

# FOCUS



## WOMEN DRIVING FOR THE TOP

### IMPEDIMENTS IN THE TECHNOLOGICAL SCIENCES

Contributors discuss the need for Australia to attract and optimise the skills of women in finding and applying the technologies to build a better Australia

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ARUP

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Photo: iStockphoto



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## FOCUS

ATSE *Focus* is produced to stimulate discussion and public policy initiatives on key topics of interest to the Academy and the nation. Many articles are contributed by ATSE Fellows with expertise in these areas. Opinion articles will be considered for publication. Items between 800 and 1400 words are preferred. Please address comments, suggested topics and article for publication to [editor@atse.org.au](mailto:editor@atse.org.au).

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 A portrait of UWA Professor Carolyn Oldham, a woman with curly brown hair and glasses, wearing a purple patterned shirt and a necklace. She is smiling and standing in front of a harbor with boats and a city skyline in the background.
 

# Achieve a fairer and more caring world

UWA Professor Carolyn Oldham  
School of Environmental Systems Engineering

Carolyn Oldham is an outstanding environmental engineer in her own right, providing a better understanding of the extent, causes and impacts of pollution in our rivers, lakes and groundwaters – issues which are vital to the future of Australia.

But as with many outstanding academics from The University of Western Australia, Professor Oldham is using her considerable experience and knowledge to tackle similar problems in developing countries, notably East Timor and the Cook Islands.

Along with that, she has been recognised with a National Teaching Award for her sustained commitment to encouraging young women to aspire to be world-class engineers.

In both cases, it's about what she describes as *"community resilience built with diversity – diversity of ways of thinking, diversity of ways of doing; opening the doors to creativity and innovation"*.

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# Leading the campaign to use our full human potential

Social change takes time and cultural change is incremental and messy. Revolution is unlikely to achieve sustained and effective change.



By Cathy Foley

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"The most important thing about a political party is ethos, or culture. It's far more important than ideology or rules. The way we treat each other, the way we handle differences, the way we process change."

– Senator Bob Carr, March 2012

I've just finished writing a report on the status of women in physics in Australia. Too often I have been the lone and/or first female in various roles during my career in physics. As a result, it has been my passion to see this change.

After some improvement in the early 2000s, my report showed that the number of girls and women in physics is beginning to slip again in recent years.

As the Australian Institute of Physics President (AIP) in 2007 and 2008, I led the campaign for physics. And as the President of Science and Technology Australia (STA, formerly FASTS) from 2009 until late last year, I championed the message to the broader science community.

Looking at what impact I have had, it is hard to see if I had any – depressing! But then I remind myself to think again. Maybe there are impacts other than just numbers ...

I have often wondered why I joined organisations and then ended up, in time, leading them – P&Cs, professional societies and a CSIRO division.

I am not driven by the need for power or recognition. My early school days at St Anthony's Primary School in Sydney's suburban Marsfield had me raising money for the starving Ethiopians by making and selling toffees. This need for action combined with a strong dose of 'Catholic guilt' – as my children call it – has meant that when I see something is not working or not right, I put my hand up to fix it.

So what was my platform for election to lead the physics and broader science community? It was not just a desire to right the wrongs of women in science. In both cases it was to shift the science sector towards greater impact and effectiveness.

'Women in science' is just a subsection of this. I saw a need for change. I wanted to create a culture that was val-

ues and principles-driven; is inclusive; and encouraged the organisation to learn to 'lean into the discomfort' when facing the hard issues. I wanted the science sector to make a difference in society.

To do this we scientists need to walk in others' shoes to fully understand the issues at hand. To achieve anything we need representative organisations that are financially sustainable by a range of funding sources and use technology to maximise time, impact and communication.

I had to pick my fights as I couldn't do everything – rather I wanted to do a few things really well and leave a legacy.

It worries me that we pay a \$20 entrance fee for Questacon exhibitions but admission to the permanent collection at the National Gallery of Australia next door is free; that the majority of Australians have not done any science and maths formal learning since they were 15 or 16 years old; that in a growing diverse society the majority of decision makers are Anglo males; that in a society that is looking to science to address the major challenges facing us, we allow pseudo science to have equal airspace; that our science



Cathy Foley addresses the WiSE summit.

sector is not able to have well-defined career paths in order to be attractive to future generations; that our absolutely world-class discoveries are not translating from the laboratories to create industries and economic prosperity that is there for the taking.

As President of the AIP, I wanted the discipline of physics to be recognised as a critical ingredient for a successful modern society. The number of teachers with physics majors is minimal (less than 40 per cent); the number of children, especially girls, choosing physics is dropping (about six per cent of girls do physics in their final year at school); the number of women who are working and studying university physics is a small minority, in some areas a single digit percentage (nine per cent of physicists in some government laboratories are women).

And then as the President of STA I wanted Australians who are absolutely dependent on science to recognise the need to be literate, to respect the difference between good science – science that is peer reviewed – and bad science. I wanted scientists and technologists to have a career path that allowed them to participate and have a sustainable lifestyle – at least to be able to own a home and pay their bills.

## Missing out

I wanted Australia to realise that it was missing out on its full human potential by not using all its talent, with too few women and ethnic minorities participating at all levels. I wanted a science sector that was not segmented and had mobility between the universities, the government laboratories and industry.

I have led campaigns on all these topics but have I made a difference? It is hard to say. I realise that leading the campaign is a little like scientific discovery. It takes a long time from the scientific discovery to its application and commercialisation of a technology. This, too, is the case for any change, especially if culture is involved.

David Suzuki once said: “Science does not progress in an easy linear fashion. It is not like you have an idea, set up an experiment to prove your theory and cure cancer!” Similarly, advocacy does not work in a linear way. Social change takes time and cultural change is incremental and messy. Revolution is unlikely to achieve sustained and effective change.

It was necessary to make sure the members of AIP and STA understood the reasons why we needed to change and that it was based on data and professional advice. The most obvious being the change of an organisation’s name.

So far I think there are ‘behavioural intentions’ of the science sector in Australia for a shift in approach. I hope that I have made a small contribution to this. There is greater cooperation and connection within the science sector now but there is still a long way to go.

We need some major structural change to break down the industry, government laboratory and university silos. Just as we see the benefit of inter- and multi-disciplinary research, we need to work out how to break down the barriers that make it so difficult for career mobility between these sectors.

We need to have accountability and measures of research quality that create a system that understands the esteems of each sector. For example, the ERA process has created a focus on publications and citations, while government laboratories are mission-driven and need to have broader measure of impact. Government laboratory researchers usually have fewer publications and are not competitive in the university system. Industry is measured by the return on investment and the success of the business, so publications are of little interest. Breaking down the barriers between universities, government laboratories and industry is our most urgent agenda for science in Australia.

As a woman leading the campaign, I have learnt from many other women and one significant male mentor.

These include: Suzanne Cory on the importance of world’s best scholarship; Margaret Shields on letting go of past responsibilities as you take on new roles; Megan Clark on always seeing the glass half full and every situation as an opportunity; my siblings on various aspects of business; my step-mother on being organised and disciplined; Anna-Maria Arabia on the political process; Hilary Clinton on the idea that you never, ever give up; and Calum Drummond on the importance of merit-based decision making.

Finally, the strength I receive from family has been essential. Their support, their wise words and being my first priority, places everything else into perspective.

Leading the campaign in science advocacy has been about the culture not the ideology. It has been about how we treat each other, how we handle differences and process change. I hope I have started the process even if we can’t measure the changes yet. ◀

**DR CATHY FOLEY PSM FTSE is the Chief of CSIRO Materials Science and Engineering. Prior to her current appointment, she was involved in CSIRO’s Superconducting Devices and Applications Project, developing superconducting systems for mineral exploration, detection of metal for quality assurance in manufacturing, terahertz imaging and UXO detection. This multi-million-dollar project assisted with the discovery and delineation of the BHPB Cannington Silver mine and her team is currently commercialising their systems. Her group was the first team to successfully fly superconducting systems. She is a Member of the Prime Minister’s Science, Engineering and Innovation Council (PMSEIC) and has won the Eureka Prize for Promotion of Science, the NSW and National Telstra Women’s Business Award for Innovation and the AusIMM MIOTA award for LANDTEM as a mineral exploration tool.**

# Anything's possible – expect the unexpected

Passion, perseverance and networking can make the unexpected, and almost anything, happen!



By Helen Garnett

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**A**nanything's possible – well almost! My career would suggest that for the unexpected to turn up, you have to be dedicated to, and passionate about, what you are doing – if you don't enjoy what you are doing, get off the bus and find another one.

Be prepared to take risks and network widely. You have to make the chances by putting your head up out of the rut you are in, but you also have to be prepared to take those chances.

I started studying medicine but became fed up being a parrot. I was bored, so I went to the scholarship office and said "I want to do science". They were so amazed they let me keep the scholarship – everyone wanted to get into medicine, not out of it! I got off one bus and onto another and have never looked back.

Towards the end of honours, I was investigating PhD options in Australia. My professor, unexpectedly, called me in and asked if I had applied for Commonwealth Overseas Scholarships. I was not aware of them – at that stage my over-the-horizon scanning and networking skills were obviously not well developed!

The applications closed at 5pm. This was an opportunity I had not even considered – remember it was 1968 and the airfare to London was more than a down payment on a house! Once aware, I raced to complete the complex forms – universities of interest, PhD proposal and photographs.

The first two were easy, I knew the universities strong in virology, I had ideas of research questions, but I had not communicated with the researchers themselves – no fax or email back then. Portrait photos – where from – maybe from one of those horrid photo booths on city railway stations. I ran out of money for the required 12 photos – ending up with eight originals and photocopies of a passport booth photo – ugh!!

Convinced that my research plan and academic record would win the day – not looks – I submitted the applications with about 30 seconds to spare. I won first prize – a scholarship to London to study in the leading department. I have travelled the globe with my PhD 'passport' ever since, albeit after transferring my registration to the University of Wales – but that's another story.

Moving to South Africa with my geologist husband – not to the US for the postdoc I was dreaming of – I found myself in an excellent university with an internationally recognised virology research institute but a fledgling initiative in microbiology courses. We needed human resources and money. We needed to cover the field, not just human virology.

## Come on board

So I found myself convincing mining companies, agricultural enterprises, brewing businesses and many others to come on board. Those experiences were education on the job! I learnt the differences in approach between academia and business and to always look at what you are doing from the outside, not just from within your own world – and ask "what is the value to the third parties?"

The initiative grew and when a professorship was advertised, I was bold enough to apply. Even after weathering a question at interview about my childbearing intentions, I won the prize – an unexpected outcome. I was up against mature males, convinced they had it in the bag, and I was in my 30s. The dedication, passion, networking and risk-taking, along with some internationally recognised research outcomes, had won the day.

