



Australia's water management options

The Academy's latest public lecture series, *Water management options for urban and rural Australia*, explores the role of science in understanding the location and amounts of water, in predicting how supply and demand may change into the future, and in developing technical responses and improved management techniques. It also examines situations where such information is being brought together to provide practical, environmentally responsible solutions.

Dr Don Blackmore set the scene for the series with his lecture in September 2009 looking at Australia's water challenges.

Australia's unique hydrology means that its rivers are unreliable as streams. In response, we have built storage capacity. In the Murray-Darling we have the capacity to store one-and-a-half years of average flow, to maintain stability in water supply.

From a world perspective, he said Australia has world's best practice in water reform. 'Most people wouldn't believe it, but in terms of the institutional settings, we are well established,' although he acknowledged that we lack the knowledge to feed the change required in water reform.

Changes in rainfall mean that governments and communities are dealing with systems that we once thought were stable. Right now we are in 'an extreme event for which nobody in the water business would have developed their business to deal with. No-one! This has led to the necessity to trade; water security for cities against water availability for irrigators ...'

Looking at what that means for cities, especially with a projected population of 35 million in Australia by 2050, he said 'there are no silver bullets to this. The smorgasbord of things we have to deal with means we have to pick winners that are reasonable for us, and we have to be well enough informed to do it.' One thing in our favour is that every city now has a water plan. Regardless of whether you agree with elements of the plan 'it is well documented and you can deal with it.' One inevitability, he said, was that the cost of water is going to increase.



Photo: ©iStockphoto.com/jamesbowyer

Groundwater and surface water resources of the Murray-Darling Basin are fully committed

Dr Blackmore summarised the wide variety of challenges by saying, 'the headline message is ... [that] there is going to be less water, more variation in supplies and we need to be able to manage that.'

He shared his concern for the irrigation industry, 'at a strategic level no-one owns the irrigation industry any more. There is no vision for it ... I think we need an industry and community renewal program that gets the industry involved in what its future will be, because it is going to change dramatically.'

He was one of a number of experts to assess the feasibility of plans to transfer water from northern Australia to the southern states. He said, 'the cheapest of the options is three times more expensive than desalination in all its forms, fully costed. So it's unlikely ... These are just simple engineering problems but economically why would we bankrupt the country to do it?'

Andrew Campbell continued the series in October with the converging insecurities of the water, energy, carbon and food nexus

He outlined a context for the challenges facing the management of water. 'In my view that context is much broader than water and includes climate, water, energy, soil and land, and food ... Global fresh water availability

per capita ... is declining quite steeply. In aggregate, we use about a litre of water for every calorie we consume.'

He said that 'the Murray-Darling Basin is typical of the world's big irrigated food bowls. They have either fully committed or over-committed groundwater and surface water resources.'

This is now the driest 13-year period in the instrumented record in Australia: much drier than the great Federation Drought, and the 1930s drought, for south-eastern and south-western Australia ... Since 1997 the average inflow to Melbourne storages is 35 per cent lower than the previous average.'

He went on to look at the implications of the coming oil crunch and an end to the era of abundant cheap fossil fuels.

To meet growing need for food, traditionally we have been able to clear more land for cultivation, irrigate more land and divert more fresh water resources to food production. But we are no longer able to do that.

'In Australia, water and energy have historically been very closely coupled to GDP.'

Outlining the challenges, he said, 'we need to decouple economic growth from carbon emissions, ... break the relationship

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Published by the Australian
Academy of Science
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Canberra ACT 2601

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ISSN 1031-9204

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Honours to Fellows



Photo: Irene Dowdy

John Mattick

Australia Day Honours

Professor Elizabeth Blackburn
(Corresponding Member) was made a
Companion of the Order of Australia (AC),
for 'service to science as a leader in the field
of biomedical research, particularly through
the discovery of telomerase and its role
in the development of cancer and ageing
of cells, and through contributions as an
international adviser in bioethics.'

Professor Max Coltheart was made a
Member of the Order of Australia (AM),
for 'service to cognitive psychology as a
researcher and academic, and to people
with learning difficulties.'

Professor Jenny Graves was made an
Officer of the Order of Australia (AO), for
'service to scientific research in the field

of genetics, particularly of Australian
marsupials and monotremes, and their
relevance to international understanding of
human evolution.'

2010 NHMRC Australia Fellowships

The NHMRC Australia Fellowships are
Australia's most prestigious award in the
fields of health and medical research,
recognising researchers with the vision and
application to tackle some of the biggest
health issues facing society today. Included
in the list of 2010 Fellowships are three
Academy Fellows:

Professor Christopher Goodnow,
Australian National University – 'to apply
the technologies of massively-parallel
DNA sequencing and flow cytometry to
identify the root cause of auto-immune
disease, as well as allergy, inadequate
immunity to infection and lymphoid
malignancy.'

Professor Charles Mackay, Monash
University – 'to gain new knowledge on
immune responses, by exploring new
ideas on inflammation and the role of
diet and gastro-intestinal microflora.'

Professor John Mattick, University of
Queensland – 'to explore the scientific
and applied dimensions of his thesis
that the majority of the human
genome encodes a hidden regulatory
system that uses RNA to direct human
development.' ■

Important dates

11 March: Public lecture *Francis Crick:
Who was the man who discovered DNA?*
by Professor Robert Olby. 5.30–7.00 pm,
Shine Dome, Canberra. Contact savita.khiani@science.org.au or call 02 6201 9462.

