University of Alabama to study ceramic femoral head/metallic taper joints.

Dr Bernard Degnan, of the Department of Zoology and Entomology at the University of Queensland, will visit the University of Washington to study marine invertebrate metamorphosis.

Dr Lila Gurba, of the School of Geology at the University of New South Wales, will visit Indiana University to study the determination of nitrogen content in coal using electron microprobe techniques.

Associate Professor Paul Munroe, of the Electron Microscope Unit at the University of New South Wales, will visit Dartmouth College in New Hampshire to study yield strength anomalies in intermetallic compounds.

Associate Professor Tom Davis, of the School of Chemical Engineering and Industrial Chemistry at the University of New South Wales, will visit Queens University in Ontario to study diffusion-controlled transfer reactions in polymerisation.

Dr Colleen Olive, of the Molecular Immunology Laboratory at the Queensland Institute of Medical Research, will visit Torrey Pines Institute for Molecular Studies in San Diego to identify novel protective malaria epitopes.

Dr Keith Ayotte, of CSIRO Land and Water, will visit the National Centre for Atmospheric Research in Colorado to study the development of three-dimensional steep terrain flow models for wind energy resource calculations.

Dr Jeffrey Baldock, of CSIRO Land and Water, will visit the University of Washington to study the chemical structure of organic nitrogen in soil.

Dr Judith Layton, of the Ludwig Institute for Cancer Research in Melbourne, will visit the Howard Hughes Medical Institute Research Laboratories in Massachusetts to learn techniques for mapping and cloning the genes in zebra fish.

Dr Zhongyi Li, of CSIRO Plant Industry, will visit Iowa State University to study a maize gene involved in starch biosynthesis.

Dr Antoinette Tordesillas, of the Department of Mathematics and Statistics at the University of Melbourne, will visit the Earthquake Engineering and Geosciences Division of the US Army Corps of Engineers in Mississippi to study granular media and soil-tyre interaction.

Associate Professor David Fairlie, of the Centre for Drug Design and Development at the University of Queensland, will visit the Harvard Medical School in Massachusetts to study molecular shapes that mimic protein surfaces.

Associate Professor Marshall Lightowlers, of the Veterinary Clinical Centre at the University of Melbourne, will visit the National Centre for Infectious Diseases in Atlanta to look at the development of a vaccine against cysticercosis.

Dr Simon Southerton, of CSIRO Forestry and Forest Products, will visit Oregon State University to study molecular strategies for flowering control in eucalypt forestry.

Dr Jennifer Stow, of the Centre for Molecular and Cellular Biology at the University of Queensland, will visit Massachusetts General Hospital to study membrane traffic in kidney cells.

Dr Heidi Dungey, of the Cooperative Research Centre for Sustainable Production Forestry, will visit North Carolina State University to study new models in the genetic analysis of *Pinus* hybrids.

Dr Nigel Preston, of CSIRO Marine Research, will visit the Centre for Investigation into Food in Mexico to study waste treatment technology for prawn farms.

New home page for science education

The Academy has set up a new science education home page (**www.science.org.au/scied**) as part of its website. The aim is to bring together the diverse educational information on the site.

One of the new resources accessible from the science education home page is *Back to basics* (**www.science.org.au/scied/basics.htm**), a collection of annotated links to high quality websites explaining basic science concepts. The first four topics are 'Atoms and molecules', 'DNA and genes', 'Electromagnetic radiation' and 'The immune system'.

Other links from the science education home page go to:

- *Nova: Science in the news* – information on topical issues in science, mathematics, health and the environment
- *Primary Investigations* – hands-on, enquiry-based lessons on science, technology and the environment for primary schools
- *Good science books for children* – an annotated list for ages 3 to 12
- Biographical information on Australian scientists – interviews with and memoirs of scientists
- Annual symposium – information about how teachers can attend the Academy's annual symposium to learn about cutting-edge science
- The Dome – the history, design and construction of this Canberra landmark, built in 1959
- Publications price list and order form for science education texts and teacher resources.

The new home page is an excellent starting point for exploring materials on the Academy website that are relevant to schools.

Supported by the Australian Foundation for Science

AIDS symposium

The National Academies Forum and the National Library of Australia are hosting a national symposium on 29 and 30 November 2000 in Canberra called *Every eight seconds: AIDS revisited*. The aims are to discuss strategies for the prevention, treatment and cure of HIV/AIDS and to help overcome Australian complacency by promoting greater public awareness of HIV/AIDS issues. For information see **www.naf.org.au/aids.htm**, or contact Sue Fraser at (02) 6247 5777 or email **ds@science.org.au**.

Cognitive processes in birds

The Academy's 2000 Selby Fellow was Associate Professor Irene Pepperberg from the Department of Ecology and Evolutionary Biology at the University of Arizona. Her research into cognitive processes in birds has called into question traditional assumptions about the nature of human uniqueness. She gave public lectures in Sydney, Armidale, Canberra and Melbourne in June.

Women scientists

Seven interviews with eminent women scientists have been completed as part of the Academy's *Video histories of Australian scientists* series. Funding was provided from the International Year of Older Persons through the Commonwealth Department of Health and Aged Care.

The women interviewed are Dr Isobel Bennett, a marine biologist; Dr Margaret Dick, a food microbiologist; Professor Maria Skyllas-Kazacos, a chemical engineer; Professor Fiona Stanley, an epidemiologist; Dr Gretna Weste, a botanist; Dr Jane Wright, an entomologist; and Dr Jean Laby, a physicist. Transcripts of interviews with Dr Bennett and Professor Stanley are on the *Video histories* website at **www.science.org.au/scientists**.