From that time on, I worked with business as well as within the academic and research environment. I learnt

## Contributions are welcome

Opinion pieces on topics of national interest will be considered for publication in *ATSE Focus*. Items between 800 and 1400 words are preferred. They must list full name, title/role, organisation (if relevant), city of residence and email address for publication. Please address to [editor@atse.org.au](mailto:editor@atse.org.au)

# Delivering excellence for both university and gender.

The University of South Australia's (UniSA) remarkable research growth is a reflection of our talented and dedicated researchers. With over 70 per cent of the university's assessed research evaluated as world-class or above in the national Excellence in Research for Australia assessment, and research income ranking in the top one-third of Australian universities, our research horizons are continuing to rapidly expand.

Across the university's diverse research areas, women are making a remarkable contribution in driving our research trajectory and delivering important research outcomes.

A prime example of these achievements is the high calibre research produced by Senior Research Fellow, Dr Gabrielle Todd. Her work investigating how the human brain controls movement and the processes that underlie movement disorders has achieved significant competitive funding. It includes an analysis of how chronic illicit drug use impacts communication between neurones, and an investigation into the impact of ADHD medications on children to pinpoint how stimulants may be impacting areas of the brain that control movement.

In recognition of her research achievements, Dr Todd has been awarded a Career Development Award from the National Health and Medical Research Council and was honoured as the South Australian Young Tall Poppy of the Year in 2010.

Another example is the work of evolutionary biologist Dr Ellen Nisbet, who is analysing the evolution of the malaria parasite. In particular, her research is examining how the function of the essential organelles are retained in the malaria parasite – a key in the development of new anti-malarial drugs.

With malaria continuing to infect several hundred million people worldwide each year, Dr Nisbet's research has far-reaching and extraordinary potential. This has been recognised through funding awarded by the United Kingdom's prestigious Wellcome Trust. Her work has also been acknowledged with a South Australian Young Tall Poppy Award.

Dr Todd and Dr Nisbet are both mid-career researchers with a very bright future at UniSA. They are just two of the many examples of the tremendous contribution that women are making to UniSA's research growth.

To find out more or to be part of UniSA's exciting research future, visit [unisa.edu.au/research](http://unisa.edu.au/research)

*"There is resistance to all the main drugs in use today for the treatment of malaria. With a better understanding of how the malaria parasite evolved, there will be a greater opportunity to design new, more effective drugs."*



**University of  
South Australia**

to appreciate the differences in institutional culture between public and private enterprises, between large and small businesses, between businesses in different fields, between businesses in different places along a value chain. I also learnt the differences between the developed and developing world and the influence of culture on an individual's beliefs and actions. As a young leader, I availed myself of every opportunity to undertake personal development courses, including media training, which I built on through regular live radio appearances. Little did I know how valuable that would be years ahead.

My research led to a question that could only be resolved by branching into a different area of science and learning new technological skills, then available in just two places around the world, both nuclear research institutions.

I headed to the US for a sabbatical year at Brookhaven National Laboratory. Unforeseen opportunities emerged. I learnt not only about bone marrow culture and radiation but about neutrons and research reactors, synchrotrons and X-rays. I consulted to New England Nuclear, then the leader in the development of diagnostic kits for viruses using radioactive techniques. I learnt to work with US companies in addition to learning much about the US research and academic environment. I expanded my international networks.

By the time I returned to Australia in 1987 after almost 18 years overseas, I had learnt much. I had been both within and outside the academic tent for 13 years; I had been involved, with scientific colleagues, in two start-up companies, both of which (after 20+ years of operation) have recently been sold to bigger companies; I had a science and technology base much broader than the discipline of virology and I had lived and worked on three more continents. I was 'globally connected', albeit weakly to Asia. I had 'made some chances' by taking risks, but the unexpected had frequently come up and by taking those chances, my career had been rewarding and exciting.

In the 25 years since returning home, I have been fortunate to build on these early experiences and learnings and thrive on the unexpected. After a few years in the academic world, I took up the Deputy CEO role at ANSTO, overseeing the scientific program – I wanted to get off the 'university bus'.

Within months a research reactor review was announced out of the blue, necessitating outreach to my US and UK colleagues for information. I drew on my early experience in Africa to bring third parties into the tent to work together for mutual advantage. Within 18 months,

I was Acting Chief Executive in a somewhat challenging political environment both externally – the word 'nuclear' was accompanied by images of atom bombs in the media – and internally – the ANSTO board had been asked to resign and a new board installed.

We were under review! Again! Flattening the structure, enfranchising all the discipline leaders across the organisation, trying to put ourselves in the shoes of those outside as well as standing up for excellence in nuclear science and technology, we gradually won the day. ANSTO survived and I became its new Chief Executive.

Planning and developing the case for the new research reactor began, as did broadening our interactions with industry, isotope end-users, universities, our sister research institutions, government and, importantly, Federal and State parliamentarians. We needed support from all quarters if OPAL – Australia's research reactor and associated scientific instruments – were to become a reality.

Leading ANSTO over 10 years drew on every learning I'd ever had and provided me with the opportunity to learn much more – particularly about working with, and the workings of, government. I learnt much about plant safety – not just nuclear safety – and about environment and finance. I learnt about leading a complex organisation with staff across the qualification and discipline spectrum – trades staff, engineers and multiple scientific disciplines. ANSTO had more than 10 unions when I joined in 1992!

As head of ANSTO, I became involved in the board, committees and programs of the International Atomic Energy Agency (IAEA). As part of the Asia-Pacific group, I



Helen Garnett – close to the  
workforce as a Director of ERA.

## Letters to the Editor

ATSE *Focus* welcomes letters from readers in response to articles. Please keep letters brief to enhance publication prospects. Longer letters may be run as contributed articles. Please address to [editor@atse.org.au](mailto:editor@atse.org.au)

was afforded opportunities to grow my Asian network, as we strengthened cooperation in nuclear science, technology and energy to mutual advantage. I learnt to take a risk-based approach, not only to opportunities – which I had inherently done for years – but also to projects, such as the ‘replacement research reactor’ project, and to hazards. In doing so I became equipped with a critical competence for a director. As a member of the ANSTO board, I needed to understand more about governance so I completed the AICD company director’s course and other programs.

Then came another opportunity from left field. NSW was corporatising the electricity sector and I ticked several boxes for appointment as a foundation director of Integral Energy: I was a woman, I lived in the Illawarra region, I was a chief executive of an entity where the staff included multiple trades and engineers, I had an understanding of operational safety, I had governance experience and I had the AICD qualification. I was known to the State Government of the day through my advocacy for the research reactor.

The ANSTO Chairman of the time supported me taking this role. He had a strong belief that as a chief executive you learnt from seeing close up how other entities function and that my involvement with Integral would be a win-

win-win; for ANSTO, for Integral and for myself.

After winning the \$350 million for OPAL from the Federal Government in 1997, completing the complex safety, environmental and public works committee processes, and with construction of the reactor well underway I felt, in 2003, it was time for me to leave the ANSTO bus.

There were options to move into the private sector as an executive or board roles. I was seriously considering the latter when the opening arose in the NT to lead the merger of four institutions to create Charles Darwin University. I have been a ‘builder’ throughout my career and decided this five-year role would draw not only on my career experiences but also my experiences of living in Africa. I believed then – and still believe today – that Northern Australia is a developing country within a developed country.

Going to the NT opened other doors. Energy Resources of Australia, an ASX-listed company, was losing a director with a strong understanding of the ‘nuclear’ world; head office was moving to Darwin and a Darwin-based director was advantageous. My name came up in their due diligence and so, unexpectedly, I was invited to join the Board and the Audit Committee, an opportunity that allowed me to expand my board experience, partic-

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CONTENT MATTERS

# Breaking boundaries and defying expectations

The cultural and systemic changes required to bring greater numbers of women into our innovation system will increase the quality of research outcomes.



By Tanya Monro

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**T**he greatest opportunities for impact from science and technology in the coming decades will not come from any single scientific discipline, but from knowledge created at the boundaries of existing fields and work focused on solving some practical challenges.

As shown by the 2010 Excellence in Research Australia (ERA) exercise, there is no doubt that in many areas of science Australia punches above its weight, but we are poor at translating this intellectual capital into tangible benefit.

For Australia to secure a significant slice of the action in the Asian Century we need to change the way we think about risk, STEM careers and the cultures within our research organisations.

There is no doubt that one of our best opportunities for building high-value industries is harnessing the potential dormant in our biggest untapped resource – Australian women. As Sharon Bell's 2009 report attests, we now attract respectable numbers of girls to the STEM (science, technology, engineering and mathematics) areas at school and undergraduate levels. Despite this, when reviewing the senior ranks of STEM-discipline professors or CEOs of technology companies, it is evident there are vanishingly few women.

The question of 'why?' has been tossed around for many years, and I do not attempt here to analyse these stark statistics, but rather to reflect on the cultural and structural factors that contribute to this reality and impede our capacity to create impact from our science and technology. While they are not just an issue for women, they disproportionately discourage women from pursuing STEM careers.

The process of becoming an expert in any area of research requires an individual to become immersed in that field. The journey towards a PhD in a STEM area is a case in point. We begin this journey by gaining research skills, whether in the laboratory or in theoretical analysis. The fledgling researcher uses these skills as tools to test hypotheses with the guidance of an experienced supervisor, gradually building the confidence to start to formulate their own questions and ultimately leading to the sheer

joy that comes from uncovering something unexpected or spotting a bridge between two previous unlinked islands of knowledge.

Pursuing a PhD is seen by many as a rocky route to an indeterminate future. This is true, despite the fact that career prospects for STEM graduates are rich and varied and occurs because STEM undergraduate degrees and PhDs do not offer the tangible career pathways that the 'professions' do.

This is a significant factor that impacts the career advice parents and schools give to children. We need to 'professionalise' science and engineering to show children that these subjects prepare them for the opportunities of the future.

## Career security

The uncertainty facing young researchers has a major impact on their choices, and this has a strongly gendered element. I have mentored many young people and have observed that a much larger proportion of women chose to leave science because of the bigger impact that career security plays in their choices.

Many men espouse the view 'Things are going well and I find it rewarding – I am sure it will all work out', whereas the women more typically ask 'Will I have a job in five years when I would like to be buying a house or starting a family?'. The result is that more women leave and that this seriously impacts our capacity to do our best science.

For people who decide to pursue a scientific career, other factors create boundaries that limit the impact of this research. Competition for funds, the use of discipline-specific funding panels, structures within many of our research institutions and the ERA process itself – all discourage researchers from straying outside the strict confines of their own disciplinary expertise.

This creates research silos that have limited capacity or motivation to interact and who struggle to communicate with each other effectively.

There are some exceptions. Examples within Australia



Australian Government

## 2012 CALL FOR NOMINATIONS

Nominations are invited for the Prime Minister's Prizes for Science, which are offered to Australian citizens or those who hold permanent residence status in Australia.

The \$300,000 Prime Minister's Prize for Science is awarded for an outstanding specific achievement or series of related achievements in the physical, chemical, biological and technological sciences, mathematics and engineering. The Prize may be awarded to an individual or jointly to up to four individuals.