25 March: Public lecture *Challenges for
the next 50 years* by Lord Martin Rees
of Ludlow. 5.30–7.00 pm, Shine Dome,
Canberra. Contact savita.khiani@science.org.au or call 02 6201 9462.

6 April: Public lecture in the water
series, *Water reform in Australia* by
Mr Ken Matthews. CSIRO Discovery
Centre, Canberra. Contact savita.khiani@science.org.au or call 02 6201 9462.

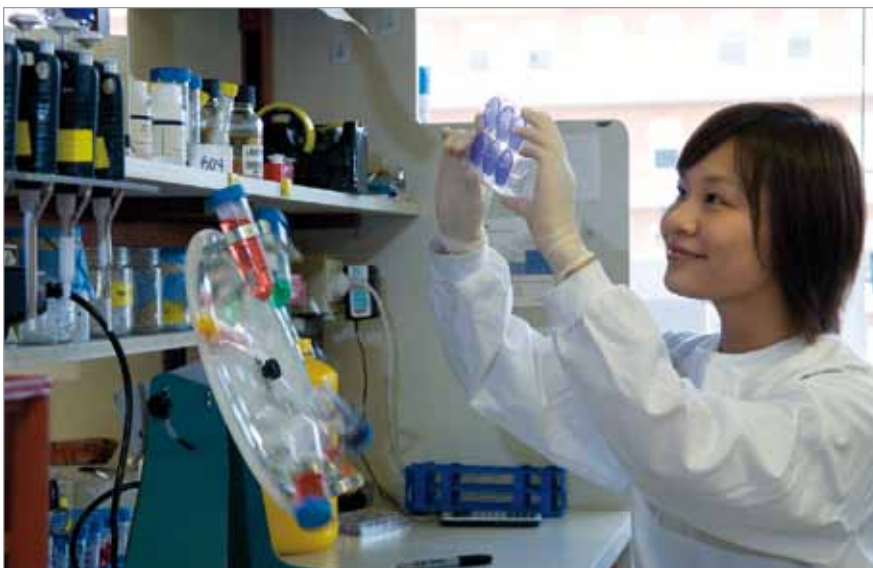
5–7 May: *Science at the Shine Dome*
annual general meeting and symposium,
Genomics and mathematics. Shine Dome,
Canberra. Contact savita.khiani@science.org.au or call 02 6201 9462.

International news

Adam J Berry Memorial Fund

The 2010 recipient of the Adam J Berry Memorial Fund is Ms Annie Xin, a PhD student at the Walter and Eliza Hall Institute of Medical Research. Ms Xin will be supported for eight weeks at the National Heart, Lung and Blood Institute of the National Institutes of Health in the US to undertake research on effective immune responses to viral infections.

The Berry Memorial Fund is co-managed on behalf of the Berry family by the Academy and the US National Institutes of Health Foundation. It aims to assist one early-career Australian researcher to work in the US at an institute of the National Institutes of Health each year. In addition to gaining valuable personal experience, recipients are expected to make a contribution to the research program of the institute they are visiting.



Annie Xin

JOINT AUSTRALIA–GERMANY CALL

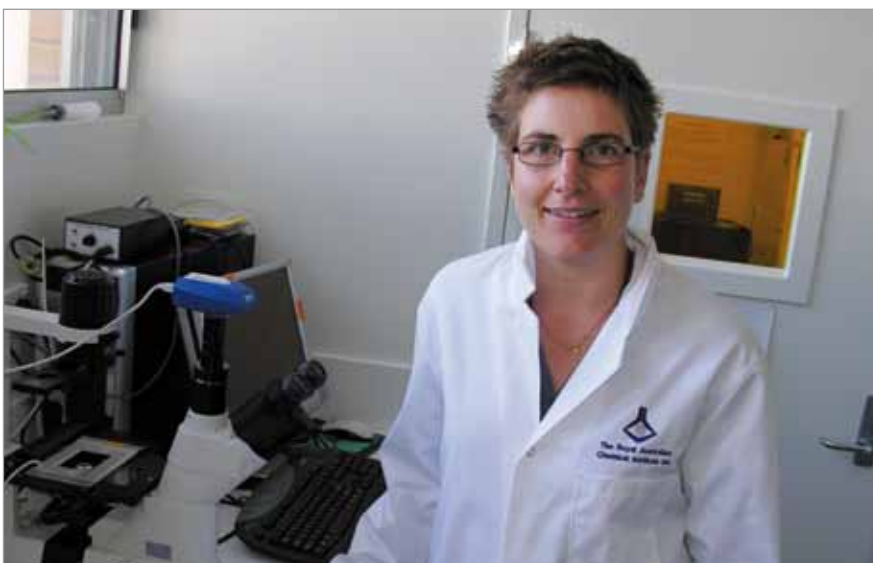
The Australian Academy of Science, on behalf of the Australian Government Department of Innovation, Industry, Science and Research, invites applications from Australian researchers wishing to establish or enhance collaborative projects with their German counterparts. Two new calls are now open:

**Australia–Germany
Researcher Mobility**
(closing date 16 April 2010)

**Australia–Germany Solar
Photovoltaics Research**
(closing date 26 March 2010)

Both programs are bilateral and the lead organisation from each country must submit an application to its respective government.

Further information is available from www.science.org.au/news



Rosanne Guijt

Rod Rickards Fellowship

The Rod Rickards Fellowship was established in 2009 by the family of Professor Rod Rickards FAA in memory of Professor Rickards' important contributions to Australian science through his outstanding achievements in the chemistry of compounds of medical, biological, agricultural and veterinary importance. The award provides funding for a researcher to

travel to Europe to undertake research in the area of chemistry or biology.