The Mazda Foundation is also funding interviews with five older women scientists. The grant will cover filming, as well as transcription and publication of the interviews on the *Video histories* website.

Supported by the Australian Foundation for Science

Grants for science awareness

The Science and Technology Awareness Program of the Department of Industry, Science and Resources has provided funding to enable the Academy to publish new technology topics on *Nova: Science in the news* (**www.science.org.au/nova**).

Part of the funding comprises matching grants, so that new technology topics can be sponsored at a cost of $2750 (including GST) rather than $5500.

The CRC for Advanced Composite Structures is the first organisation to take up the matching grant.

The NRMA–ACT Road Safety Trust has provided funding for two *Nova* topics. The first topic, 'Fatal impact – the physics of speeding cars', is available online, and explains why driving even a few kilometres per hour above the speed limit greatly increases the risk of an accident. The second topic, about new materials and car safety, will be available later this year.

The ACT Office of Adult and Community Education has given the Academy a grant to offer eight science workshops for senior citizens. The workshops include a talk by a scientist, followed by relevant hands-on activities from the *Primary Investigations* science program for primary schools.

Speakers have included Dr Arthur Brandwood, Mr Arthur Davies, Professor Neville Fletcher and Dr Murali Nayudu. The hands-on activities demonstrate what many of the participants' grandchildren or great grandchildren are doing in their science classes. Two groups from the Woden Senior Citizens Club in Canberra are involved in the program.

Supported by the Australian Foundation for Science

Biographers

Biographers have been appointed to write memoirs of former Fellows in *Historical Records of Australian Science*. The biographers of **Sir Mark Oliphant** are Professor John Carver, Professor Bob Crompton, Dr E K Inall and Dr L U Hibbard. The memoir of **Sir Robert Price** will be written by Dr Greg Simpson, Professor David Solomon, Dr John Shelton and Dr David Collins.

Einstein award to Fenner

The Albert Einstein World Award of Science has been awarded to Professor Frank Fenner, of the Australian National University.

The President of the Academy, Professor Brian Anderson, said, 'The fact that Frank Fenner has been selected confirms his standing as one of the greatest scientists Australia has produced.

Professor Frank Fenner

'Professor Fenner is the doyen of animal virology. He led the successful campaign to eradicate smallpox throughout the world.' For this he won the Japan Prize in 1988.

'His other work for Australia includes his contribution to controlling the rabbit plague through the use of myxoma virus,' said Professor Anderson.

'Frank continues at 85 years of age to make exceptional contributions to Australian life. He is a major benefactor and has established several new projects through his personal generosity. He has written, and continues to write, major works on the history of science.'

The award is made by the World Cultural Council, an international organisation of scientists and academics based in Mexico. The award was created to recognise people whose scientific and technological achievements had brought progress to science and benefit to humanity.

Award to honour Hill

The Academy has decided to establish an award to honour Dorothy Hill (1907–97), a former President of the Academy and Professor of Geology at the University of Queensland.

Professor Hill was one of the pioneers of Australian palaeontology. Her interest in fossil corals led her to study the Great Barrier Reef and Queensland coastal geology. She did research into stratigraphy and tectonics, applying it to the study of sedimentary petrology. Using this expertise she acted as a consultant to the Bureau of Mineral Resources and to oil exploration companies.

Professor Hill also supported state geological surveys and helped produce geological maps of Queensland. More information about her work is on the Academy's website at **www.science.org.au/academy/memoirs/hill.htm**.

The Academy is seeking $100 000 to support an annual Dorothy Hill award. About $60 000 has been raised to date, largely through the efforts of Professor Ken Campbell, a Fellow of the Academy who was once a student of Professor Hill's.

The award will support women undertaking research in fields related to Dorothy Hill's research interests – earth sciences, reef science, marine geology and hydrology. Researchers in physics and chemistry whose work is relevant to those fields would also be considered.

Information about the award and how to make a donation is at **www.science.org.au/awards/hill.htm,** or ring Nancy Lane at (02) 6247 5777 or email **do@science.org.au.** Donations are tax-deductible.

Prime Minister's Prize for Science

The inaugural Prime Minister's Prize for Science has been awarded to two Fellows from CSIRO Plant Industry in Canberra, Dr Jim Peacock and Dr Liz Dennis. Dr Peacock is Chief of the division. They shared the prize for their research in plant molecular biology which found and manipulated the gene that controls when plants flower. The $300 000 prize recognises scientific research conducted in Australia that promotes human welfare. A full report will be in the next *AAS Newsletter*.

*The Zoological Society of San Diego has awarded its 2000 Conservation Medal to **Professor Marilyn Renfree**, for her contribution to the cause of conservation. Professor Renfree, an authority on marsupial reproduction, is Head of the Department of Zoology at the University of Melbourne. She is pictured at the award dinner in May.*

Honours to Fellows

The French Academy of Sciences has elected **Professor Derek Denton**, of the University of Melbourne, as a foreign associate.

The Director of the CSIRO Australia Telescope, **Professor Ron Ekers**, has been voted President-elect of the International Astronomical Union. His term begins in 2003.

The Royal Australian Chemical Institute has awarded its H G Smith Memorial Award to the Dean of the Research School of Chemistry at the Australian National University, **Professor Denis Evans**.

Professor Donald Metcalf, from the Walter and Eliza Hall Institute of Medical Research in Melbourne, has won the Victoria Prize for his work on colony stimulating factors and cancer.

The Royal Australian Chemical Institute has awarded the Leighton Memorial Medal to **Professor Alan Sargeson**, of the Australian National University.