The \$50,000 Science Minister's Prize for Life Scientist of the Year and the \$50,000 Malcolm McIntosh Prize for Physical Scientist of the Year are awarded to two scientists at an early stage of their research careers, whose outstanding achievements are advancing, or have the potential to advance human welfare or society. To be eligible in 2012, nominees must have completed their PhD within the past 10 years i.e. the date of their testamur must be on or after 20 May 2002.

The \$50,000 Prime Minister's Prizes for Excellence in Science Teaching in Primary and in Secondary Schools recognise two teachers who have made outstanding contributions to science education in Australia. Nominees for these Prizes should be on the staff of a school and active in science education at the time of their nomination.

Nominations for the 2012 Prime Minister's Prizes for Science should be made by nominators who are personally knowledgeable of the nominated achievement and who can offer expert opinions on its worth. Self nominations will not be considered.

Closing Date: 27 April 2012, AEST 5.00 pm

Further information on Eligibility Criteria and Selection Information is available from:

Science Prizes Secretariat  
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# THE PRIME MINISTER'S PRIZES FOR SCIENCE



## Ezio Rizzardo & David Solomon Prime Minister's Prize for Science

Professors Ezio Rizzardo and David Solomon have reinvented polymer science and devised a means of custom building plastics and other polymers for plastic solar cells, drug delivery, paints, adhesives, lubricants and everything in between.

Their techniques are employed in the laboratories and factories of DuPont, L'Oréal, IBM, 3M, Dulux and more than 60 other companies. Their work has been cited more than 12,000 times in the scientific literature and is integral to more than 500 patents.



## Stuart Wyithe Malcolm McIntosh Prizes for Physical Scientist of the Year

A billion years after the Big Bang, the Universe burst into light. How? This is one of the mysteries of cosmic history. The theories of Professor Stuart Wyithe, a young theoretical physicist from The University of Melbourne, may give us the answers. His ideas are guiding the development of the next generation of telescopes.



## Min Chen Science Minister's Prize for Life Scientist of the Year

Associate Professor Min Chen from The University of Sydney has discovered a new form of chlorophyll, the molecule central to photosynthesis, in cyanobacteria (blue-green algae) from Shark Bay. The new form, chlorophyll f, absorbs far red light and its discovery has potential applications in solar energy and agriculture.



A national strategy for engagement with the sciences

include the Australian Institute for Bioengineering and Nanotechnology at The University of Queensland, and my own institute, The Institute for Photonics & Advanced Sensing (IPAS) at The University of Adelaide. IPAS pursues a transdisciplinary approach to science, bringing together physicists, chemists and biologists to create new sensing and measurement tools to enable scientists to ask new questions and industry to solve problems.

A number of the NCRIS national research facilities also exemplify a successful approach to bringing together researchers from disparate backgrounds, and this approach is effective in translating knowledge between fields and in stimulating effective collaborations between institutions. As it is not clear that there will be ongoing support for this critical scheme, it is important that we work together to paint a tapestry of the tangible outcomes it enables.

There are many things we can do to improve our innovation system. We need to support the creation of more, better and larger-scale links between universities and industry. We need to change the culture so that applied and industrially linked research is not viewed as second rate to pure fundamentally driven research.

While it is widely thought that innovation springs forth from pure research, I have found that it can work better the other way around. Working with industry gives researchers an opportunity to work on 'wicked' problems.

It is rare for research to follow the simple trajectory that we all articulate in our grant applications. Instead, we encounter bigger than anticipated obstacles, spot different routes to the destination, or, at times, stumble upon something new and unanticipated.

Working on applied problems gives one surprising opportunities to tackle fundamental questions. Research is, at its heart, a creative enterprise embedded with surprises and opportunities. This under-recognised truth also gives us a rich opportunity to re-cast the traditional stereotype of the scientist.

The best example I have from my own research team is work that started working with DSTO to develop a dipstick for monitoring fuel degradation in aircraft. In doing this, we developed an optical fibre sensor to measure hydrogen peroxide, and

in conversation I learnt that wine industry required similar tools. This evolved into new 'Smart Bung' technologies (bungs are barrel-sealing devices) that promise to enable wineries to remotely monitor wine quality.

This journey has led to partnerships in which we are developing tools to 'listen' to developing embryos, generating new insight into the beginning of life.

Increasing interactions between industry and academia and raising the profile of applied research would have clear economic benefits by increasing the alignment of our research capabilities with industry needs, and increasing the proportion of our intellectual property that can be translated to outcomes. It would have the side-effect of making academic STEM careers attractive to a more diverse range of people – more people are attracted to an endeavour associated with jobs and products – and I have noticed that women are disproportionately interested in outcome-focused research. This would be a win-win scenario.

Instead of categorising scientists into their fields of expertise and judging that they cannot contribute outside these narrow and specialised fields, we need to create a culture in which scientists are recognised and judged by the outcomes their teams have achieved. This will enable scientists to reach out across the disciplines without fear



Tanya Monro "at the coalface".

of being judged as non-expert by those in the other fields.

Something that goes hand-in-hand with this is the need to encourage scientists to engage with the public and people working in other fields. This takes courage and exposes one to judgement, but it is the way in which really rich opportunities and cross-cutting collaborations come about.

It is much easier for a scientist to score goals that are recognised by their own discipline and our current policy settings encourage such behaviour. It is only by finding a language to express the approaches and capabilities of a field of research in terms that are understood by those with a different background that enables truly new things to occur.

We need to encourage scientists to engage effectively with the media, and to take risks in stepping into areas in which they are not experts. This is where rich seams of untapped opportunity lie. It is undeniable that adding gender or cultural (or indeed disciplinary) diversity, produces better outcomes.

Other factors particularly impact women and can limit the opportunities of women in STEM careers. Some centre on child rearing and unequal home duties and are relatively well understood.

An under-recognised factor is that women are in general more sensitive to role expectations, typically responding more negatively when perceived by others as stepping outside their jurisdiction. Another factor that I have encountered is the perception that persistent women are perceived as aggressive, when similar behaviour in men is viewed as drive.

Women, being on the whole more sensitive to such perceptions of their behaviour, become more likely to step

back, or not step forward in the first place.

What can we do?

- we need to create a future in which our best and brightest young people aspire to careers in STEM, a future that encourages entrepreneurship to underpin future advanced manufacturing industries in Australia;
- we need to work to create better research career structures that give reasonable job security to our best researchers, regardless of gender, and based on a culture of recognising outcomes;
- we need to reduce the burden associated with getting research funded; and
- we need to create better pathways for movement between academic, government and industry roles.

Women are the biggest untapped resource in this and all of the cultural and systemic changes required to bring greater numbers of women into our innovation system will serve to increase the quality of research outcomes. ◀

**PROFESSOR TANYA MONRO FAA FTSE** is an ARC Federation Fellow, Director of the Institute for Photonics and Advanced Sensing (IPAS) and the Director of the Centre of Expertise in Photonics at the University of Adelaide. IPAS focuses on transdisciplinary science. She is a member of the South Australian Premier's Science and Research Council and regularly serves on a range of committees for the Australian Research Council (ARC) and other key national bodies in the area of science policy and evaluation. Professor Monro won the 2012 Pawsey Medal, the 2011 Scopus Young Researcher of the Year for Physical Sciences, and was named 2011 Australian of the Year (South Australia) and 2010 SA Scientist of the Year.

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## Anything's possible – expect the unexpected

ularly in listed entities. Not long after my retirement as Vice-Chancellor of CDU, I was asked to chair the Audit Committee, a role that has created further opportunities.

I am now a professional company director, with a portfolio that reflects my diverse science and technology interests, my 15 years CEO experience and 20 years of board experience. It is a portfolio that includes chairing a State-owned corporation as well as two unincorporated entities, and directorships of two ASX-listed entities – where I chair the audit committees, a ministerial company, incorporated companies with shareholders from the public and private sector and a not-for-profit.

This portfolio requires me to spread my time between Sydney, Brisbane, Darwin, Adelaide and Canberra. It is challenging and rewarding. For only one of these entities did I seek the role – the rest were doors that opened.

Ongoing learning, taking risks, a 'can do' attitude coupled

with passion, perseverance and networking beyond one's professional base help make the unexpected, and almost anything, happen! ◀

**DR HELEN GARNETT PSM FTSE** is a company director, with some 20 years' experience in executive and non-executive board roles in both the public and private sectors. Her roles include director and chair of the audit committees of Energy Resources Australia Ltd and Carbon Energy Ltd; chair of Delta Electricity, a NSW state corporation, the Australian Biosecurity Intelligence Network and the Queensland College of Wine Tourism; and director of the Crawford Fund, the National Centre for Vocational Education Research, the Grape and Wine Research and Development Corporation and the Australian Centre for Plant Functional Genomics. Following training in virology and academic, research and management roles on four continents, she spent 15 years in chief executive roles at ANSTO and Charles Darwin University.

# Women need to understand the corporate 'game'

To simply argue that corporate cultures need to change is certainly correct in principle but does not bring about the necessary changes.



By Mark Toner and Gunilla Burrowes

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**T**here are at least five excellent reasons for having much greater gender balance in professions like engineering where women continue to be disadvantaged in male-dominated organisations:

- equity (equal rights for women);
- excellence (using the most talented people to achieve quality);
- efficacy (accessing all available pools of talent);
- efficiency (not wasting the talents of educated women); and
- personality-type balance (more values-based members and less impersonal, analytical types).

There is an additional reason for businesses to have women at senior management and board levels – such organisations typically produce improved financial results. This is therefore a governance issue for companies, something that most CEOs and board members are yet to realise.

But increasing the number of women attracted to engineering and science is just the start of the process. Once women are trained and working within these professions, they are being challenged by workplace cultures and practices which in some cases favour men, alienate women and cause women to leave their profession.

To simply argue that corporate cultures need to change is certainly correct in principle but does not bring about the necessary changes.

The aim of our paper was to present to women a new approach to enhancing their career prospects, allowing women to have better career options and more control over their professional lives. This does not mean they should strive to get to the highest levels of an organisation – rather, their aim should be to use their skills and experience to get to a position and to do the type of work that gives them the most satisfaction and an appropriate return on their efforts.

With this approach, more women will be able to do more appropriate and satisfying work and reach higher levels of authority in their organisations, which by itself will bring about changes beneficial to the organisation. Some of

In Australia and elsewhere, women continue to be disadvantaged in male-dominated organisations. Engineering and some parts of science remain heavily male-dominated, and so female engineers and scientists will invariably work for organisations run by men, where some cultures and practices may disadvantage them in their careers. This was the subject of a paper the authors presented to several hundred women and several men at the 15th International Conference for Women Engineers and Scientists (ICWES15), held in Adelaide last year. The conference, sponsored by Engineers Australia's National Committee for Women in Engineering and the International Network for Women Engineers and Scientists, attracted more than 500 attendees.

these women will then proactively introduce further change.

A secondary aim of the paper was to change the attitudes and behaviours of those men (and women) who deliberately or unwittingly make life difficult for female employees.

## Problems and solutions

The problems many women face in business, and more particularly in engineering, have been well documented and include poor career prospects, far too much discrimination, harassment and bullying, and large pay gaps.