The first recipient of this award is Dr Rosanne Guijt of the University of Tasmania's Department of Chemistry. Dr Guijt will travel to the University of Basel in Switzerland to undertake research to improve sensitivity in contactless conductivity detection.

...continued on page 4

International news continued

Bede Morris Fellowship

The Bede Morris fellowship is supported by the family and friends of Professor Bede Morris FAA, in honour of his contribution to immunology and Australia–France relations. This award supports one outstanding scientist to travel to France each year to undertake research.

The 2010–11 recipient is Monash University's Professor Kerry Hourigan. Professor Hourigan will undertake research on cardiovascular and respiratory flows at the Centre National de la Recherche Scientifique in France.



Kerry Hourigan

Visit by Professor Huadong Guo, Chinese Academy of Sciences

Professor Huadong Guo, Director of the Chinese Academy of Sciences' Centre for Earth Observation and Digital Earth, met with President Professor Kurt Lambeck at the Academy in February as part of a visit to various Australian institutions. Professors Guo and Lambeck met to discuss the

ABCC Program, an initiative to strengthen cooperation with research organisations in Australia, Brazil, Canada and China.

Innovative French Clusters lecture at the Shine Dome

The Academy supported a lecture organised by the Embassy of France in Australia, titled *Innovative French clusters: Future role in the Australian-French scientific cooperation*.

Professor Kurt Lambeck opened the lecture and spoke briefly on the internationalisation of Australian science. Dr Alain Moulet, Counsellor for the French government, Professor Murray Scott, CRC for Advanced Composite Structures Limited and His Excellency Mr Michel Filhol, Ambassador of France, spoke regarding Australia–France scientific cooperation. ■

Interviews with Australian scientists

Interviews with several exceptional fellows have been scheduled for the *Interviews with Australian scientists* project in 2010.

Professor James (Jim) Lance FAA was interviewed by Professor David Burke FAA at his home in Sydney in January. Professor Lance is a world renowned specialist in headache and movement disorders who has, by his own accounts, led a blessed life. He graduated with a medical degree at the University of Sydney but was drawn towards research as well as clinical practice. Lance's career in neurology has taken him to all corners of the globe (occasionally by way of an ocean liner) and he has established a strong centre for neurological research at the Prince of Wales Hospital and University of New South Wales. At 83, Jim Lance continues to conduct research and writes papers at a desk that 'draws him like a magnet', according to his lovely wife, Judy. This interview was generously sponsored by the University of New South Wales.

Upcoming interviews include: Dr Bill Blevin FAA, Professor John Newton FAA, Professor Jim Morrison FAA, Professor Sandy



Jim Lance (left) interviewed by David Burke (right) about his career combining clinical medicine with scientific research

Mathieson FAA and Professor Jan Anderson FAA. The Video Histories Advisory Committee also met in February to decide on additional interview priorities for the coming year.

Transcripts and teachers' notes for interviews are available from www.science.org.au/scientists ■

Proceedings of the 2009 Theo Murphy High Flyers Think Tank

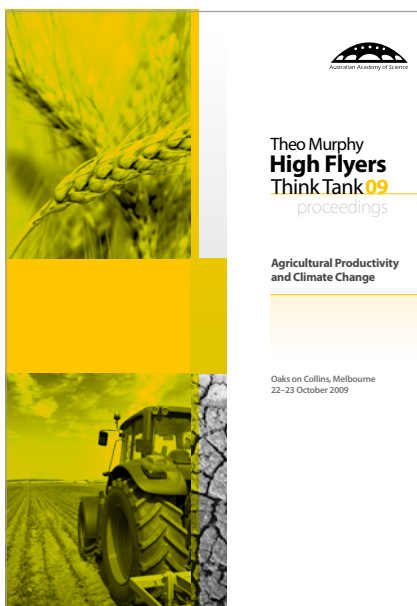
The printed proceedings of the 2009 Theo Murphy High Flyers Think Tank, *Agricultural productivity and climate change*, has been distributed to all participants and relevant members of Parliament, senior members of federal and state government departments of agriculture, and farmers' federations across Australia.

Our annual Think Tanks – now in their eighth year – are premier Academy events. Their purpose is to bring together talented early- and mid-career researchers from a diverse range of disciplines, to think about novel applications of existing science and technology to issues of national significance, and to identify gaps in knowledge that should be addressed.

These events also provide an opportunity for career development and network creation amongst the nation's next generation of research leaders, thinkers and their institutions.

The 2009 Think Tank was held at a time of growing concern over the impact climate change will have on agricultural production in Australia. It brought together recognised experts in agriculture, food security, climate change science and social science, with 63 early- and mid-career researchers nominated by their institutions as skilled contributors. The workshop was on the challenge of advancing agricultural productivity sustainably in the context of climate variability.

While climate change will clearly impose new and more challenging demands on agricultural productivity, the drivers at work



are complex and interdependent. A key outcome from the Think Tank discussions was recognition that from a productivity perspective, climate change should be seen not as a monolithic import on Australian farmers, but as one component in a complex set of processes in which all stakeholders – farmers, scientists, exporters, communities and policy-makers – are already entwined.

Maintaining and improving agricultural productivity will bring with it significant and complex biophysical, environmental, social and economic challenges across the

agricultural sector. At the same time these challenges create a range of identified opportunities. Both the challenges and opportunities can be best tackled via a holistic combination of technological, social and adaptive governance supported by evidence-based policy.

