AUSTRALIAN ACADEMY OF SCIENCE

NEWSLETTER

January–March 1997 Number 35

Government urged to maintain pharmaceutical scheme

The Academy of Science has urged the Federal Government to continue the Factor (f) scheme, at least until the Pharmaceutical Benefits Scheme is reformed.

The Factor (f) scheme subsidises pharmaceutical manufacture in Australia in an attempt to balance the effect on drug prices of the Pharmaceutical Benefits Scheme. Late last year the government responded to an Industry Commission inquiry into the pharmaceutical industry. The government will soon decide on a replacement for the Factor (f) scheme, which expires in 1999.

In a letter to the Minister for Industry, Science and Tourism, Mr John Moore, the President of the Academy, Sir Gustav Nossal, argued the case for the scheme.

He said it had been a significant element in the increased momentum of the pharmaceutical industry, particularly the impressive growth in research and development and capital investment over the last few years.

A strong pharmaceutical industry contributed to better health as well as strengthening pharmacological and chemical research. Australia is strong in pharmaceutical research. Without the continuation of the scheme, scientific advances already made would not be built on and a source of research funds would be threatened.

The Factor (f) funds helped increase the commercial focus of Australian research, employing scientists and thereby generating a greater return on the public funds invested in medical education and research.

Sir Gustav said, 'continuing a Factor (f) type scheme on an interim basis will ensure a corporate commitment by the pharmaceutical industry to Australia. This will not only benefit Australian science and medical research but it will be of social and economic benefit to Australia.'

The price of trade is eternal vigilance

Australia's reputation as a clean country may be threatened by incursions of pest species unless significant resources are devoted to the implementation of the recent Nairn report, *Australian quarantine – a shared responsibility*, the President of the Academy, Professor Sir Gustav Nossal, said in December of last year.

'As in most defensive operations, the effort has to be made before the threat is apparent,' said Sir Gustav. 'Once foreign pests, either plant or animal, have breached Australia's quarantine defences, it will be too late. The recommendations of the Nairn review will require significantly increased expenditure on quarantine – to establish a statutory authority, a plant health council and a plant health quarantine facility – and an increase in the number of scientists to guide and implement the quarantine measures.'

Allied to the issue of quarantine is the problem of the decline in the number of taxonomists and the availability of courses in taxonomy. Taxonomists are the ones who will provide the speedy identification so crucial in stopping inadvertent incursions of pests.

In calling on the Federal Government to implement fully the recommendations of the Nairn report, Sir Gustav pointed out the importance of maintaining our high quarantine standards.

'We must balance short-term economic considerations affecting trade and export markets with the longer term interests of sustainable agriculture, human health and environmental protection,' he concluded.

Foundation seeks scientists

Members of the Alexander von Humboldt Stiftung recently visited the Academy as part of a tour to encourage young Australian scientists to apply for fellowships to study in Germany. The picture shows the Head of the organisation, Dr Manfred Osten, left, Thérèse Lewis of the Academy, the Foreign Secretary Professor Roger Tanner, and Dr Alexander Hansen.

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The Australian coordinator of the workshop, Professor David Boger, left, and the Korean coordinator, Professor Jae Chun Hyun.

Workshop on rheology

As part of their efforts to increase collaboration between Australian and Korean scientists, the Australian Academies of Science and Technological Sciences and Engineering and the Korea Science and Engineering Foundation hosted an Australia-Korea workshop on polymer melt and polymer solution rheology from 25 to 28 November 1996.

The workshop was held at the University of Melbourne and coordinated by a Fellow of the two Australian academies, Professor David Boger, from the Department of Chemical Engineering at the University of Melbourne, and Professor Jae Chun Hyun, from the Department of Chemical Engineering at Korea University.

The workshop was opened by the Deputy Vice-Chancellor (Research) at the University of Melbourne, Professor Frank Larkins, a champion of international collaboration, and Professor David Solomon, whose topic, 'Making money out of plastic', reflected his role in developing Australia's plastic banknotes. Both are Fellows of both academies.

The remainder of the program was divided into three areas: constitutive modelling and flow studies, rheology of complex materials, and melt and solution rheology: techniques and applications. Thirty-six speakers from universities, research institutes and companies in Korea and Australia covered the field.

Participants agreed on the need for further meetings between Australian and Korean scientists working in rheology. Professor Boger said, 'The ultimate objective is to establish collaboration between individuals in their research in the two countries.'

Abstracts from the workshop have been published in a book and are available from Thérèse Lewis at the Academy, email **is@science.org.au**.

ARC funding by discipline

In October 1996 the Australian Research Council circulated a paper on funding strategies for basic research. The paper contains the distribution of 1995 funding against disciplines, between private and public sectors, and across socio-economic objectives.

The Academy's Secretary (Science Policy), Dr Keith Boardman, has responded. He wrote that the ARC was correct in identifying the international dimension of basic research as central to the balance of funding across disciplines. While the ARC was not seeking to set national research priorities, the Academy considered that better methods had to be found for the allocation of resources between disciplines.

Dr Boardman wrote, 'The role of basic research in the national R&D effort would be strengthened by a stronger R&D effort in the private sector and the establishment of stronger links between the universities and industry.'

Blevin delivers Rees Lecture

Dr William Blevin delivered the third Lloyd Rees Lecture on the topic of *Australian science made to measure* in Melbourne on 30 September 1996. The Academy holds the Lloyd Rees Lecture every two years to commemorate the life and work of Dr Lloyd Rees, who was Chief of the CSIRO Division of Chemical Physics from 1958 to 1978. Dr Rees made major contributions to the advancement of science and education and to the development of the scientific instruments industry in Australia.

In his lecture Dr Blevin emphasised the need to revise the definitions of the seven SI (Système International d'Unités) base units of international measurement as science and technology progress, and the continuing need to improve the accuracy and international uniformity in the physical realisation of the units.

He described the major advances that had taken place during the past 50 years, which included changes to the definition of the metre, second, ampere, kelvin, mole and candela. The continuing definition of the kilogram in terms of a material prototype is regarded as unsatisfactory and more fundamental alternatives are being investigated.

Advances in science and technology, said Dr Blevin, had led to greatly improved realisation of the units and, in particular, much use was made of newly discovered quantum effects and of cryogenic technology. These advances included several notable contributions from Australian scientists. In many instances this progress in metrology had been made possible by new discoveries resulting from uncommitted basic research.

Professor Geoffrey Opat, convenor of the Victorian Group of the Academy, left, Mrs Marion Rees, Dr Blevin and Dr Peter Hannaford, organiser of the lecture.

Dr Blevin has made outstanding contributions to measurement science, particularly in the fields of optical radiometry and photometry. He led the National Measurement Laboratory as Chief Standards Scientist from 1980 to 1988 and was Chief of the CSIRO Division of Applied Physics from 1988 to 1994.

He is currently Vice-President of the International Committee of Weights and Measures and was President of its Consultative Committee for Photometry and Radiometry from 1980 to 1996. In 1996 Dr Blevin was chosen by the Academy to deliver the Matthew Flinders Lecture.

Supported by the Australian Foundation for Science

Draft copyright rules may threaten research

The President of the Academy of Science, Sir Gustav Nossal, asked the Federal Government to oppose the introduction of new, restrictive copyright rules on databases. A treaty on database extraction rights, proposed by the World Intellectual Property Organisation, was to be discussed at a diplomatic conference in Geneva in December.

'Data collected in many different places, often at public expense, is the life-blood of much scientific research,' said Sir Gustav. 'The progress of science and the advancement of many other kinds of human knowledge and endeavour is based upon the principles of free exchange of data and information.'

At the moment, huge quantities of information from databases are available for use by researchers at nominal cost. While the Academy understands that some people want to strengthen their property rights, Sir Gustav pointed out that the suggested changes to copyright rules will endanger access by researchers. 'By increasing the control available to the database-makers, the new treaty threatens researchers' access to data. Those using large volumes of data, such as biological and climate researchers, simply cannot afford to pay for that data with their current research budgets.'

Australia will be particularly badly affected, as it uses more data than it generates.

It is not only the Academy which is concerned about this proposal. The International Council of Scientific Unions has also called for a delay while it studies the effects of the treaty and scientific academies in the USA have called on their government to oppose the treaty.