As an example of their poor career prospects, women comprise 53 per cent of all professionals in Australia but in the ASX200, women comprise only 14 per cent of board directors, three per cent of CEOs and 10 per cent of executive managers.

In the ASX500, only 9.5 per cent of directors are women and 267 (53 per cent) of these top 500 listed companies have no women on their boards at all. Reasons for these problems are well known, a major one being overt and covert gender bias (both conscious and unconscious), but progress in rectifying these problems has been unacceptably slow.

At the conference, Dr Cathy Foley PSM FTSE, then President of Science and Technology Australia (formerly FASTS), pointed out in a keynote speech that, at current rates, it will take a further 150 years for us to achieve gender equity in Australia.



# Science in Action

The most commonly cited reason why students stop choosing science in upper secondary is that they do not see the relevance.

Despite the fruits of science being all around us.

Not any more. STELR is an in-curriculum program that brings relevance to students. STELR provides hands on opportunities to work with wind turbines, solar panels and more. STELR provides career guidance, challenges and social context.

STELR has completed the 2012 round of teacher professional learning workshops in all states and territories. There are over 1,100 STELR teachers.

STELR is now running in 300 schools throughout Australia benefitting over 30,000 students per year. STELR could be running in your school, too.

Find out more about STELR by visiting the web site ([www.stelr.org](http://www.stelr.org)) For pricing, contact STELR Project Manager Peter Pentland at +61-3-9864 0906 or [pentland@atse.org.au](mailto:pentland@atse.org.au)



STELR is a key initiative of the Australian Academy of Technological Sciences and Engineering (ATSE), [www.atse.org.au](http://www.atse.org.au)

The solution to these problems is first to attract and retain more women in engineering, the 'hard' sciences and in business generally and, second, to change the culture of the engineering profession and business to value gender diversity.

All employees are playing a corporate game, whether they realise it or not, and women can enhance their career prospects by understanding the game. It is a game because all employees are working to rules and boundaries set by their organisations and from a career point of view there are winners and losers.

To call it a game is not to trivialise its importance – it is a very serious game spanning a large proportion of our lifetime. Employees can enhance their careers by observing the way the game is played, understanding the rules (both written and unwritten) and then deciding if, and how much, they want to be willing participants.

As a prerequisite, female employees need to understand that, in general, men and women can differ in key areas like decision-making, communication style, assertiveness, competitiveness and career management, and they therefore may need to develop some new skills if they decide to play in the men's game.

The World Economic Forum's finding in 2010 that the greatest barrier to women rising to senior positions in engineering and construction world-wide is the prevalence of masculine and patriarchal corporate cultures is testament to the game being a male one, run by male managers. Because it is a male game, it is harder for women to recognise than for men, and even if they do recognise it, it is even harder for them to participate in it.

## Playing the game

In order to recognise the game and participate in it, all employees, especially women, need to 'read' the game being played and understand a number of relevant issues. To read the game, an employee needs to observe and decide inter alia:

- what are the rules (written and unwritten) of the game;
- who are the people with power (official and unofficial);
- what are all the relevant relationships;
- which men are sexist or uncomfortable with women;
- what is the culture of the organisation, and is there any gender bias (systemic or personal); and
- how are employees recognised and rewarded by management, and who is likely to be promoted?

With the ability to read the game, an employee has then to decide how much she/he wishes to play it. To play it, the employee may need to both gain new insights into how the organisation actually runs and to develop new skills to effectively participate in the game. For example, good work and conscientious behaviour are by themselves generally insufficient for promotion, a fact not widely un-

derstood by many employees.

A far more important factor is the qualities management is really looking for in assessing candidates for promotion. Another insight for an employee is that 'managing upwards' and being visible to middle and senior management are important for career development.

With the right skills, women can recognise the corporate game that is typically played in male-dominated organisations and give themselves the option of whether to engage in the game and if so, how much to play it, to advance their careers.

We are certainly not saying that women should play the game, conform to male organisational cultures or act like men. We do believe, however, that women need to



Gunilla Burrowes and Mark Toner at ICWES15 with Dr Maria Jesus Prieto-Laffargue, President of the World Federation of Engineering Organisations (centre).

understand their working environment so they can make a better decision about their participation in the game and its effect on their careers.

However, the real issue is how the game can be changed to generate gender-neutral workplace cultures and true gender equity across organisations. Achievement of increased gender equity in Australia and elsewhere will only happen when progressive-minded men (and women) have the knowledge, power and commitment to effect such major change. ◀

**DR MARK TONER** FTSE is a management consultant and a director of a number of companies involved in technology commercialisation.

He is a former CEO of Kvaerner (now Jacobs) E&C Australia which was a successful but very male-dominated engineering and construction company. He and GUNILLA BURROWES run a gender consulting business, Gender Matters. Ms Burrowes is an electrical engineer with a background in both academia and industry. She has extensive experience with gender issues in engineering and helped initiate Engineers Australia's theme year 2007: The Year of Women in Engineering. Ms Burrowes has been Division President and Councillor of Engineers Australia and is currently Deputy Chair of Engineers Media. She has worked in various industry sectors, has a number of board positions and chairs an angel investment group.

# The view through ATSE's looking glass

ATSE is committed to taking a leadership role in the identification and promotion of female talent within ATSE and in the Australian SET sector.



By Susan Pond

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Let's get right to the point. ATSE is a male-dominated organisation. This statement is not made with any malice. It reflects the Academy's roots in technological sciences and engineering, its establishment in mid-1975 when the workforce in these sectors was predominantly male and its subsequent history.

Two among the 65 Foundation Fellows of the then named Academy of Technological Sciences were women (three per cent).

When the President, Professor John Zillman AO FAA FTSE, wrote the history of ATSE's first 30 years, in 2005, the Academy admitted 30 new Fellows, including two women (6.6 per cent) and in its first three decades had:

- six Presidents, all men;
- 115 Members of Council, including six women (4.5 per cent);
- 690 Fellows, including 31 women (4.5 per cent);
- 48 Chairs of Regional Divisions, including one woman (2.4 per cent); and
- 27 Academy Orators, all men.

Although ATSE's figures then more or less reflected the representation of women in science, engineering and technology (SET) at senior levels in industry and academia, the Academy recognised that talent that could have been made available to the benefit of ATSE and Australia was being wasted. This wastage was depicted recently by Ernst & Young as the 'Smart Curve' (Figure 1).

ATSE made some progress during the next five years. By 2010, there were:

- 785 Fellows, including 51 women (6.5 per cent);
- 29 members of Assembly, including 4 women (14 per cent);
- two women appointed to the Board – one as Director and one as Vice President;
- six members of the Clunies Ross Awards Committee, all men;
- one woman among 12 Topic Forum leaders (8.3 per cent); and
- a female CEO.

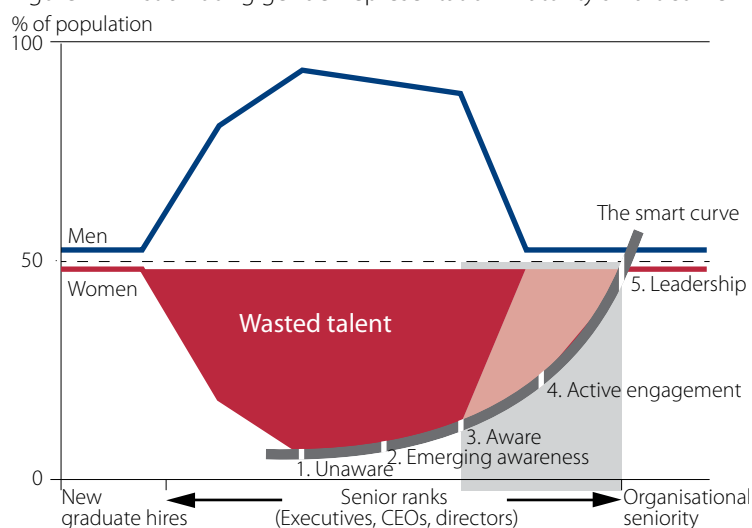
That year the Academy admitted 27 new Fellows, including six women (22 per cent).

In July 2010, the ATSE Board committed to taking a leadership role in the identification and promotion of female talent within ATSE and in the Australian SET sector. "The Board recognised the serious gender imbalances in the SET fields at all stages from participation in tertiary education to employer recruitment, retention and promotion. These imbalances have serious implications for Australia's productivity and prosperity."

These imbalances have been longstanding and resistant to the measures taken to redress them during many decades. Sharon Bell's 2009 report, *Women in Science in Australia: Maximising Productivity, Diversity and Innovation*, prepared for the Federation of Australian Scientific and Technological Societies (FASTS – now STA) references an earlier report and notes:

"Most obviously almost a decade and a half has passed since the first report, yet the issues are yet to

Figure 1 Ernst & Young gender representation maturity smart curve



■ The smart curve represents behavioural and structural maturity

■ Point at which wastage is minimised and value is derived

SOURCE: WOMEN IN LEADERSHIP. HOW SMART ARE YOU? 2011 ERNST & YOUNG AUSTRALIA

be addressed. A comparison between the two reports reveals that any changes have been minimal. The 1995 report, like this report, noted that women were seriously under-represented in some specific disciplines of science, engineering and technology (SET), and were not well-represented at the most senior levels in all disciplines.

"They affirmed the importance of this in terms of diversity and innovation as well as in terms of maximising productivity, noting that continued underrepresentation and under-participation of women in SET-based education, training and employment is a cause for social concern on equity grounds.

"Further, it is also likely to inhibit Australia's capacity to develop internationally competitive research and industries."

In November 2010, the Academy's Assembly endorsed unanimously the organisation's Gender Equity Policy which was subsequently ratified by the Board. The policy outlines the immediate and ongoing priorities for ATSE in relation to gender diversity and informs all of the internal activities of ATSE and its roles externally. Progress must be reported to the Board and Assembly every six months.

## Current initiatives

ATSE was a sponsor of the Women in Science and Engineering (WISE) Summit held at Parliament House, Canberra, in April 2011. The Summit was convened by the Australian National Commission for UNESCO, the Australian National Committee for UN Women and FASTS.

Among other resolutions, the attendees agreed to take the UN Women's Empowerment Principles – Equality Means Business to their organisations with a view to adopting them (see [www.unglobalcompact.org/Issues/human\\_rights/equality\\_means\\_business.html](http://www.unglobalcompact.org/Issues/human_rights/equality_means_business.html)).

The Women's Empowerment Principles (in brief) proclaim:

- establish high-level corporate leadership for gender equality;
- treat all women and men fairly at work – respect and support human rights and nondiscrimination;
- ensure the health, safety and well-being of all women and men workers;
- promote education, training and professional development for women;
- implement enterprise development, supply chain and marketing practices that empower women;
- promote equality through community initiatives and advocacy; and
- measure and publicly report on progress to achieve gender equality.

On the same day, the three female Directors of ATSE

attended a private roundtable with the Minister for Employment Participation and Childcare and for the Status of Women, Kate Ellis, to discuss how to boost productivity and equity by attracting and more women into SET education and retaining them in the workforce.