Recommendations were made to address identified gaps in our understanding. These include: developing a national policy on food security which is linked to other current and future government policies and initiatives; supporting national research and knowledge management strategies through full implementation of the National Research Development and Extension Framework; and engaging Australian communities in the planning and implementation of social or structural adjustment, such as water-use habits.

The findings of this Think Tank are intended to be of value to both policy developers and decision makers, and they formed part of the Academy's submission to the recently-amended Productivity Commission review presented to the Australian Bureau of Agricultural and Resource Economics' Outlook 2010 conference on 2 and 3 March. Recipients of the printed proceedings were invited to comment both on the recommendations and more broadly about agricultural productivity and climate change science.

Copies of the proceedings are available from www.science.org.au/events/thinktank2009 ■

Climate change science questions document

In December 2009 an agreement was signed between the Academy and the Australian Government Department of Climate Change for the provision of \$40,000 to support the preparation of a document responding to questions the Australian public is asking about climate change, using language that can be understood by a non-specialist.

An eight person working group, co-chaired by Drs Mike Raupach FAA and Ian Allison, has been appointed. All

members of the group have a proven and recent track record of personally contributing to climate science, and disseminating their knowledge and understanding to the wider community.

The assessment of the questions will involve a survey of the literature, including the Australian media, and input from the Department of Climate Change, paying particular attention to issues or impacts specific to Australia.

An oversight committee, comprising

Academy Fellows and chairs of relevant national committees, will also be established to review the draft product. Publication of the document is expected by the end of June.

While it is recognised that there have been a number of attempts to produce such documents, there is value in having an authoritative, Australian-focused document available, which can be used as part of the broader effort to inform the Australian public debate on this important issue. ■

Nova: Science in the news

The following two topics have been posted on the Academy's educational website, *Nova: Science in the news* (www.science.org.au/nova):

Making light of metals

The light metals aluminium, titanium and magnesium are taking a load off transport and other everyday objects.

Look at the frame of your bicycle. It will be made of metal tubing, strong enough to carry your weight but light enough so you can carry its weight if you have to. It also needs to resist rusting and be affordable. In most bikes that metal is steel. But increasingly, 'high-end' bikes are being made of other, more exotic metals, alloys containing aluminium or magnesium, or even titanium. As time goes by, more 'everyday' bikes will be made the same way, and other goods as well.

Through advances in production and processing, light metals are becoming cheaper and more versatile. We are starting to see them in everyday items: in cars, aircraft, bicycles, the cases for laptops, mobile phones and even iPods. And Australian scientists are helping in this transformation.

Why light metals?

Industry is excited by light metals because they combine many of the traditional advantages of metals with the virtue of being much lighter than the iron and steel we have used for so long. By replacing steel in things like cars and aircraft with lighter metals, they become more efficient, consuming less fuel and producing fewer greenhouse gases – big pluses in today's world.

Everyday objects like mobile phones, cookware and soft drink cans, or exotic objects like medical implants, can be made both more convenient and more durable by using light metals. They are also readily recyclable. In fact, extracting metals from their ores usually takes so much energy it can be much cheaper to recycle them than to use a newly produced metal.

Light metal researchers have big challenges if they want to make their metals more competitive and more widely used. They have to cut the cost and environmental impact of extracting the metals from their ores. They also need to find new ways to process the metals once extracted, so they can be produced in more useful and versatile forms. Some of these forms will be alloys, where other metals



Photo: ©Stockphoto.com

Light metals are taking a load off transport



Photo: ©Stockphoto.com

Livestock produce around 14 per cent of global methane emissions

or non-metals are added to improve the properties of the metal.

Australian research reducing the load

Having some of the world's largest deposits of aluminium, magnesium and titanium ores, Australian researchers are very active in the field of light metals research. Through advances in production and processing, light metals are becoming cheaper, more versatile and able to compete with traditional metals like iron and steel in a wide range of applications. That trend is sure to continue. You will see more titanium, aluminium and magnesium in your lives in future years, and enjoy the benefits.

This topic is sponsored by the Australian Research Council Centre of Excellence for Design in Light Metals.

Excuse me! The problem with methane gas

When you ask people about greenhouse gases, chances are they'll focus on carbon dioxide. But there's another more potent gas contributing to global warming. Meet methane, the forgotten greenhouse gas.

There is much more carbon dioxide in the Earth's atmosphere than methane. But methane's global warming potential, tonne for tonne, is 23 times higher than that of carbon dioxide. And human activities are increasingly adding to atmospheric levels.

Luckily, methane lingers in the atmosphere for only 11 to 12 years, compared with up to 200 years for carbon dioxide. With a greater potency and shorter lifetime, the impact of methane can be reduced more rapidly. Another advantage

of methane is that it can be used as a fuel – a useful way of preventing it from entering the atmosphere.

Sources of methane

Methane can occur naturally in wetlands, it's made by animals, and it can be released as a result of human activities such as agriculture and extraction of fossil fuels.

One form of methane that's causing concern is the vast amount locked away under the oceans and within the Arctic permafrost. The 'clathrate gun hypothesis', which sounds like a doomsday scenario from a science fiction novel, suggests that if the frozen stores in ocean floor sediments are released – possibly by global warming – they could trigger a global catastrophe.

Methane is currently responsible for about a fifth of the enhanced greenhouse effect. Hopefully, further research into this relatively potent greenhouse gas will help us to stall global warming. It may even avoid possible catastrophe by putting a safety catch on the trigger of the clathrate gun.

This topic is sponsored by the Australian Government Department of Climate Change.