'The ramifications of the proposal are so wide that very careful consideration and wide consultation, especially beyond the boundaries of commerce and the electronic media, are essential. It is symptomatic that the scientific community has, until recently, been unaware of the proposal and has not had any input in its development,' said Sir Gustav.

Foundation AGM

The annual general meeting of the Australian Foundation for Science was held in Canberra on 26 November 1996. Copies of the report of the Board are available from Nancy Pritchard, telephone (06) 247 5777.

The Chairman of the Foundation, Mr John Ralph, previewed *Nova: Science in the news*, the Academy's new site on the World Wide Web (see page 5). In his remarks he noted: 'We will have a serious problem if we do not maintain standards that match those of nations which value education. The consequences will take years to become obvious and, unfortunately, just as many years to rectify if we allow this to occur. The comparative competencies in mathematics and science among students from different countries, which were released recently, certainly sounded a warning for Australia.'

He said that Australia needed scientists and technologists of world standing, operating at international best practice. 'Unless our standards and performance at the secondary level are sound and challenging, we will not produce a sufficient number of adequately prepared students to undertake the kind of university courses that are necessary in the fields of science, technology and engineering.'

The Making of Australia

At the Foundation AGM, Dr David Tilley, from the Geological Society of Australia, described progress on an educational project being produced by the Geological Society, CVA Film and TV, and Anarco Systems. *The Making of Australia* is an interactive CD-ROM for high school students, who will use it to investigate Australia's geological past and present. Ten well-known locations will be used as examples.

Foundation membership

Welcome to new Foundation supporters Dr Ray and Mrs Jill Garrod, Professor Noel and Mrs Gracie Murray, Dr John and Mrs Barbara Nixon, Dr Tania Obranovich and Dr Senga Whittingham. Thanks to Dr Victor and Mrs Mary Maslen for their continued support.

The Academy has received pledges of $3 362 184, with contributors recognised through membership of the Australian Foundation for Science. Over $2 million has been received. The Foundation has 239 supporters, comprising 144 Fellows, 18 other individuals, 24 scientific societies, 13 corporations, 10 trade associations and 30 other institutions. Membership levels show 4 Patrons, 13 Governors, 16 Trustees, 72 Members, 112 Donors, 19 Sponsors and 3 Friends.

The author of the successful book, *The future eaters*

Dr Tim Flannery

will speak at Becker House (the dome) in Canberra

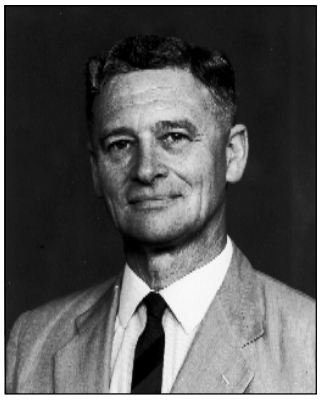
on 13 March 1997 at 5.30pm.

Dr Flannery is the Academy's 1996 Rudi Lemberg Fellow. His talk is titled, *Evolutionary trends in low-nutrient ecosystems*.

Low soil fertility and the Southern Oscillation in climate have had a profound effect on the development of Australian ecosystems. Coupled with global cooling and a northward continental drift, these factors have led to enormous biodiversity. Carnivores have been profoundly affected. There have also been effects on the body size of mammals and their adaptive strategies.

Dr Flannery will speak about his model containing two ecosystem types – nutrient shedding and nutrient maximising – which have evolved in response to these influences.

Dr Flannery will later visit Adelaide and Perth as part of the Fellowship.



Sir Ernest Titterton

Titterton on Internet

With the death of Sir Ernest Titterton in 1990, Australia lost one of its most controversial scientists. The Australian Academy of Science and the Australian Science Archives Project have now made information about him available on the World Wide Web. The project was launched before the annual general meeting of the Australian Foundation for Science in November 1996.

Titterton played an important role, both within the Australian scientific community and beyond it, for almost 50 years. He was highly regarded by some and attacked by others because of his forthright and uncompromising views about nuclear power.

Titterton's papers – 113 boxes of files – are in the Academy's Basser Library and are available for teachers and researchers to use.

The Internet site on Titterton contains a career summary and biographical memoir, photographs, and a detailed description of his papers. Among the papers listed are those from the Atomic Weapons Tests Safety Committee, the Royal Commission into British Nuclear Tests relating to Maralinga and the Ranger uranium mine environmental inquiry. The site is located at **http://www.asap.unimelb.edu.au/pubs/guides/titterton/**.

Financial assistance for the project was provided by Western Mining Corporation, the Australian Nuclear Science and Technology Organisation, the Australian Institute for Nuclear Science and Engineering, CRA Ltd, Energy Resources of Australia and PNC Exploration (Australia) Pty Ltd.

Supported by the Australian Foundation for Science

Nova coming to a computer near you

The Academy's *Nova: Science in the news* site on the World Wide Web will be launched early in 1997. The site will provide up-to-date and accurate information on science, technology, the environment and health issues in the news.

The Chairman of the Australian Foundation for Science, Mr John Ralph, provided a preview of the site at the Foundation's annual general meeting in November 1996. He said that *Nova* would overcome the curriculum gap between textbook theory and real-life applications of Australian science and technology.

The need for high-quality educational material on-line and the difficulty in identifying and locating good material were obvious problems. 'The goal of *Nova* is to meet this need, by becoming the network intermediary for secondary school teachers in the key learning areas of science, technology, the environment and health,' said Mr Ralph. 'There are more than 60 million sites on the Web. *Nova* will filter the glut of on-line information and add valuable educational support material.'

Nova is designed as an on-line exploration of the science behind the news. It gives teachers access to material that has not yet found its way into textbooks, and shows that science is a continuing process, not just cut-and-dried facts that were discovered years ago. *Nova* will be particularly useful in planning lessons and setting assignments, although the site will be useful to anyone with an interest in science. Links between *Nova* and other sites on the Web have been carefully chosen for their content and their ease of use.

Six topics are available. They are:

- mad cow disease
- rabbit calicivirus disease: biological control
- the Human Genome Project
- ozone depletion
- uranium mining in Australia
- direct solar energy.

Academy staff consulted widely with secondary school teachers from the ACT, Queensland and Victoria, who contributed to the final format. The teachers were delighted that Australian information on recent scientific discoveries would become more easily accessible.

A number of individuals and organisations have financially supported the development of topics for *Nova*. BHP has given a grant for environmental topics, and ACT Healthpact has contributed to topics on asthma, and sun and skin. The CSIRO Division of Plant Industry and the Walter and Eliza Hall Institute of Medical Research are sponsoring topics in their areas of research. The infrastructure of *Nova* is supported by the Foundation for Science and by the Science and Technology Awareness Program of the Commonwealth Department of Industry, Science and Tourism.

Nova can be found at **http://www.science.org.au/nova/**.

Supported by the Australian Foundation for Science

Primary Investigations training package

The Academy's *Primary Investigations* science and technology program for primary schools is more effective when teachers have been trained in its use. With the Starlit Cooperative Multimedia Centre at the University of Wollongong, the Academy is planning to produce a training package that teachers can use in small and isolated schools.

The package will include videotape, overhead transparencies and printed material. One of the teachers in the school will serve as a facilitator.

About 2300 schools have purchased *Primary Investigations* materials. Starter grants are being provided for New South Wales schools with special needs by an anonymous donor, and for schools in the Gladstone to Rockhampton area by Queensland Metals Corporation.

Students from St Thomas the Apostle Primary School, a **Primary Investigations *in Action*** *school in the ACT, carry out one of the activities from the Academy's* Primary Investigations *program. Photograph courtesy* The Valley View.

Supported by the Australian Foundation for Science

Academies meet on climate

The National Academies' Forum held a forum on climate change in Canberra on 25 November 1996. The forum, called *Australians and our changing climate: past experiences and future destiny*, brought together speakers from the natural sciences, the social sciences and the humanities.

The forum was organised by Professor Graham Farquhar, from the Australian Academy of Science (chair); Professor Stuart Harris, Academy of the Social Sciences in Australia; Professor Rhys Jones, Australian Academy of the Humanities; and Dr John Zillman, Australian Academy of Technological Sciences and Engineering. The four academies make up the National Academies' Forum.

The forum was opened by the federal Minister for the Environment, Senator Robert Hill.