The May 2011 meeting of the ATSE Assembly

- endorsed adoption of the Women's Empowerment Principles;
- set the target for the 2012 round of election of new Fellows that 33 per cent should be women, provided that they meet all of the criteria for Fellowship; and
- agreed with the proposal that ATSE should conduct Roundtable discussions with highly influential individuals from industry to identify and support significant action to address the interrelated matters of decline in innovation and productivity in Australia; deepening skills shortages in technological sciences and engineering; and the multi-decade lack of progression of women in these fields to senior executive ranks and Board positions.

In so doing, ATSE was aware of the substantial and growing body of evidence that recruiting and retaining women into senior leadership roles and onto Boards improves the financial performance and governance of companies, large and small.

The evidence for Australian companies is summarised by Women on Boards Director Claire Braund in her article 'Why women are good for business' in December 2011 ([www.womenonboards.org.au/pubs/articles/1112-why-women-are-good-for-business.htm](http://www.womenonboards.org.au/pubs/articles/1112-why-women-are-good-for-business.htm)).

She concludes: "The global business case for more women on boards and in leadership roles is overwhelming. It no longer needs to be proven and debated, but believed and acted upon. This will require a significant shift in corporate culture and in the attitudes and behaviours of many who occupy positions of power."

## ATSE Roundtables

The first Roundtable was hosted by ATSE Fellow Ms Catherine Livingstone, Chairman of Telstra, in Sydney in September 2011 and attended by Academy President Professor Robin Batterham, Dr Susan Pond (ATSE), Dr Margaret Hartley (ATSE), Mr Rupert Grayston (Engineers Australia), Dr David Cook (ATSE), Professor Graham Davies (Dean of Engineering, UNSW), Ms Kathryn Fagg (Chief Executive Women member and President, Corporate Development at Linfox), Dr Catherine Foley (STA and CSIRO), Ms Marianne Foley (Arup) and Mr Steve Lennon (Arup).

All of the Roundtable participants made strong commitments to work together to influence the national agenda on innovation and productivity and continue to be champi-

ons for gender equity within their respective organisations.

The second Roundtable was hosted by ATSE Fellow Mr Leigh Clifford, Chairman of Qantas, in Melbourne in March 2012 and attended by Professor Batterham (ATSE), Dr Pond (ATSE), Dr Paul Donohue (ATSE), Professor Doug Hilton (WEHI), Ms Roslyn Sayers (Siemens), Dr Mark Toner (ATSE and Toner & Associates), Mr Bill Petreski (Ai Group), Mr David Peever (Rio Tinto), Dr John Skerritt (ATSE and Victorian Government) and Mr Graham Hodges (Deputy CEO, ANZ).

With a view to enhancing female participation in SET fields at all levels, the Roundtable participants agreed to support and promote initiatives and systems that will:

- improve gender equity in Australian organisations and companies, particularly in senior ranks, and demonstrate that gender diversity improves the financial performance of companies across all industry sectors;
- re-skill employees (females or males) after career gap and promote the benefits to employees of flexible working hours and part-time work;
- similar to the Australian Institute of Company Directors Chairman's mentoring program, specifically target women from SET fields who are suitable for senior executive and Board positions; and
- educate women and men about male-female differences and the biases that disadvantage female engineers and scientists in the work place and about ways to deal with them.

"Gender equality needs 'all the hard yards' says Westpac chief" (Ms Gail Kelly, *Sydney Morning Herald*, 9-10

July 2011). Through its Roundtables, ATSE is joining a growing band of individuals determined to put in these hard yards. These individuals are to be found in companies, organisations such as the Australian Institute of Company Directors, Australian Stock Exchange, Chief Executive Women and WISE, the media, academia and government.

They take their role seriously. As the Sex Discrimination Commissioner, Elizabeth Broderick, said in 2010, when she established The Male Champions of Change and its Charter: "It is strong male leadership that's going to change the picture for women in Australia".

Broderick completed her sentence with "... which in a sense is a little bit depressing".

The 'Through the Looking Glass' analogy for the difficult road ahead for women and men – mirror images, time running backwards, chess games, hidden codes, and endless opportunities for confusion and contradiction – seems most apt. ◀

**DR SUSAN POND AM FTSE is Adjunct Professor in the Dow Sustainability Program at the United States Study Centre at the University of Sydney. Her area of interest is the development of the advanced transportation biofuels industry, including the critical success factors required for commercially viable production at scale. Dr Pond is a Board Member of ANSTO and Commercialisation Australia and Vice-President of ATSE. Previous appointments include senior executive positions with Johnson & Johnson, as Director of Pharmaceutical Research for six years and Managing Director for the next six years of its Sydney-based biotechnology company, Johnson & Johnson Research Pty Ltd (JJR). Dr Pond was Director and then Chairman AusBiotech Ltd, from 2004–08.**

## GENDER ISSUES HIGHLIGHTED IN UNESCO ATLAS

○ To mark International Women's Day in March, UNESCO released its *World Atlas of Gender Equality in Education*, which includes more than 120 maps, charts and tables featuring a wide range of sex-disaggregated indicators.

The vivid presentation of information and analysis calls attention to persistent gender disparities and the need for greater focus on girls' education as a human right.

The atlas illustrates the educational pathways of girls and boys and the changes in gender disparities over time. It hones in on the gender impact of critical factors such as national wealth, geographic location, investment in education, and fields of study. It shows that:

- although access to education remains a challenge in many countries, girls enrolled

in primary school tend to outperform boys.

Dropout rates are higher for boys than girls in 63 per cent of countries with data;

- countries with high proportions of girls

enrolled in secondary education have more women teaching primary education than men; and

- women are the majority of tertiary students in two-thirds of countries with available data.

However, men continue to dominate the highest levels of study, accounting for 56 per cent of PhD graduates and 71 per cent of researchers.

The atlas also provides a fresh perspective on the progress countries are making towards gender-related targets set by the international community under *Education for All* and the

*Millennium Development Goals*.

The print edition of the atlas will be accompanied by an online data mapping tool that enables users to track trends over time, adapt maps and export data. This eAtlas will be regularly updated with the latest available data from the UNESCO Institute for Statistics.



The Atlas is at [www.uis.unesco.org/Education/Documents/gender-atlas-2012-web2-en.pdf](http://www.uis.unesco.org/Education/Documents/gender-atlas-2012-web2-en.pdf)

# Can we be ourselves *and* be engineers?

We need a balance in our society, a balance in our values and a balance in the way we think about what technology we create for the future.



By Caroline Baillie

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In 1998, I co-wrote a paper for an American Society of Engineering Education conference titled 'On Values, Role Models and the Importance of Being Me'.

With Cynthia Mitchell, from the University of Queensland, I wanted to explore the notion that we could be ourselves and be engineers, and perhaps help others to do so too. We felt we were increasingly being made to be and to act in particular ways that we were not completely comfortable with and which did not match our values.

These forces seem even stronger today. So, how can we encourage more women to study engineering in a climate that seems to some of us to be intent on putting efficiency and profit before humanity?

From my perspective, it is ever more critical that we do so. We need a balance in our society, a balance in our values and a balance in the way we think about what technology we create for the future. This can only be done by a balanced workforce that is representative of the whole of society.

I studied engineering in Britain in the 1980s. I thought anyone could do anything so long as they tried hard enough (and were weak if they didn't). I thought society no longer needed feminists because they were now serving only to provide distrust among the 'new men' who, after all, were trying their hardest.

This way of thinking has actually developed even further in the decades since. Today, it appears many students believe even more in 'equality'. In most school leavers' minds, there is no concept that we might find 'equity' if we allow for 'difference'.

Here is a comment from a female engineering student I interviewed about the need for a gender-inclusive curriculum:

*The biggest difficulty studying in Australia is this chronic endeavour to single out females; pro and con. Accepting oneself as equal is the only true barrier to equality. Then just do it.*

For most young women who choose engineering today, all the role models are males and a very high proportion of their student colleagues are males. Most of us start out



UWA  
engineering  
students.

declaring that we want to be equal but is this really what most female engineering students feel?

US feminist, ethicist and psychologist Carol Gilligan is often credited with discovering the concept of a "different voice" after her study of moral development contested the theories of prominent fellow US psychologist Lawrence Kohlberg. Gilligan reasoned that women tended to talk about caring for the needs of others and valued relations between people, which the men in Kohlberg's all-male study had not mentioned.

I rediscovered this different voice when, exasperated by a dismal focus group about the experiences of studying with a group of female engineering students, I talked openly about my own views. The next day there was a knock at the door:

*I was very interested in what you had to say yesterday and I came to thank you. I had no idea that I could be 'myself' in my profession. I thought I had to become someone else or I wouldn't fit in. I really hadn't considered that I could bring some of who I am into my work and that that might be a good thing.*

What we have here is strong independent young women who have already made a significant, difficult decision in choosing engineering as a career. They do not want others to think they have any problems with the way things are because it would look like a failure on their part as women. So when asked, they respond with "what gender bias?"

When I began lecturing, I suddenly realised that there

were hardly any girls taking the course. It was funny that it hadn't occurred to me before as odd, considering I was one of only two women in my own course. I guess I thought things were changing slowly but surely.

However, it became apparent that bullying girls into taking non-traditional subjects in schools was not working. This forced me to rethink my own situation – I was stuck in a mindset of wanting to be equal.

It was not until I started researching the reason why girls were not taking engineering that I began to come across a literature that was saying 'why should girls take engineering the way it is?'

That literature and my own research led me to some very important conclusions. Women will take on engineering if they recognise its value to society. They also have a seriously important contribution to make engineering what it can and should be.

Following my mantra of being myself, I have always continued to work on my passion – theatre. One example of my merged engineering/theatre work was a production I developed for an outreach project.

I decided to write a play about the first Australian female electrical engineer who had also gained an OBE and set up the Women's Royal Naval Service – but nothing seemed to have been written about her.

We went to Sydney Girls High School where she had studied and found that school archivists had actually con-

ducted research into Mrs Mac, as she was known. They had original transcripts of interviews with her and much other archival material. We borrowed some of this material and created a play about her.

Mrs Mac wanted to do an electrical engineering degree in the 1920s but Sydney University at that time wouldn't let her register because she was female. So she went down the road to ask at the Technical College (now University of Technology, Sydney) and was told she was required to be an apprentice of some kind.

*As soon as I found out about the regulations, I had some cards printed with my name and "electrical work" on them. My first job was wiring a house, way beyond Marrickville. It was a mile from the end of the tram line. I went out there because nobody else was silly enough to take that job.*

She actually taught herself how to install electricity, installed it in someone's house, got herself a certificate and, as a result, gained acceptance to Sydney Technical College.

It's a little easier for women to get a place in universities today!

We put on the play at local schools with a workshop that explored the idea of women in engineering and asked students 'What is an engineer like?' The students' answers, as expected, produced some rather crude stereotypes: old; sad; someone with glasses; someone with a beard; someone with a uniform; boring; man; and wears a white coat and safety specs.