Information on both of these topics is available on the Academy's *Nova: Science in the news* website at www.science.org.au/nova. A glossary, student activities, further reading and annotated links to relevant websites are also available. The Australian Foundation for Science is a supporter of *Nova*. ■

Nova sponsorship

We are currently seeking sponsors for the development of *Nova* topics in the following areas:

dark matter
climate change and agriculture
cryptography
sustainable fisheries
autism
electric cars
biochar
geoengineering

For more information please contact Roz Johnston on (02) 6201 9444 or roz.johnston@science.org.au.

Academy objections to the NewActon Nishi development



The estimated bulk and size of the proposed building

The Academy has been aware since November 2009 of a proposed development on the small block of land directly across Edinburgh Avenue from the Shine Dome, between the Shine Dome and Lake Burley Griffin. The developer has proposed a 10-storey office block and a 17-storey residential block, known as the NewActon Nishi development, adjacent to the Diamant Hotel, which was refurbished by the same developer.

A prominent Canberra architect has assisted the development of submissions arguing that the heritage values of the Shine Dome and Ian Potter House should be protected. An objection was lodged

with the National Capital Authority during the public consultation period. A detailed objection was subsequently made to the Australian Government Department of Environment, Water, Heritage and the Arts regarding the minister's consideration of whether the development complies with the *Environment Protection and Biodiversity Conservation Act 1999*.

The essential elements of the Shine Dome 'setting' are its strong ties to the geometry of the city, its response to the functions and forms of its immediate neighbours, including the low rise buildings of the Hotel Acton, and its proximity and visual connection to the

west basin of central Lake Burley Griffin. These connections are integral parts of its heritage significance and its values, and should not be lost or damaged. Academy objections to the development opined that the developer's representations appear to understate the likelihood that this would occur.

The Academy is of the opinion that the siting, height, width and bulk of the proposed Nishi development will cause significant damage to the heritage values of the Shine Dome and Ian Potter House, and have suggested that planning and building forms should be reconsidered to reduce these impacts. ■

Photo: courtesy of J. Myers

News from national committees

Meeting of chairs of national committees

The proceedings of the meeting of the chairs of the national committees held on 19 November 2009 are available on the national committees web page at www.science.org.au/natcoms

Astronomy

The National Committee for Astronomy met at Ian Potter House on 7 December. The main item of business was a mid-term review of *New horizons: A decadal plan for Australian astronomy 2006-2015*. Other items included International Year of Astronomy activities, a report from Astronomy Australia Limited and the presentation by Professor Warrick Couch FAA at the meeting of the chairs of national committees in the presence of Hon Lindsay Tanner MP, Federal Minister for Finance and Deregulation.

Data in science

The National Committee for Data in Science met by teleconference on 14 December. Discussion included developing the concept of an annual workshop, and reports on the state-of-play of data in science. The committee is also considering making a bid to host the international congress of the Committee on Data for Science and Technology of the International Council for Science.

Earth system science

The National Committee for Earth System Science held a planning committee meeting in early February for an Earth System Outlook conference. This is a result of feedback from the Earth system science community as part of the decadal planning process.

Earth science

The National Committee for Earth Science (NCES) met via teleconference, although a number of members were also present at Ian Potter House on 1 December. The focus of the meeting was the preparation of a mid-term review of the NCES national strategic plan for the geosciences (www.science.org.au/natcoms/nc-es/documents/nc-es-strategic.pdf) which was released in 2003. The next meeting is to be held on Friday 9 July in Canberra.

Geography

The National Committee for Geography (NCG) met at Ian Potter House on 20 November. The main topic of discussion



National Committee for Astronomy

Photo: Jeannette Mill



(L to R) Andrew Parfitt, David Skellern and Kurt Lambeck at WARS2010

Photo: Connie Berridge



Jean-Michel Le Floch being congratulated by Andrew Parfitt

Photo: Connie Berridge

was the national geography curriculum. Geography is to be included in the second phase of the national curriculum roll-out and is expected to be implemented in 2012. Two members of the NCG, Professor Margaret Robertson and Professor Lesley Head, are members of the reference group that is to develop the curriculum.

Nutrition

The National Committee for Nutrition met during the joint Nutrition Society of Australia and Nutrition Society of New Zealand annual scientific meeting in Newcastle on 10 December. The main topic of discussion was the proposed Symposium on Agriculture, Food and Nutrition – Health and Sustainability. The next meeting planned is a teleconference on 16 February.

Radio science

The National Committee for Radio Science 2010 Workshop on Applications of Radio Science (WARS2010) was held at the Shine Dome on 11 and 12 February (www.unisa.edu.au/itee/WARS/default.asp).

The event was opened by Academy President Professor Kurt Lambeck and was attended by about 50 people. WARS2010 celebrated two firsts: a special issue of *Radio Science* to be published from the WARS2010 proceedings, and the inaugural Young Radio Scientist Keynote Award. This year's awardee is Dr Jean-Michel Le Floch. Dr Le Floch presented his paper *From micro to millimetre waves low phase noise and filtering devices design* during the workshop. A student poster prize was also awarded. The winner was King Yuk (Eric) Chan, for his poster *The enabling technology for the next generation wireless communications: RF MEMS*.