Public policy

Professor Stuart Harris, from the Department of International Relations at the Australian National University, spoke on the public policy aspects of climate change. He described the complex scientific and human issues that decision makers need to consider when devising solutions to the problems posed by climate change. The standard approach to costs and benefits of proposed actions or inaction was often a problem for environmentalists, who have problems with what is included and how valuations are made.

He also discussed Australia's position in relation to the position and interests of other countries.

International panel

The Director of the Bureau of Meteorology, Dr John Zillman, reviewed the second assessment of the Intergovernmental Panel on Climate Change. This international body's first assessment in 1990 formed the basis for negotiation of the Framework Convention on Climate Change.

The second assessment report, the work of thousands of experts, has recently been released. This report concluded that greenhouse gas concentrations have continued to increase with the balance of evidence suggesting that humans have a discernible influence on global climate. However, there are still many uncertainties about the impact of climate change.

Dr Zillman commented on criticisms of the report: confusion on the definition of climate change, tension between scientists and diplomats, the influence of lobby groups, the pressure for consensus, and the question of who decides what constitutes dangerous human interference with the climate. He concluded that, overall, the assessment has worked remarkably effectively in its performance of an extremely difficult task.

Aboriginal responses

Professor Rhys Jones, a prehistorian from the Australian National University, described Aboriginal responses to environmental change. The last glaciation about 15 000 years ago would have greatly stressed human populations, with whole groups probably dying out in arid Australia. Paradoxically, the relatively treeless parts of western Tasmania may have supported a higher human population during this period than later, when the region became clogged by unproductive rainforest.

Between 14 000 and 6500 years ago the sea rose about 150 metres. People living in lower regions had to move to higher ground and islands were created. The Aboriginal people adapted to these changes, which make the predicted changes due to greenhouse gas emissions seem trivial. The greatest catastrophe could be a return to glacial conditions. Mobile hunters and gatherers with small population densities may have been better able to adapt than huge populations with fixed capital resources.

Human influence

The Director of the Cooperative Research Centre for Southern Hemisphere Meteorology in Melbourne, Professor David Karoly, examined the evidence indicating a human influence on climate. Climate model simulations based on three human factors showed good agreement with observed changes in the thermal structure of the atmosphere over the last three decades. This agreement is unlikely to have occurred by chance, through natural climate variability.

Vegetation and climate

Vegetation influences and is influenced by the atmosphere. Dr Roger Gifford from the CSIRO Division of Plant Industry described the effects of plant on land surface temperature and the plants responses to increases in carbon dioxide.

He said that, combining uncertainties about primary production, plant mass, organic matter in soils and plant responses to changes in carbon dioxide concentration, produced an alarmingly wide range of possible carbon dioxide sequestration rates. The major limitations on improving this estimate were observational and experimental, rather than modelling requirements.

Professor Graham Farquhar, from the Research School of Biological Sciences at the Australian National University, looked at the likely consequences of carbon storage in the biosphere. From the plant's perspective, the effect of doubling the carbon dioxide was roughly the same as doubling the rainfall. In Australia that was very important.

Australia had the opportunity for the clever use of genetic material – material that exists or that could be developed – to take advantage of the climate changes if they occur. Biology could be used to generate sinks for carbon dioxide: Australia could reduce its emissions by planting trees.

Human health

Dr Charles Guest, from the National Centre for Epidemiology and Population Health at the Australian National University, showed the importance of heat-related health problems in Australia. Heatwaves posed significant risks for public health. He also considered indirect effects of climate change: mosquito-borne diseases like malaria and dengue fever. The populations of developing countries were most vulnerable to the health effects of climate change.

Sources and sinks

Dr Ian Galbally, from the CSIRO Division of Atmospheric Research, looked at the national inventories of greenhouse gas sources and sinks being prepared as part of the Framework Convention on Climate Change. How much confidence could be placed in the inventories? He compared the data in the inventories with scientific observations of the atmosphere, compared Australia's

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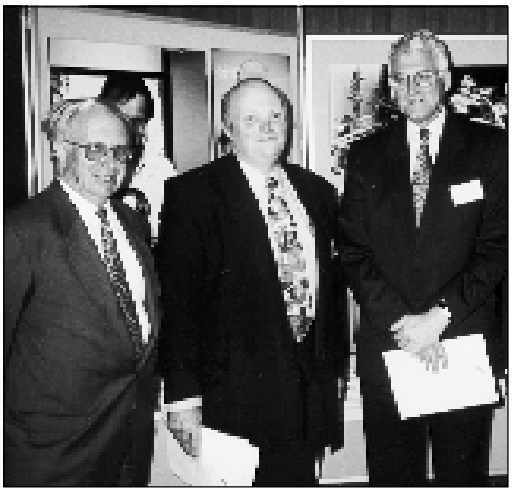
Reversing the chemical deficit



Professor Graham Johnston, left, Dr Greg Simpson and Dr Tom Spurling, organisers of the forum on the chemical deficit.

The 57th National Science and Industry Forum, entitled *Enhancing Australian chemical manufacture – reversing the chemical deficit*, was held in Sydney on 11 November 1996. Speakers from research institutions and companies described Australia's balance-of-payments problem in chemicals and made suggestions about what could be done.

Thirteen years ago the former Unichema Development Manager, Dr Robert Killick, and his wife Judy bought the 50-year-old Victorian Chemical Company. It was sink-or-swim. Now, with five times the sales and booming export growth, it is a different story. Bob told the forum that, by getting out there and having a go, small and medium enterprises can make big inroads on the chemical deficit.

As Chief of the Division of Chemicals and Polymers within the CSIRO at a time when it is increasingly orienting its research to commercial purposes, Dr Tom Spurling is at the interface between public sector research and industry. He said that technology is the key for industry to have any chance of redressing the chemical deficit. Otherwise Australia will find itself importing both technology and products.

The Victorian Government is optimistic about attracting new investment and is currently examining opportunities for investment in the chemical, plastics and rubber industries. Mr Richard Fowler, an industry specialist with Business Victoria, described the details of a study being undertaken for the state government by Stanford Research Institute.

Dr Graeme Blackman, Chair and Managing Director of the Institute of Drug Technology Australia Limited, described his company's progress from the consulting arm of a public educational institution to a small, yet serious and ambitious player in the high-risk business of developing the capacity for manufacturing active drug substances in the pharmaceutical industry. High-value pharmaceuticals were a shining example, but there is still a way to go.

Mr Michael MacKellar, Chief Executive of the Plastics and Chemicals Industries Association, presented the forum with a wealth of data from the association's imports study, and concluded with a challenge for governments: they have to decide whether they really want balanced trade and be prepared to offer investment incentives to get it.

Mr Keith Croker, who heads the federal Department of Industry, Science and Tourism resource processing industries branch, provided a perspective on the role of government and gave a commitment to work with the sector to increase exports.

Mr Leo Hyde, DuPont Australia's Research and Development Manager, outlined what he sees as some of the basics of a good relationship between a private company and public research institutions and provided examples of his company's successful relationships with two Australian research providers.

With the Federal Government committed to tax reform, the plastics and chemicals group partner of KPMG Chartered Accountants, Mr Rae Vecchio, outlined possible changes he felt would improve the industry's investment climate. He said not to look for tax concessions, but to go for grants.

The group discussions held as part of the forum's afternoon program came up with a series of points that were later reported back to the final plenary session.

The CSIRO Division of Chemicals and Polymers has set up an email address to encourage interactive discussion on the chemical deficit.

For a copy of the report of the talks given to the forum, email Faye Nicholas at the Academy at **ac@science.org.au**. (The report is also available at **http://www.science.org.au/industry/nsifr/dec96contents.htm**)

Academies on climate

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inventory with other countries, looked at estimates for the future and trends derived from the past.

Industry response

Professor Greg Tegart, from the University of Canberra, spoke on industry's response to the greenhouse challenge. Seventeen industries and five industry associations have joined the Federal Government's Greenhouse Challenge Program. They are planning to reduce greenhouse gas emissions and develop new technology which will reduce emissions further.

At the end of the forum there was a panel discussion with Mr Ian Carruthers from Environment Australia, Ms Meg McDonald from the Department of Foreign Affairs and Trade, and Mr Vivek Tulpulé from the Australian Bureau of Agricultural and Resource Economics.