## WOMEN AMONG WOMEN "LESS RISK-AVERSE"

New research from The Australian National University has shown that women are more likely to make risky choices when they are surrounded by other women.

In an experiment at the University of Essex, Professor Alison Booth from the ANU Research School of Economics, and colleagues tested whether single-sex classrooms in co-educational environments altered students' risk-taking attitudes.

Professor Booth said the results showed risk-taking in women came down to social learning and environmental factors, rather than inherent gender traits.

"We designed a controlled experiment using first-year university students who made



Alison Booth

choices over real-stakes lotteries at two different dates. Students were randomly assigned to classes of three types: all female, all male and co-educational," said Professor Booth.

"We found that, on average, women are less likely to make risky choices than men at both dates. However, after eight weeks in a single-sex environment,

women were significantly more likely to choose the lottery than their counterparts in co-educational groups. Indeed, by week eight women in all-female groups behaved in a similar way to men.

"It was also interesting to note that the risk-taking behaviour of men was unaffected by group composition.

"Women, even those endowed with an intrinsic propensity to make riskier choices, may be discouraged from doing so because they are inhibited by culturally driven norms and beliefs about the appropriate mode of female behaviour-avoiding risk. But once they are placed in an all-female environment, this inhibition is reduced."

Professor Booth said that the findings had implications for the labour market.

"Recent studies in experimental economics have shown that, on average, women are more risk-averse than men. If much of the remuneration in high-paying jobs consists of bonuses linked to a company's performance, relatively fewer women will choose high-paying jobs because of the uncertainty. Given that risk attitudes can be shaped by the environment, changing the educational or training context could help address under-representation of women in certain areas."

When we asked ‘What does an engineer do?’ we got the following student responses:

- plays around with scientific equipment;
- fixes things;
- makes things no one wants;
- never smiles;
- fiddles with things;
- reads a lot of books;
- uses equations and formulae; and
- works in a big grey office block.

But to the question ‘Is Mrs Mac a typical engineer?’ they said ‘no’. And to the question ‘What would you do if you were an engineer?’ many students suggested they would look for ways to improve the lives of others and help to solve global poverty and environmental issues.

Instinctively they knew what engineers are capable of – what they can contribute to society. It inspired me to realise that if we could increasingly bring this aspect into engineering education, not only would more women take an interest in the subject – but engineering and society would also benefit!

That was when I started my own not-for profit waste recycling organisation Waste for Life (wasteforlife.org) which supports marginalised groups of people in several countries and involves the work and projects of many hundreds of engineering students all over the world ... but that’s another story.

Today, there is an increasing focus on engineering and its social impact. At The University of Western Australia, all first-year students who want to be engineers take a unit entitled Global Challenges in Engineering. Many universities, including UWA, involve students in Engineers Without Borders projects.

The tide is changing and we are beginning to appreciate that engineering does not operate in a vacuum. Women are needed to help the overall aim of developing technology and systems to improve the health and well-being of all in our society. ◀

**WINTHROP PROFESSOR CAROLINE BAILLIE** is UWA’s first Chair in Engineering Education for the Faculty of Engineering, Computing and Mathematics. She is the Research Theme Leader for Engineering Education Research and Director of FASE (Faculty Academy for the Scholarship of Education). Before moving to Perth, she was Chair of Engineering Education Research and Development at Queens University, Kingston, Ontario, where she was also cross appointed into Chemical Engineering, Sociology and Women’s studies. Formerly Professor Baillie was lecturer at Imperial College, UK, and the University of Sydney. Professor Baillie has several theatre productions under her belt as well as a BBC documentary series, *Building the Impossible*, in which a team of experts undertook the challenge of building historical inventions to their original specification to see if they really worked.

## WOMEN SHOWED THE WAY TO HEALTHIER SOCIETIES



The controversial 1970s Australian women’s health movement was a booster shot for the existing health system and has vital lessons for health reform today, according to a leading health and welfare expert from The Australian National University.

Dr Gwen Gray, from the School of Politics and International Relations at ANU, has completed the first full-length history of the women’s health movement in Australia and its impact on public policy. Her findings have been published in her latest book *Reaching for Health*, launched at ANU in February.

Dr Gray said that the women’s health movement shocked and scandalised the nation in the early 1970s.

“It cast the light of day onto taboo subjects such as sexual assault, abortion and domestic violence, provoking outrage and condemnation,” said Dr Gray.

“Some of the services women created for themselves were subjected to police

raids, and sex education material was branded ‘indecent’. Yet, for all its perceived radicalism, the movement was part of a much broader and relatively conventional international health reform push, which included the ‘new’ public health movement, the community health centre movement and, in Australia, the Aboriginal health movement – all of which were critical of the way medical systems had been created in the 20th century.

“The movement has had an important and continuing impact on public policy, particularly in the area of different forms of violence against women. However, it also created opportunities for health reform which unfortunately have still not been embraced, except at the margins.”

*Reaching for Health* is published by ANU E Press and is available online at <http://epress.anu.edu.au>

# Dish it out and take it too

"I was nominally in charge but the only person who believed that was my mum."



By Sue Murphy

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**Y**ou would think that more than 30 years of being the only 'girl' on the construction site who wasn't employed to type should involve horror stories of discrimination and the need for steely determination to claw one's way to the top.

In my case, though, it has been quite the converse.

Of course there have been issues, but most of them result in learning a new skill – for example, a lack of female-friendly toilets (those without urinals lined with men) in my early site years has given me great bladder control and a continuing reluctance to drink too much tea early in the day!

I chose engineering as a career largely to annoy the teachers and family members who told me to study medicine.

I was strong in maths but not particularly endowed with practical skills, so when I arrived on remote construction sites as a young engineer I knew I had a lot to learn and turned to the supervisors on site for help. These amazing men had little formal education but vast knowledge of every aspect of construction.

I was nominally in charge but the only person who believed that was my mum. I wrote the letters, ordered materials, managed costs, claims and clients, sorted drawings

and technical queries and soaked up how to plan work, deliver safely, schedule plant and labour efficiently and, most important of all, how to lead.

Those old foremen were superb man-managers, natural leaders who would praise where needed, tease and cajole some, put a rocket up others, be clear on what was needed while understanding who was under pressure from home, who drank too much, who had a dodgy back and who craved overtime. Today there are PhDs in this and 'leadership' is the buzzword but I was lucky enough to watch and learn from the masters.

Interestingly, these strong men thought women were from another planet but were proud to have a 'girl boss' and saw that as a bit unique. We learned from each other, I think.

No flash title wins respect in the field. It must be earned by a mixture of really caring, astute forward planning and the ability to mix dry sarcastic wit with enthusiasm – by being able to 'dish it out and take it too'.

Construction is where scientific theory and reality collide – where the rubber hits the road. I feel honoured to have grown up in that world and feel sorry for those who have not. ◀

National Water Commission Chair Chloe Munro (left) and Sue Murphy inspecting the Beenyup Wastewater Treatment Plant near Perth.



**SUE MURPHY** FTSE graduated as a Civil Engineer from the University of Western Australia in 1979. After winning a Clough Scholarship as an undergraduate, she joined Clough Engineering in 1980 commencing what would be a 25-year career in that organisation. Twelve years in the field as a site engineer and project manager led to corporate roles with a focus on human resources, safety and engineering design management and her appointment in 1998 as the first woman on the board of the Clough Engineering Ltd. In 2004, she joined the Water Corporation of WA with responsibilities for delivery of capital projects and long and short-term planning and in 2008 became its CEO. She is a Board Member of the University of WA Business School, Chairman of the Water Services Association of Australia and, in 2009, 2010 and 2011, was listed in the top 100 most influential engineers in Australia by Engineers Australia.

# An energy-filled job

Engineers not only help understand complex problems, but can help solve them.



By Beverley Ronalds

beverley.ronalds@csiro.au

**B**eing Group Executive Energy at CSIRO for the past five years has been my dream job in a 30-plus year career filled with many wonderful experiences. I have been very privileged in this role to be able to work towards delivering the triple goals of clean energy, energy security and wealth creation from energy for Australia. And powering the future is one of the greatest environmental, economic and social challenges we have to resolve in the early decades of the 21st century.

In addressing our global sustainability and carbon challenges we all need to work together – governments, business, scientists and the community – to help clarify pathways to a new future. There is a special role for my profession of engineering, because engineers not only help understand complex problems, but we can help solve them.

At CSIRO, our key focus is to help accelerate large-scale emissions cuts through developing and scaling-up a suite of new energy technologies – getting them out of the lab and into the field. Together with our partners, we are currently involved in pilot and demonstration-scale activities both here and overseas including carbon capture and storage, concentrated solar thermal energy, photovoltaics, geothermal, smart grids, energy storage, advanced biofuels, and enhanced coal bed methane.

The next step – reinventing our energy infrastructure to deliver secure and affordable low-emissions energy – calls for a large number of engineers!

When I was Professor of Oil and Gas Engineering at The University of Western Australia, I saw first-hand how the major energy companies recruited talented engineering students – especially women. These companies were highly visible on campus, for example contributing guest lectures and project supervision, and offering internships and prizes even at first year undergraduate and school level, to increase awareness of energy as an rewarding career option. Such proactive and sustained targetting paid strong dividends. I am particularly proud that these female former engineering students are now holding senior jobs in the en-

PHOTO: CSIRO



ergy sector around the world and are being wonderful role models. In my experience, international energy companies have also worked hard to ensure an inclusive work culture and offer flexibility in career paths.

Although playing a part in creating a better future is a very stimulating and satisfying career opportunity for many young people, we cannot expect to quickly increase the proportion of women in more non-traditional roles without putting some energy into it. ◀

CSIRO's  
pilot solar  
thermal  
energy  
tower.

**DR BEVERLEY RONALDS** FTSE retires in April as Group Executive Energy after nine years at CSIRO. She was previously the Woodside Chair in Oil and Gas Engineering at The University of Western Australia. Her offshore petroleum industry experience includes design, fabrication and installation support for fixed and floating platforms for the Australian North West Shelf, North Sea and Gulf of Mexico. Dr Ronalds' external roles include the Australian Centre for Renewable Energy, Innovation Australia, National Carbon Capture and Storage Council, Australian Low Emissions Coal R&D Ltd, Queensland Clean Coal Council, and the Technology and Industry Advisory Council. She has been included in Engineers Australia's list of most influential engineers over several years.

# 'Male' career trajectories and academic outputs more valued

We still struggle to recognise those who focus in more than one area, or who integrate research, teaching and service.



By Judy Raper

[jraper@uow.edu.au](mailto:jraper@uow.edu.au)

**R**electing on being a female academic today, compared to 25 years ago when I was beginning my career, leads me to conclude that while we have made some huge inroads (such as in the numbers of women in senior leadership positions) there are some aspects that appear almost unchanged.

In my role I meet with many young female academics who are trying to build their careers and I find the obstacles they face are consistent with my own experiences.