Space science

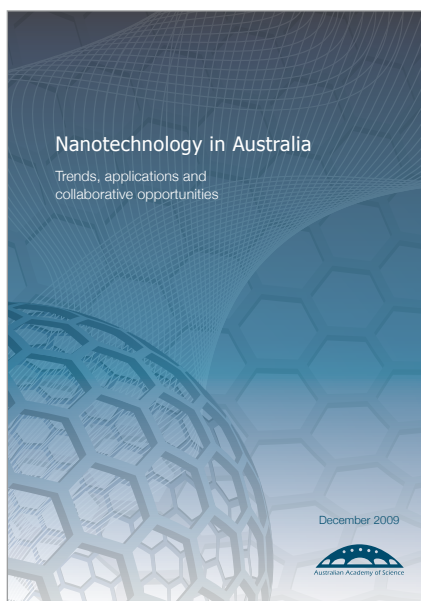
The National Committee for Space Science *Decadal plan for Australian space science: Building a national presence in space* has been endorsed by the Academy's Council, and is in the final stages of production. ■

Nanotechnology in Australia

The Academy's Australian Research Council Learned Academies Special Project – *Nanotechnology in Australia: Trends, applications and collaborative opportunities* – has been finalised. The report was launched by Parliamentary Secretary Richard Marles on behalf of the Minister for Industry, Innovation, Science and Research, the Hon Kim Carr, at the Shine Dome on 22 February, in conjunction with the Australian Government's release of its *National Enabling Technologies Strategy*.

Nanotechnology has emerged as a critical field with the potential to impact on nationally significant issues as diverse as health, water and energy. The report characterises Australia's current research capacity and capabilities. This was achieved through the completion of a series of quantitative and qualitative research activities during 2009.

International benchmarking using bibliometrics indicates that Australia is improving its position relative to other countries, although further work is required to achieve world averages. The data also show that Australia's collaboration partners changed in the past decade, with China now being Australia's second most frequent partner by publication.



A survey of Australia's nanotechnology community examined research trends and collaborations. Indications are that while nanotechnology is strong across a variety of fields, it is mostly at the earliest stages of development (basic and applied

research). Collaborations are almost equally distributed between Australian and international partners, and are most likely to involve the exchange of ideas, data and/or joint publication.

One of the most significant issues identified in the survey was the need to increase the number of collaborations between different types of organisations, particularly between universities/institutes and industry/business, and between universities/institutes and government research organisations.

On 25 September 2009 the Academy hosted a Nanotechnology Stakeholder day, to enable members of the nanotechnology research community to identify and discuss critical issues impeding the development of nanotechnology. Based upon the Academy's research and the Nanotechnology Stakeholder day discussions, eight prioritised recommendations were developed, several of which addressed the issue of funding research. The report is available on the Academy's website at www.science.org.au/reports ■

Australia's renewable energy future

The Academy has released a scientific report outlining the possible future of renewable energy in Australia.

The report provides an authoritative scientific analysis of existing and emerging renewable energy technologies, and the strategies that can be used to replace power generation based on the use of coal and oil.

The costs, advantages and problems associated with solar power, wind power, biomass, fuel cells, geothermal energy and wave energy are compared and analysed. Many currently available technologies, if deployed, can decrease Australia's carbon dioxide emissions and contribute to meeting the target of 20 per cent of Australia's energy being from renewable energy sources by 2020.

The report arose from the Academy's 2008–09 public lecture series, and provides a list of 25 policy options for



Photo: ©Stockphoto.com

the implementation of renewable technologies. The options include not only alternative energy sources, but also development of a 'smart' electricity grid, alternative transport systems and reductions in domestic energy consumption.

Professor Michael Dopita FAA, who chaired many of the lectures and co-edited the report with Professor Bob Williamson FAA said, 'What's lacking are feasible deployment paths and supportive policies to speed and smooth the deployment of renewable energy technologies that are already known to be effective.'

It is hoped that the report will facilitate national discussion on the role renewable energy may play in a transition to a low carbon economy. A copy of the report is available from www.science.org.au/reports ■

Wind power is expected to provide the largest share of renewable energy by 2020

Obituaries

Charles Birch



Charles Birch

Louis Charles (Charles) Birch was born in Melbourne on 8 February 1918 and died in Sydney on 19 December 2009. He was educated at the Universities of Melbourne (BAgrSc 1939) and Adelaide (MSc 1941, DSc 1948).

On graduation he accepted appointment as a research entomologist at the Waite Agricultural Research Institute at the University of Adelaide where, under the supervision of Dr Herbert Andrewartha, he became aware of the 'social responsibility of the scientist'. He remained at the Waite until the end of World War II. In 1946 he went to the University of Chicago to study biology and the following year he studied animal population dynamics at the University of Oxford. In 1948 he moved to Sydney as a senior lecturer in zoology. He remained there until his retirement, progressing to reader in 1954 and Challis Professor of Biology in 1958. During his time as professor he was involved in laying the foundations for the new science of ecology and became a close friend of the environmentalist Paul Ehrlich. He retired in 1984, when he was awarded the title of Emeritus Professor.

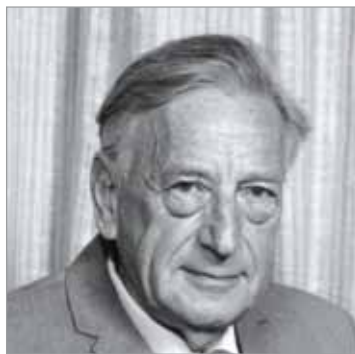
Charles Birch started out as an agricultural scientist, switched to biology and ecology and soon confronted questions that were to occupy him for the rest of his life: where humankind was really going, preoccupied as it was with its eternal conflicts and relentless pursuit of wealth. The world could not sustain this forever and he believed progress could only be made when spiritual values were married to the empirical world he probed as a scientist. The titles of some of his nine books give an idea of the range of his work: *Distribution and abundance of animals* (1954), *Nature and God* (1965), *Confronting the future* (1975, 1994) and *Living with the animals* (1997).