Mr Tulpulé described the bureau's model of the global economy which covers the impact of climate change policy. This showed that developed countries were becoming less important in carbon dioxide emissions. Developing countries needed to be brought into the process of greenhouse gas reduction. Developed countries with low emissions, like Japan, might find it costly to reduce emissions further.

A summary of the proceedings is available from Rachel Meissner at the Academy, email ns@science.org.au. A follow-up forum, *The challenge for Australia and global climate change*, convened by Professor Stuart Harris, is planned for April 1997.

Mander lectures on plant hormones

As noted in the last *AAS Newsletter*, Professor Lew Mander delivered the Australian Foundation for Science Lecture at the ANZAAS Congress in Canberra on 2 October 1996. His lecture was entitled, *A quest for selectivity in the bioactivity of the gibberellin plant bioregulators - a parable of our times*. Professor Mander is from the Research School of Chemistry at the Australian National University. Below are some excerpts from his lecture.

'As a high school student in the mid-1950s I was intrigued by a report in the press of a group of compounds that had profound effects on the way that plants grow. Little did I know that I would become more closely involved in the science of these compounds.

'The compound in question is called gibberellic acid. It is representative of a group of chemicals that regulate the way plants grow and develop.

'Gibberellic acid is a complex molecule. It is a challenging and fascinating task for chemists to understand how to manipulate this molecule and to find the molecular basis of its activity.

'When plants grow – from germination, growth, flowering, fruit formation to eventual senescence (the ripening of fruit and yellowing of leaves) and dying – they are regulated by a complex array of hormones.

'Gibberellic acid was discovered in Japan, in a fungus growing on rice plants. It had some fairly devastating effects on the way that the rice plants would grow: they would grow very tall and then fall over and the crop would be damaged.

'Within a few years it was discovered that these gibberellins were formed not only by a fungus, but they were endogenous to a whole range of higher plants – maize and other cereals, pine trees and poplars. They are associated with the breaking of winter dormancy, stimulating the formation of enzymes essential for growth.

'Gibberellins could be used to grow bigger plants. But inducing growth is not always a useful trait. The green revolution bred dwarf, hybrid cereals by limiting the action of gibberellins.

'There is a cornucopia of activity and potential. Unfortunately it has not been realised to the extent that we might have envisaged back in the 1950s when these compounds were discovered. World production of about 100 tonnes a year of gibberellins, from the fermentation of the fungus *Gibberella fujikuroi*, finds its way onto seedless table grapes, apples, citrus fruit and camellias.

Professor Lew Mander at the ANZAAS Congress.

'My prime motivation has been to try and understand the science of these compounds. If out of that could come applications to horticulture and agriculture that would be terrific – for the country and to help me finance my research.'

Professor Mander described some of the chemistry of gibberellins. More than 100 naturally occurring gibberellins have been identified, and although many of these compounds are biological precursors or by-products of the physiologically active derivatives, in many cases the structural variations are associated with a diversity of function. 'One of the things we are trying to work out is why there should be such variety,' he said.

A systematic search for structural patterns that specifically elicit a flowering response using the long day plant, *Lolium temulentum*, as a primary screen, has led to the discovery of new families of gibberellins with promising biological properties. Members of one of these families generally promote flowering, but with less stem growth than is induced by most naturally occurring gibberellins. In one case, growth was actually inhibited.

Two further families of gibberellins inhibit growth quite strongly and furnish the prospect of producing commercially useful materials from fungal gibberellins that constitute an environmentally more acceptable alternative to other inhibitors used in agriculture and horticulture. It appears that the modified gibberellins exert their effects by interfering with the natural biosynthesis of growth-active gibberellins.

Professor Mander went on to reflect on science policy and practice.

'In this country pursuing science is becoming an increasingly unattractive career. I don't think many scientists are motivated by financial reward; that is fortunate because if they were there would be a grave deficit of them. I don't think they are being rewarded relative to their merits. Those rewards are dropping relative to the rest of society and there will be a limit to what we can tolerate.

'Science is becoming an increasingly tenuous career in this country. Students go from postdoctoral fellowships to postdoctoral fellowships to postdoctoral fellowships. We must get more security, more structure into the careers of our young scientists.

'Scientists are part of a very international community. If Australia does not give them the right conditions, if it does not recognise their efforts appropriately, they'll go away and they won't come back.

'It falls to all of us to try to convince our political masters of some of the hazards associated with the current trends in the funding of science.'

Supported by the Australian Foundation for Science

Mineral exploration: industrial research at the boundary of science

Mr Roy Woodall delivered the 1996 Ian William Wark Lecture to a group of Fellows and guests at the University of Melbourne on 28 November 1996. Over more than 40 years Mr Woodall has applied scientific techniques to the search for minerals, leading a team which discovered nickel at Kambalda in Western Australia and copper, uranium and gold at Olympic Dam in South Australia. He retired from his position as Director of Exploration for Western Mining Corporation in 1995 but continues as a non-executive director. Mr Woodall was elected a Fellow of the Academy of Science in 1988.

Sir Ian Wark (1899–1985) worked as a research chemist for mining companies before becoming Chief of the CSIRO Division of Industrial Chemistry in 1939. He admired the creativity of those who designed and improved technological processes by use of the scientific method.

Mr Woodall's lecture is printed below.

This lecture honours Sir Ian Wark whose joy it was to work at the boundary between science and industry and which he did with such brilliance. I did not know him personally but early in my career I found and read his book *Why Research* which was published in 1968 and dealt with his life of scientific research.

He then became an example to follow, as exploration for minerals and petroleum, which aims to apply science, is scientific research. First there is the idea or hypothesis, then careful observations, often in the field and at other times in some of the best equipped laboratories, then data classification and interpretation, and, most likely, a new phase of creative thinking. Finally the revised hypothesis is tested, usually with the drill.

Scientific mineral exploration is a research activity in which each 'experiment' is high risk, and costly. Moreover, as most of these experiments fail, the ultimate cost of an economic mineral discovery can be very high. The cost of a typical sequence of experiments in the Australian environment leading to the discovery of an economic nickel or gold deposit, has averaged, since 1955, $46 million: $23 million if exploring for nickel, $32 million if exploring for gold and $120 million if exploring for copper-lead-zinc. For companies with outstanding skills and innovative management the cost has been much less; for others, much more.

'There are few more important decisions for a scientist than choosing his mentors.' So said Sir Ian Wark when reviewing his own career. For me there were a succession of mentors. In 1948 it was Dr Tiller, one of a group of brilliant teachers who unselfishly gave of their time to teach at night at the Perth Technical School. It was there that I was able to complete my high school education while working as a junior clerk in the Western Australian Department of Public Works. Dr Tiller was enthusiastic about geography and geology and passed on that enthusiasm.

There are few more important decisions for a scientist than choosing his mentors.

Then there was Professor Rex Prider at the University of Western Australia and later, Professors Charles Meyer and Edward Wisser at the University of California, Berkeley. The love of science and the challenge of scientific research, which these mentors passed on to me, has never waned thanks in no small measure to the fertile environment I found when, in 1953, I joined Western Mining Corporation (now WMC Resources Ltd).

WMC's founder and early mentor was that outstanding Australian WS Robinson who, while not a scientist himself, was alert to the financial benefits that can accrue to those who prowl the boundaries of science seeking applications. He had heard of gold discoveries at mines in North America which had resulted from applying the high standards of geological observation and interpretation being taught at Harvard University. This application of science was pioneered early this century by a young engineer-surveyor, Reno Sales, whose precise geological mapping of the rich copper-silver lodes at Butte, Montana, was critical in the legal defence of his company's ownership of the mining rights: the giant Anaconda Copper Company was the result.

With this knowledge 'WS' commissioned Professor Donald McLaughlin, Harvard University's Professor of Geology, to establish an exploration team and strategy for WMC based on the application of the best of geological science. 'We had to use', Robinson said, 'all the latest skills and devices of science if we wanted success'. That strategy remains a precious part of WMC's culture to this day. It is interesting that Professor McLaughlin, WS Robinson's adviser, and Sir Ian Wark were almost contemporaries although I doubt that they knew each other: McLaughlin 1891 to 1984, Wark 1893 to 1985.