Although this is a generalisation, it still seems common for senior leadership to value 'male' career trajectories and

As long as we stay healthy, and recognise our own value, our collaborative work style and breadth of focus often leads to successful and rewarding academic careers.

academic outputs. Traditionally in academia (as reflected in selection and promotion committees) the focus is on depth – valuing a consistent record of high-quality teaching or large numbers of research outputs – rather than on breadth. We still struggle to recognise those who focus in more than one area, or who integrate research, teaching and service – something more often accomplished by women.

There have been some cultural and legal changes over the intervening years. No woman today would receive a rejection letter for an internal research grant, as I did, with the justification that I wouldn't have time to do the research with a young baby.

While today's funding bodies are more sensitive, our academics (both male and female) must continually balance the competing priorities of work and family life.

Female academics may share family chores with partners but, as in other professions, the burden of responsibility for managing the family often rests with the woman. Perhaps that is why we are more often broad than deep – as we have learnt to juggle multiple tasks and priorities – or perhaps it is our propensity for breadth that compels us to

take on the family responsibility,

Within a university environment, women are often forced to be broad by being asked to take on wide-ranging duties, such as selection committees outside our disciplines. Women are often less forthcoming in promoting themselves, defer seeking promotion as they feel they lack 'depth'. They may feel guilty when they are at home because they are not working, and guilty when they are at work because their children are in childcare.

I want to end on a positive note, as I believe a university career provides a wonderful opportunity for women (and men) to balance work and home life – and succeed in both. I remember feeling very lucky to be able to leave work in the middle of the day to watch my sons' swimming carnivals – not many jobs allow you to do this and still be seen as committed to your career and profession.

While the 'extra' tasks women are asked to take on in their academic roles can be burdensome and take away from our ability to produce large numbers of research outputs in our discipline, they also give us the breadth of understanding that makes women competitive for leadership opportunities.

As long as we stay healthy and recognise our own value, our collaborative work style and breadth of focus often leads to successful and rewarding academic careers. ◀

**PROFESSOR JUDY RAPER FTSE** is Deputy Vice-Chancellor (Research) at the University of Wollongong and Executive Director, Australian Institute of Innovative Materials. Her portfolio includes research policy, grant management, higher degree students, commercialisation and technology exchange. Since 2008, she has been part of and spearheaded three successful bids for Federal Government capital grants including SMART Infrastructure (\$60 million); Australian Institute for Innovative Materials – Processing and Devices (\$50 million); and Retrofitting for Resilient and Sustainable Buildings Projects (\$25 million). Professor Raper is a chemical engineer and a past recipient of the Sheddon Pacific Award for the most outstanding young chemical engineer in Australia; and the Professional Engineer of the Year.

# “You’re just the sort of bloke we’re looking for”

We need to make structural changes to improve the retention and promotion of women.



By Kathy Hirschfeld  
kathy.hirschfeld@bigpond.com

**W**hen I graduated from university 30 years ago, I couldn’t get a job as a chemical engineer. At interviews I heard comments such as: “We had a female engineer once – she got pregnant and left” or, even worse, “If you were a man we’d give you the job – you’re just the sort of bloke we’re looking for”.

The term ‘sex discrimination’ had not been invented then and it took one of my classmates to recognise that’s what was happening and say: “Kath, you’re not getting a job because you’re a girl”. I thought: “What’s that got to do with it, I passed the same exams as the rest of my class?”

To get a job at that time, I explored other options like joining the Army and getting involved in running the Chemeca conference in Brisbane that year. I worked on my networks to build my profile in the industry and after a number of roles in sales and consulting I joined BP at its Kwinana Refinery in Western Australia. At the end of my first year, I was promoted into a team leader role but it took another two years and a new boss before I was given the same grading as my male counterparts. This was a common situation for the rest of my executive career.

With BP, I spent 20 years in leadership and executive roles in Australia, the UK and Turkey, which culminated in becoming Managing Director of the Bulwer Island Refinery in Brisbane. Prior to that I was General Manager of BP’s joint venture refinery in Mersin, Turkey, where I had responsibility for the daily operation of the refinery as well as the project to shut down the plant and convert the site to a large terminal. I was the only female refinery manager in BP’s global portfolio.

Towards the end of my career with BP, I became interested in why there were so few women in leadership roles and why retention of women particularly around late 20s/early 30s is so difficult. The issues of unconscious bias and corporate structures designed around a male breadwinner with a wife looking after children and the home seem most significant to me.

To improve the retention and promotion of women



in science and engineering, we need to make structural changes such as creating targets and ‘pulling women’ up rather than waiting for them to put their hand up (which women typically don’t do, or when they do are viewed as ‘aggressive’).

Support and contact during maternity leave is important and I think the Scandinavian idea of both partners being encouraged to take parental leave helps move society to greater gender equity. ◀

Kathy Hirschfeld  
– doing the job.

## Further reading:

Alice H. Eagly and Linda L. Carli, *Harvard Business Review* September 2007 “Women and the Labyrinth of Leadership” and “Through the Labyrinth” (Harvard Business School Press 2007)

Avivah Wittenberg-Cox & Alison Maitland, *Why Women Mean Business: Understanding the Emergence of our next Economic Revolution*, John Wiley & Sons, 2008

**MS KATHY HIRSCHFELD FTSE** is a Director, Snowy Hydro Ltd and the Queensland Reconstruction Authority, a member of the Solar Flagships Council and a Member of the Senate of The University of Queensland. Her corporate career included 20 years in leadership and executive roles in Australia, the UK and Turkey with BP, which culminated in the role of Managing Director of the Bulwer Island Refinery in Brisbane. She was an officer in the Australian Army Reserve from 1981 to 2005.

# Chief Scientist lured from the laboratory bench ...

... to persuade more school students, especially the girls, to consider science or engineering as a career.



By Lyn Beazley

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I have had a marvellous life, as a Woman in Science. In 2006 I became the first woman to be appointed as a Chief Scientist anywhere in Australia when my home state (Western Australia) lured me away from the laboratory bench and the banksia heathland sites where I was studying honey possums. Now there are two of us, with Professor Mary O'Kane subsequently being appointed Chief Scientist for New South Wales.

I have always thought of science as something women did right from the beginning at my all-girl school in the south of England. One of our teachers took us to the home of Charles Darwin, 'Down House', a trip that galvanised my interest in biology from seeing his work on carnivorous and aquatic plants.

Then it was a big step to Somerville College, Oxford, in the days when the Colleges were strictly segregated and only one in 10 students university-wide were women! One's social life required, after midnight lock-out, an ability to athletically scale high walls decorated with barbed wire.

The College had amazing women teachers and wine was served (a very small glass each) to celebrate the announcement of Dr Dorothy Hodgkin's Nobel Prize for elucidating the structure of insulin. The Principal, Dame Janet Vaughan, was another inspiring woman, even though I had no idea of her achievements. It was her suggestions that led to the introduction of the blood donation and storage system we so applaud today.

After doctoral studies in Edinburgh, where I was lucky

enough to meet my life partner, we came to Perth along with the first of our three daughters. I chose a research path in developmental neuroscience and neurotrauma. The laboratory team grew, with many of the staff and students being women.

Little did I think that one of the most satisfying parts would be working with obstetricians, notably Professor John Newnham, to help establish the appropriate regime of corticosteroid treatment for women at risk of pre-term delivery. The goal was to discover how to mature the baby's lungs but not compromise brain development. Little did I know that one of our own daughters would benefit from this therapy during her second pregnancy!

Now one of my main aims as WA's Chief Scientist (for Twitter fans, you can see what I do on ChiefSci\_WA) is to try to persuade more school students, especially the girls, to consider science or engineering as a career. We have a very real skills shortage in Australia for university and TAFE graduates in these areas and the women are always under-represented.

On visits to schools I always take with me an inspiring young woman scientist or engineer from academia or industry. One visit exemplified that girls are just as interested in science as boys when a Year 6 girl at a primary school in Kalgoorlie asked: "What is the role of magnetism in the evolution of galaxies"!

All I can say is "Go girl, go" – it sounds as if science is for you, just as it has always been for me. ◀

**LYN BEAZLEY AO FTSE** is Chief Scientist of Western Australia and Professor in Zoology at the University of WA, where her research career has spanned 30 years, during which she built up an internationally renowned research team that focused on recovery from brain damage. Her research also changed clinical practice in the treatment of infants at risk from pre-term delivery. Professor Beazley has served on numerous peak bodies advising State and Federal Governments such as the NH&MRC Fellowships Committee (2006–09) and as a board member of Neurosciences Australia. Internationally, she has served the Swedish Research Council and the International Brain Research Organisation.

Lyn Beazley on the road as WA's Chief Scientist.



## PART-TIME BALANCE KEY TO RETENTION

University of Queensland academic Dr Kate O'Brien and Monash University Associate Professor Karen Hapgood are raising awareness of the universal issues facing professionals, particularly women, who work part-time.

Although the numbers of women in science and engineering courses and postgraduate studies have increased markedly in recent decades, women tend to leave these professions at greater rates than men, a phenomenon often referred to as the 'leaky pipe'.

Dr O'Brien and Associate Professor Hapgood believe removing the barriers to part-time work and career interruptions are vital for addressing this problem.

Dr O'Brien, a lecturer within UQ's School of Chemical Engineering, sees a need for more family friendly practices within the workplace, so that women (and men) who work part-time or take time off to raise their families can still remain engaged with their profession.

"Although the university sector is commonly perceived as a very flexible work environment, like many other professions the paradigm is full-time, continuous employment," Dr O'Brien said. "Those who do



Tough choices for working women.

work part-time generally do so in isolation, with few role models."

Engineering has seen a marked increase in recent years in the number of female enrolments. In 2011, the number of female students enrolled in UQ's Bachelor of Engineering stood at 19 per cent. UQ's

percentages are even higher in specific engineering disciplines. As a top specialisation for enrolments of female students, Chemical Engineering and related specialisations stands at 40 per cent, while Environmental Engineering is about 60 per cent.

While there is a lot written about trying to get more women in science and engineering, there is very little written about working part-time, a key factor to retaining women in these professions. To address this, Dr O'Brien and Associate Professor Hapgood wrote the article 'Part-time balance', which was recently published in *Nature*.

"It takes a lot of courage to work part-time within a full-time environment and encourages those doing so to keep finding ways to make the system work for them, all the while recognising the obstacles they face," Dr O'Brien said.

"While focused on academia, the article will have relevance for those working part-time in many other professions. It is much easier to work part-time when you are well established in your field. However, in professions with long training times, like academia, it's difficult for women to become well established before they have children."

## HOW TO IMPROVE YOUR CAREER PROSPECTS



Taking up the academic challenge.

Gender Matters, a gender consultancy run by Dr Mark Toner FTSE and Ms Gunilla Burrowes, will hold a workshop in Melbourne on 3 May titled 'How to Improve Your Career Prospects in a Male-Dominated Organisation'.

They will discuss the common problems faced by women in male-dominated organisations and suggest appropriate skills that can be developed to understand:

- cognitive bias causing discrimination against women;
- male-female differences in decision-making, communication and assertiveness;

- the unwritten 'rules' of the organisation that impact on all employees, but especially women;
- influencing and leadership skills that increase your personal power; and
- how to 'play' the game to enhance your career prospects.