Birch also had a lifelong interest in the interconnections of biology, philosophy and theology and spent 20 years on the World Council of Churches' program on science, technology and the future, 13 of those years as the Council's vice-moderator, church and society. A member of the Club of Rome, he was very involved in the Zero Population Growth movement. He was also publicly opposed to the Vietnam War.

Birch was elected to the Australian Academy of Science in 1961. He was awarded the David Syme Research Prize in 1953. In 1988 he won the Gold Medal of the Ecological Society of Australia, as well as the Ecological Society of America Eminent Ecologist Award. The Ecological Society of America later honoured him with an Honorary Life Fellowship, as did the British Ecological Society and the Academy of Environmental Biology, India. Other honours included the Templeton Prize for progress in religion in 1990 and being made a Member in the General Division of the Order of Australia in 2008.

Charles never married. He is survived by his twin brother Sid.

Hans Buchdahl



Hans Buchdahl

Hans Adolf Buchdahl was born in Mainz, Germany, on 7 September 1919 and died in Adelaide on 7 January 2010. He was educated at Imperial College in London (BSc, Associate of the Royal College of Science (ARCS) 1939). He was awarded a DSc by the Universities of Tasmania (1949) and London (1956).

He came to Australia on the *Dunera* in 1940 and was detained first at Hay and then, from May 1941, at the Tatura centre in Victoria. It is said that while in detention

he continued his general relativity research using the backs of jam tin labels for paper. In October 1941 he was released under a guarantor and transferred to the University of Tasmania to assist with lecturing. There, while continuing his research in general relativity and classical thermodynamics, he also developed an interest in the theory of geometrical optics and worked out formulae for higher order coefficients for optical aberrations which were used world wide in designing imaging systems, including those in satellites.

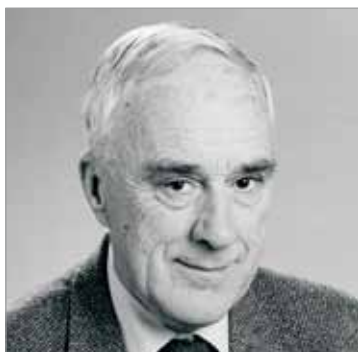
He was appointed research physicist in 1946, part time lecturer and research physicist in 1947, senior lecturer in 1952 and reader in 1956. In 1963 he moved to the inaugural chair of theoretical physics in the Faculty of Science at the School of General Studies of the Australian National University, a post he held until his retirement in 1985. After retirement he continued his research at the ANU as a University Fellow 1985-88 and later Visiting Fellow, as well as having the title of Emeritus Professor conferred on him.

His optical work has already been mentioned. Hans was also internationally recognised for his work on 'relativistic fluid spheres' obtaining a more physically realistic solution than the earlier one by Schwarzschild for the interior of a perfect fluid-spherical symmetric-non-rotating star. The literature refers to the 'Buchdahl fluid spheres' and also to 'Buchdahl's Theorem'. He corresponded with Einstein on his relativistic research. His work on classical thermodynamics is also noteworthy and resulted in two books.

An early award was a Nuffield Foundation Dominion Travelling Fellowship 1950-51. He was elected a Fellow of the Australian Academy of Science in 1968, received the Academy's Thomas Ranken Lyle Medal in 1972, the Walter Burfitt Medal from the Royal Society of New South Wales in 1980, the CEK Mees Medal from the Optical Society of America in 1993 (he had already become a Fellow of this society in 1974) and the AE Conrady Award of the International Society for Optical Engineering in 1997. He was awarded a Centenary Medal in 2003.

Hans is survived by his wife Pamela, and two of their three children Tanya (Tintner) and Nicholas. Their second daughter Catriona (Kate) died of cancer in 1992.

Alan Head



Alan Head

Alan Kenneth Head was born in Melbourne on 10 August 1925 and died there on 9 January 2010. He was educated at the University of Melbourne, where he graduated with both a BA and a BSc, and Bristol University, where he was awarded a PhD. The University of Melbourne later conferred a DSc on him.

He began his research career at CSIRO Division of Aeronautics, where he worked from 1947-50. In 1953 he was appointed as a research scientist at the Aeronautical Research Laboratories, moving to CSIRO Division of Tribophysics in 1957. He spent the remainder of his working life at CSIRO, becoming a Chief Research Scientist in the Division of Tribophysics in 1968. From 1978 there were various name changes to the Division and as a result when he retired in 1990 it was from the Division of Materials Science. At that stage he was appointed as an Honorary Research Fellow in CSIRO Manufacturing Science. During his career he held a number of visiting fellowships and professorships at Oxford University, Florida University and Brown University. He was also a Permanent Founder-Member of the International Congress on Fracture, established in 1965.

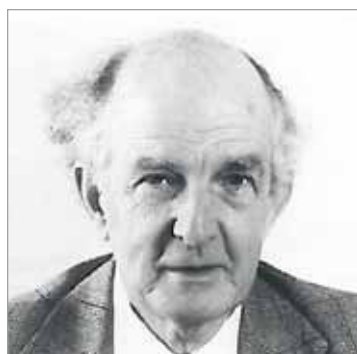
Dr Head was a theoretical physicist who developed his work to the stage where he could make predictions which could be checked experimentally. He had an international reputation for his work on the mechanical properties of materials, in particular on the failure of metals by fatigue and the defects (on an atomic scale) which are responsible for plasticity and strength. He also made contributions to the area of aspherical optics and short radio waves, which led to the construction of radio telescopes in the USA to his design. His wide range of interests is also shown by his work on refrigeration by selective radiation.