So it was that WMC, in 1933, set out on a bold adventure to use the sciences of geology, geochemistry and geophysics to explore for new gold deposits in Western Australia. It was not long before some of the first regional air photography in the world was undertaken and it was not long before more finance was needed to save the company from bankruptcy. Many bold investors in science have had a similar experience for the commercial application of science invariably takes longer, and is more costly, than early expectations.

'Geologists rank very high in describing what is, but those who describe what is likely to be are indeed rare birds.'

Mr Roy Woodall

Twenty years later, in 1953, WMC, led by Mr Lindsay Clark (later Sir Lindsay Clark), still remained committed to applying the best of geological science, despite financial difficulties. It was this commitment which attracted me on graduation to join the company. WMC was still a small, struggling Australian mining company, producing only 230 000 ounces of gold each year at a profit of £215 000, or about $4 million in today's monetary terms. Annual revenue was £240 000. The company's revenue is now 400 times larger, exceeding $2 billion, and much of this increase is the result of the application of science.

In 1953, gold was still the focus of all exploration in Western Australia and it seemed that all geologists agreed that only gold would be found. After all, 70 years of prospecting had found nothing else of significance in the state, except a little coal. It was none other than WMC's founder, WS Robinson who warned of such limited thinking.

'Geologists,' he said, 'rank very high in describing what is, but those who describe what is likely to be are indeed rare birds.'

WS wanted to support only scientists bold enough to be predictive. My mentor, Professor Prider was one of those rare birds, for in the 1950s he predicted that the Kimberley region of Western Australia was worth prospecting for diamonds.

A new era dawned in 1957 with WMC's 'discovery' of the Darling Range bauxite deposits. Known for many years, but ignored because of their high silica content, their rediscovery related to the observation that the silica occurred as quartz rather than in undesirable clay minerals. Hence the prediction that the deposits may have very favourable metallurgical properties, a prediction which proved to be true.

The important role of the geologist, as WS Robinson said so long ago, is not to just describe what is, but to be bold enough to say 'what is likely to be.' WMC exploration subsequently proved the deposits to contain some of the best bauxite ores in the world. Was WMC the discoverer? Most certainly yes, for, as Sir Harold Raggert correctly pointed out, the discoverer is one who sees what everyone else has seen and thinks what no-one else has thought before.

When the Norwegian Professor Victor Moritz Goldschmidt wrote his classic treatise on the elemental composition of the earth, he was a World War II exile in Great Britain and frequently in hospital or nursing homes. Little did he know his book, titled *Geochemistry*, would have relevance to a young geologist on the other side of the world in Kalgoorlie.

Early in the 1960s qualitative emission spectrographic analysis became available from the Australian Mineral Development Laboratories (AMDEL). This proved important when in September 1964 samples of fairly innocuous-looking ironstone were brought to me by a prospector. They were known to contain nickel, but so did so much iron-rich material overlying unmineralised rocks. Many such rocks contain nickel, but only in their silicate minerals and thus not in an economic form.

A field inspection showed the samples had been obtained from the base of a magnesium-rich igneous rock. This is a classical location for sulphides to accumulate, like the sulphide ores of nickel, and thus the ironstone samples were seen as possibly the weathered surface expression of nickel sulphides.

'Mysterious are the moments that…brushed me with their wings…when fate beckoned…'

When AMDEL reported the samples to contain, besides nickel, significant amounts of copper, molybdenum, silver and tellurium this became more certain. Copper was known to be associated with nickel sulphides and Professor Goldschmidt's comments on the other elements proved equally significant. He had this to say:

Concerning silver: 'silver should be preferentially connected with gabbroid magmas.' Such magmas are known to be associated with nickel sulphide ores.

Concerning molybdenum: 'small amounts of molybdenite are sometimes found in genetic relationship to basic gabbroid magmas…where it is a minor constituent of pyrrhotite-pentlandite-chalcopyrite ores.' Pentlandite is the main ore mineral of nickel sulphide ores.

Concerning tellurium: 'The element is present in significant amounts in pyrrhotite magmas together with pentlandite and chalcopyrite.'

It was as if Logan Pearsall Smith's words from his essay 'Trivia' had special relevance.

'Mysterious are the moments that…brushed me with their wings…when fate beckoned…'

The field observations, the AMDEL assays and Professor Goldschmidt's words were fragments of science which 'brushed me with their wings' and caused me to write to WMC's General Superintendent, Mr Laurence Brodie-Hall (now Sir Laurence) on 23 September 1964, as follows:

'As you will no doubt be discussing base metal exploration while you are in Melbourne, I think you will be interested in a prospect I visited on Monday… A prospector brought in several specimens…from the Red Hill area, 35 miles south of Kalgoorlie… The material is leached gossan and it can be expected that in the sulphide zone the nickel and copper will both be higher… I am not suggesting that I have found an orebody but the occurrence is of great interest… It confirms my belief that the country is not prospected for base metals…

'I would like you to spend a morning having a look at the occurrence some time. It is fair warning that we should not spend all our effort looking for base metals in the 'fashionable' areas of Eastern Australia while we have good 'hunting grounds' in our own backyard and still very little competition. The grass always looks greener on the other side of the fence…

'I would like to see us obtain a reserve over the area of Crown Land and thoroughly map the area during the summer vacation when I will have several university students on hand.'

The results of the summer mapping program exceeded my wildest expectations for we traced the gossan-bearing horizon, a contact between an ultramafic rock and an underlying basalt, for 22 kilometres and located many other occurrences of nickeliferous gossans.

In 1965 WMC was a small, struggling company, with very limited financial resources. The world's nickel mines were in Canada on the other side of the earth and the universal opinion was that Western Australia was good only for gold. After all, in many years of prospecting that is all that had been found.

So, for four months I showed the evidence; the gossans, their assays and the results of the field mapping to the wise and experienced scientists of several major foreign and Australian companies seeking their financial support in exchange for equity. If they believed in the significance of the data their masters did not show it with their cheque books. They could not see

beyond what is to what WS Robinson demanded of geologists, namely, predictions as to what is likely to be.

Prophetically, on Australia Day, 26 January 1965, the Managing Director of WMC, Mr Bill Morgan, came out boldly in a letter to Mr Brodie-Hall: 'discussions are to be called off and WMC will go it alone testing the gossans at Red Hill'. So on 20 April, 1965 I asked for £14 000 to test the hypothesis that the ironstone outcrops would yield nickel sulphides at depth. Still negotiations continued with some companies until June when Mr Bill Morgan's directive was finally accepted.

In January 1966 the first drill hole was underway at Red Hill, later renamed Kambalda after a nearby townsite surveyed at the turn of the century to support local gold mining. At a depth of 131 metres the hole passed through the predicted ultra-mafic-basalt contact and it was barren of any signs of nickel mineralisation. The sceptics were right! Or were they? Fortunately the geologist-in-charge, Dick Elkington, remembering his experience in Canada, kept the drill hole going and after another anxious 16 metres, cut 1.7 metres of 8 per cent nickel sulphide ore.

How close we might have been to abandoning the Kambalda experiment can be judged from the events that followed the initial drill hole. The next hole located on a separate prospect was barren, the third hole was abandoned before reaching its target, and when the drill returned to the site of the encouraging first hole, the next two holes, numbers 5 and 6, also failed to find any signs of nickel sulphides. The Kambalda experiment in the hands of a company with a different culture may well have fulfilled the following words which describe lost opportunities:

'mysterious are the moments that…brushed me with their wings and passed me by; when fate beckoned and I did not see it; when new life trembled for a second on the threshold; but the word was not spoken…and the might-have-been shivered and vanished, dim as a dream, into the waste realms of non-existence'

But it was not to be. There was enough encouragement in the first hole, and deep in hole No. 4, to keep the project alive; and there was that trust of science and scientists. Finally, the code was unlocked and a succession of intersections of high-grade nickel sulphides in subsequent drill holes put all doubt to flight. Eighteen months later, Australia exported its first nickel sulphide concentrates to world markets and the spectacular nickel exploration boom of the late 1960s was underway.

Thirty years later Kambalda's mines have produced almost a million tonnes of nickel in concentrate, and 700 000 tonnes of nickel has been identified in reserves and resources yet to be mined.

Mineral exploration, even when guided by the best science, is high-risk research. But its rewards can be spectacular. The ore so far found in the Kambalda region is equivalent to $17 billion of new national wealth and exploration continues to find more ore, thanks to science.

Science did not stop at Kambalda once the discovery had been made. Scientists at the mines, geologists, geophysicists and geochemists continue high standards of scientific inquiry as they carefully document the geology of the area. Each year their research results in the discovery of more ore and has developed the Kambalda region as a mecca for earth scientists interested in the earth as it was long ago, especially an area where, 2700 million years ago, there was such a prolific eruption of those unusual high-magnesium lavas and the associated nickel sulphides which poured out beneath the Archaean sea at temperatures of 1500 to 1600 degrees celsius. Scientists worldwide are still investigating their genesis which may well relate to events initiated at the core-mantle boundary, 3000 kilometres below the earth's surface.

The Kambalda nickel sulphide deposits were the first of their type found anywhere in the world; so was the WMC-discovered calcrete-hosted Yeelirrie uranium deposit, so was the giant Olympic Dam copper-uranium-gold deposit – discoveries which bear testimony to the power of science when harnessed by management.

Kambalda's ultimate worth to Australia and Australians is dwarfed by the 2000 million tonnes of copper-uranium-gold ore at Olympic Dam which will yield at least $100 billion of new wealth for Australia. But its discovery was the result of 20 years of scientific endeavour during which there were many occasions when that search might well have been abandoned but for trust in science and scientists.

In 1957 WMC commenced exploration for a major copper deposit on the Australian continent. Proterozoic rocks were considered, on the basis of empirical scientific evidence, to be the most likely age to be well-endowed with copper mineralisation. The first experiments were conducted in the Tarraji River valley of the Kimberley region of Western Australia but failed after four years. In 1966 a second series of experiments in the Warburton Ranges of Western Australia commenced but also failed after four years. In 1967 exploration commenced in the Pilbara region but 11 years of scientific observation, interpretation and hypothesis testing failed to find any economic mineralisation. The company's investment in this exploration, this research, was now a debt of $22 million in today's monetary terms.

In 1969 one of our geologists, Douglas Haynes, went on study leave to undertake doctoral research at the Australian National University. By this time I was, you might say, more like the head of the laboratory than an active researcher and explorer. The research at the Australian National University demonstrated that certain basaltic rocks when oxidised can be the source of copper-bearing fluids.

In 1971, in response to this new knowledge, a wide search was undertaken for such rocks and evidence of their existence was found in South Australia. The focus of the copper search thus changed over time from areas where science was telling us the rocks were favourable to host copper deposits, to areas where the rocks were most likely to have generated copper-bearing fluids.

From then on, teamwork became critical. In the team, led by Jim Lalor and Dan Evans, was a geophysicist, Hugh Rutter. Hugh interpreted anomalous gravity and magnetic patterns north of Port Augusta as due to potential source rocks, that is, oxidised basalts, concealed beneath desert sands and barren sediments.

Dr Tim O'Driscoll brought the results of his years of scientific research to bear on the search for deep fractures in the concealed bedrock, fractures which could form pathways for migrating copper-bearing solutions. The search finally focused west of the old opal mining town of Andamooka and a drill was sent to this remote area to test the theories.

In 1975 weak copper mineralisation was intersected in the first wildcat hole at a depth of 330 metres near a cattle watering point called Olympic Dam. The mineralisation was deeply buried under barren, younger sediment and was not economic. The next three drill holes failed to find any signs of mineralisation. Hole number 5 contained a little copper but holes 6 and 7 were barren and holes 8 and 9 only weakly mineralised.

But the search continued. We were seeing signs of copper mineralisation in rocks enriched in iron and severely brecciated and this was enough to maintain optimism even though the debt from copper exploration was now $25 million. When hole number 10 intersected 170 metres of 2.1 per cent copper the company's faith in science and trust of its scientists was finally shown to be justified.

Tenuous are the threads which link ideas and observations to discovery. How critical it is for there to be confidence in the scientists involved. How vital are the clues along the way; in the case of Olympic Dam, the extensive iron mineralisation, the shattered rocks, the signs of copper mineralisation, and the judgement of the team.

What do we learn from these encounters with research at the boundary of science which we call scientific mineral exploration? Firstly, we must have talented, highly motivated people at the laboratory bench, hence the reason staff recruitment was for many years one of my priority tasks. Once recruited, scientists must be encouraged to keep up-to-date and the best sent back to universities for study leave and research. Over the years 113 of WMC's earth scientists have been sent on such sabbaticals to the enormous benefit of the company.

Then there are the important non-technical people; board members, the managing director and other senior executives. They bear ultimate responsibility for the millions of dollars invested and at risk in exploration. There would not have been a Kambalda discovery in 1966 and an Olympic Dam discovery in 1976 without their trust, a trust built on mutual respect and frequent opportunities for the scientists to explain the concepts being pursued and the progress of their research and exploration.

Teamwork is critical and there is no better example of its importance than the discovery of the Olympic Dam deposit. Exploration teams are a mix of problem-solving scientists and creative scientists and their most critical ask of management is that most fragile commodity – trust. For creative teams need autonomy and freedom from regimentation and bureaucracy if they are to be effective. Such freedom is not possible without trust.

It is vital to preserve precious individuality if we wish to foster creativity and encourage intuition. Intuition is important because the explorer, like any research scientist, is so often faced with the need to make decisions when only fragments of information are available. But regimentation stifles intuition as does a scientist's fear of severe reprimand if wrong.

Tenuous are the threads which link ideas and observations to discovery.

Often being wrong is the cross we must be prepared to bear, as Sir Ian Wark learnt as manager of his laboratory. 'My function as the head of a laboratory was to battle for facilities, to encourage the staff in their brighter and more topical proposals, and to turn thumbs down on those which seemed hare-brained or too far removed from the accepted program. Always it was a question of priorities; we never lacked ideas, and we had to decide between them. And it would be a very foolish man who would claim that the choice was always right.'

'Research is a calculated risk,' he wrote. As for regimentation, it must be and can be avoided. As Sir Ian Wark said, 'It is a mistake to introduce restrictions for the few when most don't need them.'

Scientific mineral exploration is industry interfacing with science and WMC can boast many examples of its rewards. Besides discoveries of nickel, copper and uranium, gold discoveries have been among the company's rewards. For example, 60 years of scientific inquiry at Norseman has resulted in a succession of discoveries. More recently, in the country south of Kambalda we call St Ives, the combined skills of geologists, geophysicists and geochemists have resulted in even more spectacular gold discoveries.

All that changes year by year is the breadth of science with which the committed explorer finds it desirable to keep in touch and to apply. The sciences of geology, geochemistry and geophysics are of course critical but so is scientific research which is investigating Australia's exceedingly ancient and complex land surface. Even scientific inquiry concerning the deep earth, as deep as the core-mantle boundary, may well be relevant, as it is possible that from this region comes the energy required to drive the great epochs of ore formation which have occurred episodically throughout the earth's history. Then there is the interface with the world of microbiology with its potential to enhance our understanding of many geological processes as well as our ability to extract metals from their ores.

Finally, a word on that most critical human attribute, motivation. Mineral exploration scientists, and the technicians that support them, often are forced to make their observations and to do their thinking in lonely, desolate places far from home and the comforts of an air-conditioned laboratory. For the best, their motivation to succeed goes far beyond thoughts of personal financial gain. Their hearts and minds are stirred by the scientific challenges mineral exploration presents, the desire to be creative and their commitment to show that applying good science and technology is a worthwhile community activity. I can only recall one occasion in 30 years when a geologist, who had contributed to a discovery, sought a financial bonus. For the best explorers, working at the boundary of science, believe what poet Henry Longfellow said in 'The Song of Hiawatha', that stirring story of skill development, devotion and achievement.

You shall hear how Hiawatha
Prayed and fasted in the forest,
Not for greater skill in hunting,
Not for greater craft in fishing,
Not for triumphs in the battle,
And renown among the warriors,
But for profit of the people,
For advantage of the nations.

We remember Sir Ian Wark and his contribution as a scientist working at the boundaries of the industry. He too, I am sure, was motivated by such high ideals.

Measuring biodiversity – a master class

A Master Class entitled 'New Technologies for the Measurement of Biodiversity' will be held at the Universiti Pertanian, Malaysia, from 27 April to 17 May 1997. Its aim is to provide theoretical and practical material on modern methods of assessing biodiversity.