The principle behind this is that a body can be cooled below ambient without any expenditure of work by establishing radiative equilibrium with outer space, by making it a selective radiator at wavelengths such as 10μ for which the Earth atmosphere is transparent.

Dr Head was elected to the Australian Academy of Science in 1971 and to the Royal Society in 1988. In 1992 he was made an Officer of the General Division of the Order of Australia for his service to science. He received a Centenary Medal in 2003.

In 1951 he married Gwen Barlow, who survives him.

Bert Main



Bert Main

Albert Russell (Bert) Main was born in Perth on 6 March 1919 and died there on 3 December 2009. He grew up on a vineyard in the Swan valley and was educated at Midland Junction Central School. When he first left school he worked for the State Public Service and studied accountancy and some matriculation subjects at night school. During World War II he served in Australia in the AIF and in Europe as a navigator bomber in the RAAF. He spent the last part of the war as a POW in Germany.

On his return to Australia he matriculated and then completed a BSc with 1st class Honours in Zoology at the University of Western Australia (UWA) under the Commonwealth Reconstruction Training Scheme. After two years at the University of Chicago as a Fulbright Scholar, he took up an appointment at the UWA, where he completed a PhD, and which also awarded him an Honorary DSc. He remained at the UWA for most of his career, serving as Professor of Zoology from 1967 until his retirement in 1984.

Professor Main lived within walking distance of the bush as a child and was taken there most weekends by his grandfather, who was his natural history mentor. There his curiosity was aroused about species, their adaptive traits and evolution and his later work was concerned with the total (behavioural, genetic and physiological) adaptation of animals to aridity. His Royal Society of Western Australia Medallist Lecture in 1995 covers four main areas of his research: frogs, other species (reptiles and birds), macropods and conservation.

Professor Main was elected to the Fellowship of the Australian Academy of Science in 1969. In 1970 he received the Britannica Australia Award with Professor Harry Waring. He was elected an ANZAAS Fellow in 1981 and awarded the Mueller Medal of ANZAAS in 1990 and the Gold Medal of the Australian Ecological Society in 1988. He was made Commander Civil Division of the Order of the British Empire (CBE) in 1981 and received a Centenary Medal from the Australian Government in 2003.

Bert had a longstanding interest in environmental management and conservation, dating back to his youth and his membership of the Western Australian Naturalists Club. He served on the Fauna Advisory Committee and later the Western Australian Wildlife Authority and was a foundation member and later chairman of the Western Australian Environmental Protection Authority. He was also president of the Zoological Gardens Board and the National Parks Authority. His accomplishments were also recognised overseas when he was elected an Honorary Foreign Member of the American Society of Ichthyologists and Herpetologists.

In 1952 he married Barbara York, who had been a zoology undergraduate with him. She survives him, together with their children Rebecca, Gilbert and Monica and three grandchildren. ■

Memoirs of deceased Fellows are published in *Historical Records of Australian Science* and are also available from www.science.org.au/fellows/deceased

Australia's water management options

...continued from page 1

between calories and litres of water consumed, ... and radically increase our energy productivity so that we get more food energy out for the amount of energy we put in, ... while transitioning away from fossil fuels and towards renewable energy.'

There are also very significant concerns around modern industrial food systems.

'We need to do all of the above while developing food systems that look after the natural landscapes we have left, that improve animal welfare and that lead to improved human health. At the moment we have a food system where the cheapest calories in the supermarket are by far the worst ones for you.'

In December, Dr John Passioura went on to look at water as a limiting resource in dryland agriculture.

He started by saying, 'We have come to believe, collectively, that our crops are normally limited by water ... What comes with it is a tinge of fatalism that we are at the mercy of the weather and that there is nothing much that we can do about it if water is really limiting.'

He argued that while water does limit our crops on many occasions, especially during catastrophic droughts, it doesn't always do so, and went on to look at what

our prospects are for increasing the productivity of dryland crops.

A healthy crop is responsive to water, 'but there are many circumstances in which you have a huge range in yield with the same amount of water.'

Looking at the other factors that can affect yield – bad weather, frost, inappropriate agronomy – there are incentives to improve the management of crops. This results in a decreasing gap between actual yields and the water-limited potential.

'We have also come to understand something about the flag fall – the loss of water by direct evaporation from the soil.'

He said, 'there is promise both of reducing the gap between actual yields and that attainable with the given water supply ... You can ... trade the water for CO₂ to get as much biomass as you can, and convert as much of that biomass into the grain.'

There are ways of improving the water supply, for example sowing earlier so that the crop is in the ground for longer. It is also important to store summer rainfall in the subsoil, 'because what is stored in the subsoil at the time of sowing can have an enormous impact on the final yield!'

There is a very large body of work that is now exploring the possibilities and leading to substantial improvements in water efficiency.

Transcripts and slides from the lectures in the series can be found at www.science.org.au/events/publiclectures/wm

The 6 April lecture is by Mr Ken Matthews on water reform in Australia. Due to maintenance work in the Shine Dome it will be at the CSIRO Discovery Centre at Black Mountain, Canberra. There will be no lecture in May due to *Science at the Shine Dome*, but they will resume in June. ■



Photo: Matt McCallum

Modern farming practices can make the most of water available for crops



Photo: Richard Bray

Don Blackmore answers the insightful questions of an engaged audience



Photo: Richard Bray

John Passioura