The class participants will also have the opportunity to attend the Malaysian National Symposium on Biotechnology. A 'class within a class' will be undertaken for three days in which chief executives of private corporations, senior public servants and others in positions of importance will be exposed to the basics of recombinant DNA technology and biodiversity technology.

The Master Class constitutes Australia's contribution to the program of the Federation of Asian Scientific Academies and Societies which the Academy joined on Australia's behalf in 1993. The secretariat of the Federation is located at the Indian National Science Academy.

The Academy invited the Crawford Fund for International Agricultural Research of the Australian Academy of Technological Sciences and Engineering to arrange the meeting, with funding from the Department of Industry, Science and Technology, the Academy of Science, the Crawford Fund and the Universiti Pertanian. The class will be led by a Fellow of the two Australian Academies, Professor Bruce Holloway.

The Crawford Fund Master Classes in Biotechnology are a means of transferring technology from Australia to countries in Asia.

The master classes emerged from an Australian Centre for International Agricultural Research-funded project 'New Approaches to the Control of Bacterial Wilt (*Pseudomonas solanacearum*) in Tomato and other Vegetable Crops' which ran from 1992 to 1995. This project involved the collaboration of Asian laboratories which had insufficient experience to adopt the required technology without further training.

Three such master classes have been held, with 15 participants in 1992, 17 in 1993 and 18 in 1994. Participants came from Indonesia, the Philippines, India, Sri Lanka, Nepal, Bhutan, Thailand, Bangladesh, South Korea, Brazil and Australia. In 1993 it was decided that Australians could participate, which has proved to be a major improvement, allowing better interactions between the providers and the class.

In 1993 Professor Holloway was appointed the Coordinator and the Crawford Fund for International Agricultural Research, as a component of the Academy of Technological Sciences and Engineering, was given the formal responsibility for providing three such classes a year.

It has been reported that demand for places in the Master Class has exceeded its capacity. The Academy hopes to be able to support further classes of a similar character in the future.

Science in the year 2000

The Executive Board of the International Council of Scientific Unions (ICSU) indicated their desire to have the celebrations associated with the commencement of the new century include science and scientific activities. ICSU is calling on all member bodies (scientific associations and national members) to do what they can.

The Australian Academy has established a small working group convened by Professor Tony Thomas looking at preparing a national effort for the year 2000. ICSU is planning to hold a special event associated with its 1999 General Assembly.

Some other topics on which resolutions were taken were:

- the need for radio frequency spectrum for radio science
- principles for the use of animals for research and education
- move of the secretariat for the Freedom in the Conduct of Science Standing Committee to the Swiss Academy
- the establishment of an ICSU Program on Capacity Building in Science
- Standing Committee on Responsibility Ethics in Science
- Committee on Science for Food Security
- reaffirmation of the principle of full and open exchange of data and information for scientific and educational purposes
- call to all ICSU members to work to remove the barriers encountered by women and to ensure that they have the same opportunities as men to work in science.

Dr Graeme Pearman

Great Barrier Reef

The Academy has stated that the Federal Government's decision on the Port Hinchinbrook development in Queensland failed to adequately consider the World Heritage status of areas adjacent to the development.

In a letter to the Minister for the Environment, Senator Robert Hill, the President of the Academy, Sir Gustav Nossal, wrote, 'The consideration of this proposal, by the public and by the governments concerned, has not been enhanced by some serious deficiencies in the environmental impact assessment process.'

The Academy encouraged the Commonwealth Government to work with the Queensland Government in such a way that any development in the region be required to be consistent with the Great Barrier Reef World Heritage Area Strategic Plan.

Sir Gustav wrote that science had a big stake in the consideration of complex environmental matters with significant impact. 'The good name of science is not always enhanced by the causes to which it is harnessed.'

Ninham: Ned Kelly & polymath

After 25 years as Head of the Department of Applied Mathematics at the Australian National University, which he founded, Professor Barry Ninham is taking a year's break to pursue his work in Sweden. Last October the university hosted a gathering of Ninham's colleagues who paid tribute to the man who has forged new paths through many fields. At that gathering, Emeritus Professor of History, John Molony, spoke with affection of his old friend and colleague.

Referring to Professor Ninham as his 'Ned Kelly', Professor Molony recalled battles they had undertaken together. 'I remember explaining to him once in a perfectly abstract way that my definition of a tyrant is a leader who places his own good before those for whom he is responsible. Unfortunately, I added that we have a sacred duty to overthrow a tyrant. Barry didn't hesitate. He said, "In that case, the Vice-Chancellor must go."' From then on, the battle was on, with many good things coming from the struggle, such as the welding of the research schools and the faculties 'in a way that had never been achieved before'.

Professor Ninham, observed Professor Molony, is one of the last of the polymaths, being familiar with the classics, the great English poets and writers, and, of course, science. 'When I say that he is a man steeped in an honourable past, I want to also affirm how he stretches towards the future. In so doing, he always steps with the uncertainty of a person approaching the, as yet, unknown. Nonetheless, he goes forward with the courage and the assurance of the true scholar. Because he has done the hard work and has the insight, Barry always knows that he is armed with the knowledge that leads to a further grasping of the sight of a glimmering truth.'

Honours to Fellows

The Ramaciotti Foundation Medal was awarded to **Professor Max Bennett**, of the University of Sydney's Institute for Biomedical Research, for his outstanding contribution to this field.

The British Endocrine Society has awarded its 1997 Dale Medal, its highest accolade, to the Director of Prince Henry's Institute of Medical Research in Melbourne, **Professor Henry Burger**, in recognition of 'outstanding studies which have changed our understanding of endocrinology in a fundamental way.'

The Davenport Distinguished Lectureship of the American Physiological Society for 1997 was awarded to **Professor John Furness,** of the Department of Anatomy and Cell Biology of the University of Melbourne.

The National Health and Medical Research Council has honoured two distinguished Australian researchers by dedicating awards in their names. Recent Nobel Prize winner, **Professor Peter Doherty**, and President of the Academy, **Sir Gustav Nossal**, will have postdoctoral fellowships and the top postgraduate medical scholarship named after them.

Sir Gustav Nossal, President of the Academy, received the Robert Koch Gold Medal in honour of 'outstanding scientific contributions to clonal antibody formation, clonal deletion / anergy, and the induction of immunological tolerance'.

James Quirk, retired Director of the Waite Agricultural Research Institute, has received the Soil Science Distinguished Service Award, presented to him by the Soil Science Society of America.

Emeritus Professor Robert Stokes, Foundation Professor of Chemistry at the University of New England, was awarded a special certificate to mark 50 years' membership of the Royal Australian Chemical Institute.

Dr Ross Taylor, of the Department of Nuclear Physics at the Australian National University, has been invited to visit Johns Hopkins University as the 1997 Ernst Cloos Scholar. Dr Taylor has an outstanding reputation based on his seminal studies of the origin and evolution of the earth, moon and solar system.

The Centre for Australian Cultural Studies has honoured **Robyn Williams**, ABC Radio National presenter, for his outstanding contribution to Australian culture. Mr Williams presents the acclaimed programs, *The Science Show* and *Ockham's Razor*.

Australia Day honours

Professor Peter Doherty continues to add to his many recent honours. It started with the 1995 Albert Lasker Basic Medical Research Award. In 1996 there was an honorary doctorate at the Australian National University and the Nobel Prize for Physiology or Medicine.

On Australia Day 1997 he was named a Companion in the General Division of the Order of Australia (AC) and Australian of the Year. All this for research done more than 20 years ago.

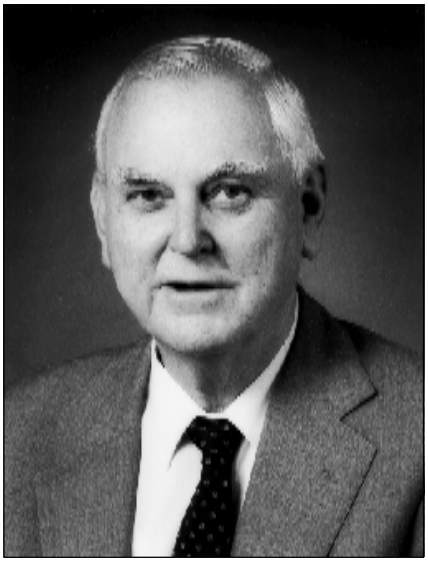
There is an interview with Professor Doherty on the Academy's World Wide Web site at **http://www.science.org.au/educatio/doherty.htm**.

The National Australia Day Council has declared **Professor Martin Green** the 1997 Australian Achiever for his contribution to renewable (particularly solar) energy technology. Professor Green is Professor of Electrical Engineering at the University of New South Wales and Director of the Photovoltaics Special Research Centre.

The Head of the School of Civil Engineering at the University of Sydney, **Professor John Booker**, became an Officer in the Order of Australia (AO) for his work in geomechanical engineering, particularly research and educational administration.

OBITUARIES

Geoffrey Thorburn



Professor Geoffrey Thorburn

Professor Geoffrey Thorburn died on 28 October 1996. His groundbreaking research has given us a greater understanding of a number of aspects of reproduction, parturition and foetal physiology.

Born in Sydney in 1930, he gained honours degrees from the University of Sydney in science (specialising in pharmacology) and in medicine and surgery. Apart from a short period spent as Travelling Fellow at Harvard Medical School, he stayed in his home town until the 1970s, working variously in Royal Prince Alfred Hospital, the University of Sydney and CSIRO.

One of Professor Thorburn's first breakthroughs came in 1967 in the field of reproductive physiology. He discovered a simple yet sensitive assay for progesterone, based on the competitive protein-binding method. He also developed a preparation which permitted the measurement of ovarian steroid secretion rates in conscious ewes over long periods. Using these techniques, Professor Thorburn was able to define precisely, in the same animal, the temporal relationships of oestrous behaviour and ovulation to the secretion pattern of three major reproductive hormones.

While visiting Oxford in the 1970s, Professor Thorburn had a chance to study parturition in the rhesus monkey. This research added a new dimension to our understanding of the maintenance of pregnancy and parturition in primates. However, despite this new insight, it is still unclear what causes premature labour and how it can be prevented. This formed the focus of much of his latest research at Monash University.

Professor Thorburn and his Monash team, in carrying out studies on prostaglandins, have given us important information on the factors that help maintain pregnancy. They have discovered a prostaglandin called PGE_2, which is essential in maintaining the specialised metabolism of the developing foetus. This prostaglandin, according to Thorburn, could play a central role in bringing on labour, by promoting the maturation of a number of organ systems that the baby depends on when it is born, while at the same time suppressing their function before birth. Furthermore, this research has unearthed the disturbing possibility that the use of painkillers during pregnancy could lead to foetal distress, by suppressing the placenta's production of PGE_2.

Professor Thorburn was elected a Fellow of the Academy in 1991. His contribution to our understanding of physiology will ensure he is long remembered throughout the scientific world. He is survived by his wife, Alison, and three children.

Lord Todd

A Corresponding Member of the Academy, Lord Todd, died on 10 January 1997. He was 89.

Alexander Robertus Todd was born in Glasgow and studied science at the Universities of Glasgow and Frankfurt. He did research at the Universities of Oxford and London, becoming interested in the chemistry of natural products. His work on the structure and synthesis of vitamin B1 led to industrial production of the vitamin. He studied the chemistry of other vitamins, aphid pigments and marijuana.

He became a professor in Manchester in 1938 where he studied the role of vitamins in coenzyme systems which are vital to the metabolism of animals. He then turned to the structure of nucleic acids, then seen as an unpromising field for experiment. He first synthesised nucleotides, the compounds which make up nucleic acids. This research led to other scientists discovering the genetic code and its double helix structure, probably the most significant biological advance of the century. For this work Todd received the 1957 Nobel Prize for Chemistry.

From 1944 to 1971 he was professor of organic chemistry at the University of Cambridge. He was knighted in 1954.

Lord Todd served on British government bodies advising on science policy and medical education. He was President of the Royal Society. He won many awards including honorary degrees from the Universities of Melbourne and Adelaide, and the Australian National University.

In his citation for the ANU degree in 1968, the former President of the Academy, the late Professor Arthur Birch, said, 'Lord Todd is a man of many parts: a research scientist of the highest calibre, a participant in government and industrial affairs, an outstanding educator and an organiser of science. His example successfully contradicts the idea that scientists are only at home in the laboratory.'

Professor Birch recalled turning up to Lord Todd's Cambridge laboratory one icy winter day. 'It speaks volumes for Lord Todd's organising capacity and humanity that he succeeded in rescuing me and soon put me down in more pleasant surroundings.' Lord Todd rehoused the old chemical laboratories in 1958.

New Corresponding Members

Two distinguished scientists have been elected Corresponding Members of the Academy. Corresponding Members are eminent scientists who do not live in Australia but have special links with Australian science. The Academy has 20 Corresponding Members.

Professor Pierre-Gilles de Gennes is Director of l'Ecole Supérieure de Physique et Chemie Industrielles de la ville de Paris. He won the Nobel Prize for Physics in 1991.

Professor de Gennes is a world leader in the physics of condensed matter, including the fields of magnetism, surface superconductivity, liquid crystals, polymer statistics and rheology, and the dynamics of wetting and drying. Beyond his scientific pre-eminence, he skilfully injects his science into industrial applications, he is a consummate expositor of science to the public and especially to young people.

Through Rhône-Poulenc, he has made contributions to Australian science-based industry; he collaborates with scientists from the Australian National University, the University of Sydney and CSIRO. He has visited Australia as a Bede Morris Fellow, giving seminars and talking to research groups in Melbourne, Canberra and Sydney.

Professor Rolf Zinkernagel is Director of the Institute of Experimental Immunology at the University of Zurich. He shared the 1996 Nobel Prize in Physiology or Medicine with Professor Peter Doherty (see the last *AAS Newsletter*).

Professor Peter Doherty, left, and his wife, Penny, Professor Rolf Zinkernagel, right, and his wife, Katrin, in Stockholm in December for the Nobel Prize presentation.

Professor Zinkernagel studied medicine at the University of Basel and biochemistry at the University of Lausanne before coming to the Australian National University to gain his PhD. He worked with Professor Doherty at the John Curtin School of Medical Research, where between 1973 and 1975 they carried out their prize-winning work on major histocompatibility antigens.

From 1976 to 1979 he did research in California, then he returned to the University of Zurich. He visited the Australian National University in 1996 for the conferring of honorary doctorates.

Polanyi delivers Frew Lecture

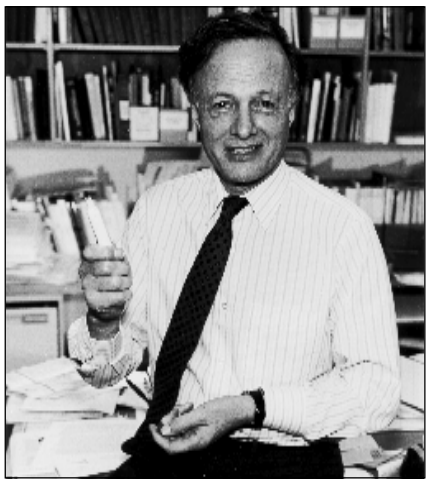
Professor John Polanyi, of the University of Toronto, Canada, delivered the Academy's Frew Lecture on the photochemistry of adsorbates and complexes on 15 July 1996 at the 20th International Quantum Electronics Conference in Sydney.

Since 1956 Professor Polanyi has been based at the University of Toronto, researching the molecular motions in chemical reactions in gases and at surfaces. He shared the 1986 Nobel Prize in Chemistry for his work in the field.

In his lecture he outlined the new field of chemistry in which molecules are aligned and positioned at a crystal surface before a reaction is triggered by a laser pulse, referred to as 'photochemistry in the adsorbed state'. In such experiments, the light can cause an electron to jump from a metallic substrate to the adsorbate, whereupon the latter reacts with the metal. This process is known as 'photoinduced harpooning', in which the harpoon is the electron and the fish being speared and hauled-in is the adsorbed molecule. The main interest of this area of research is its application in the nanofabrication of semiconductors using lasers and surface aligned photochemistry as an intelligent molecular cutting tool.

While in Australia, Professor Polanyi gave another lecture in Sydney and Canberra entitled 'Photochemistry in the adsorbed state: using light as a scalpel and a crystal as operating table'.

He also gave lectures on 'How discoveries are made and why it matters' in Melbourne and Canberra. The full text can be found in the *Australian Journal of Chemistry*.



Professor John Polanyi