Workshops in Western Australia are planned for Kwinana on 22 May and Perth on 23 May.

Further information  
[www.gendermatters.com.au](http://www.gendermatters.com.au).

# ENERGY FUTURE NEEDS A PORTFOLIO APPROACH

With the growing pressure across the national and international communities to develop low-carbon energy policies and sources Australia cannot simply rely on one or two renewable technologies to supply its energy.

A portfolio approach that takes account of all national and regional energy resources is essential – and discussion of this portfolio must include all the potential energy sources and technologies that we have available, or projected.

Our energy portfolio for 2030 and beyond will have to include an economically appropriate and socially acceptable mix of both advanced fossil fuel technologies – coal, oil, gas and CCS – and renewables such as geothermal, biomass, solar, wind and ocean energy, depending on the location in Australia.

But Australia must keep all its energy options open, which means putting nuclear on the discussion agenda – now.

These were key points the Academy made in its recent response to the Government's Draft Energy White Paper (EWP).

ATSE noted the EWP made limited mention of nuclear power for low-emissions base load generation, apart from its possible application should other technologies fail to meet the energy market demands ahead – in which case the deferred lead time for nuclear power becomes too long to contribute to Australia's needs.

This lead time could be 15-20 years, due to Australia's lack of requisite infrastructure – legislation, regulation and technical expertise. The economic consequences could be substantial, ATSE said.

This lead time could be shortened significantly if community support was established ahead of the necessary infrastructure (including regulatory and skills) platform. This would ensure that the nuclear option, if needed, could be available in time to alleviate the industrial, commercial and political consequences of inadequate, affordable base-load power and failure to

meet declared emission goals.

Nuclear power, currently generating around 14 per cent of the world's electricity, should be given more serious consideration as a component of the national generation portfolio by 2030 and beyond.

The submission noted Australia was already the third-largest exporter of uranium. Australia also contributed significantly to international bodies working towards the safe and efficient use of uranium, to the safe disposal of radioactive wastes and towards enhancing the non-proliferation safeguards regime.

Nuclear power was the only large-scale, commercially proven, low-emissions technology available able to deliver a substantial proportion of Australia's base-load power demand, at appropriate cost, within 10-15 years, ATSE said.

It noted that Australia faced other key policy and investment issues in facilitating a move to low-carbon energy:

## 1 Consistent regulation

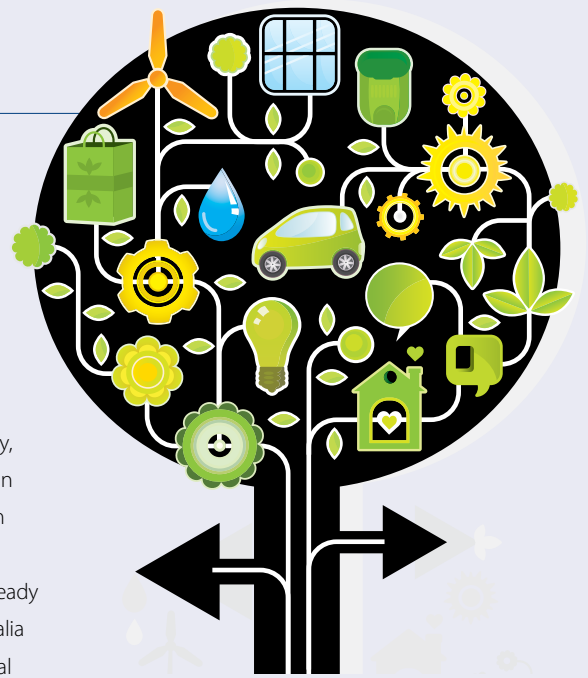
Consistent national regulation was crucial. Complex and inconsistent legislative frameworks created barriers to energy resource development and implied large implementing bureaucracies.

## 2 Technology review

To cover gaps in the broad range of review skills available to the Government from its departments and agencies, a properly qualified independent technology advisory body should be established to monitor, review, evaluate and report on the potential for Australia to adopt existing and emerging energy technologies.

## 3 Carbon pricing impacts

The current policy to price carbon was a necessary step, but the projected price would not be sufficient to result in any large-scale demonstration plants being built in Australia. Current grants-based programs were struggling to deliver outcomes and the level



of government funding available appeared insufficient to offset the perceived level of financial, technical and market risk around these projects.

## 4 Emissions reduction

The Government should review its decision to rely mainly on carbon pricing for emissions reduction, rather than establishing emission standards or CCS standards for future coal-fired generation investment. Without demanding emission standards there remained a real risk that generators could find it more economic to buy low-cost carbon credits on the international market than to invest in low-emission technologies.

## 5 Community support

Informed community understanding and support for new energy resources and technologies was crucial. Without a 'licence to operate', sound commercial projects in the national interest may not eventuate. Governments needed to encourage effective community engagement on these issues.

## 6 Investment planning

Consistent long-term planning policies and incentives were essential to ensure the timely sourcing of the billions of dollars required yearly for new energy infrastructure can be sourced attracted within an acceptable timeframe. This was a key to attracting the necessary foreign capital.

**The Academy's submission was developed by the Energy Forum, led by its Chair, Mr Martin Thomas AM FTSE.**

# ALAN FINKEL IS NEXT ACADEMY PRESIDENT

Dr Alan Finkel AM FTSE, a prominent Australian engineer, entrepreneur and philanthropist, will be the next President of the Australian Academy of Technological Sciences and Engineering.

Dr Finkel, Chancellor of Monash University, will take up his new role on 1 January 2013, succeeding former Australian Chief Scientist Professor Robin Batterham AO FREng FAA FTSE, who completes his term at the end of 2012.

Dr Finkel will lead the ATSE Fellowship of more than 830 members – one of the nation's four Learned Academies – with a strong focus on achieving improved public discussion and policy on key national issues where applied science and technology offer solutions.

Dr Finkel, a former member of the Academy Board, will rejoin the Board and become its chair from 2013. He was elected by the Academy's Assembly, which represents the broad Academy Fellowship and includes the Board and leaders of ATSE's divisions and topic forums.

Professor Batterham, announcing Dr Finkel's election, said it had been a great privilege to serve in the role.

"Alan Finkel will do a great job as President of the Academy and will bring a range of skills, experience and commitment that will enhance its activities and its impact," Professor Batterham said.

"His commitment to education – which he backs with strong personal involvement – has been the key to developing our own STELR program in high schools across the country.

"And his understanding of science and technology policy and the ability of our nation's scientist and technologists to contribute to building a better Australia will position him to make a great contribution to the work of the Academy and the advice it provides to government and industry.

"His unique combination of engineering, entrepreneurship, innovation and management in Australia and overseas will serve the Academy well."

Dr Finkel said he was honoured to succeed Professor Batterham as the Academy's eighth President and join the group of distinguished Australians to lead the Academy.

## Dr Alan Simon Finkel

Dr Alan Finkel has served as Chancellor of Monash University since January 2008.

Dr Finkel received his Bachelor of Engineering in 1976 and Doctorate in Electrical Engineering from Monash University in 1981, following which he worked for two years as a neuroscience research fellow at the John Curtin School of Medical Research, located at the Australian National University.

In addition to his role as Chancellor, Dr Finkel is also the Chief Technology Officer of Better Place Australia, a company that will provide clean energy to run Australia's future fleet of electric cars.

Previously, for 20 years Dr Finkel ran Axon Instruments, an ASX-listed American company that made electronic instruments used by pharmaceutical companies in the discovery of new medicines.

Between running Axon Instruments

and joining Better Place Australia, Dr Finkel established two magazines. The first, *Cosmos* magazine, promotes science awareness and the second, *G* magazine, promotes environmental sustainability.

Dr Finkel has a passionate interest in education. He established the Australian Course in Advanced Neuroscience to provide advanced training to early career scientists. He also established the STELR secondary school science program, administered by ATSE, which is currently running in nearly 300 secondary schools around Australia.

Dr Finkel currently serves as the Chairman of the Australian Centre of Excellence for All-Sky Astrophysics, a research consortium that is preparing to analyse the data from the world's largest radio telescope that will be built by the end of this decade.



Alan Finkel

## ATSE Presidents

Sir Ian McLennan KCMG KBE FAA FTSE (1975-1983)

Sir David Zeidler AC CBE FAA FTSE (1984-1988)

Sir Rupert Myers KBE AO FAA FTSE (1989-1994)

Sir Arvi Parbo AC FTSE (1995-1997)

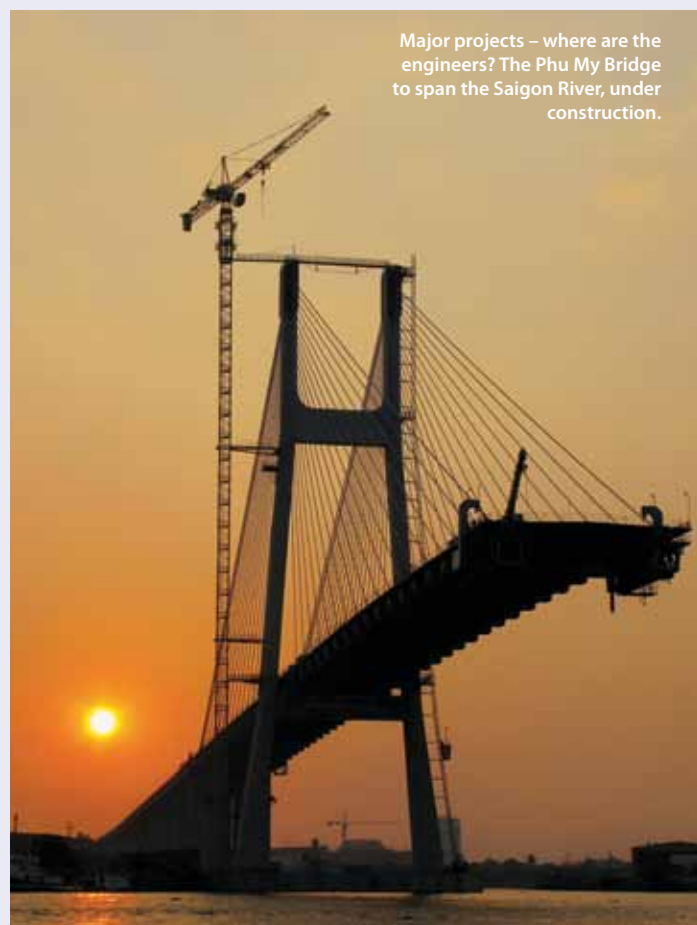
Mr M A Besley AC FTSE (1982-2002)

Professor John Zillman AO FAA FTSE (2003-2006)

Professor Robin Batterham AO FREng FAA FTSE (2007-2012)

# VARIED CAUSES FOR ENGINEER SHORTAGE

○ Australia faced multiple reasons for its shortage of engineers, the Academy said in a recent submission to a Senate inquiry into the shortage of engineering and related employment skills.



Major projects – where are the engineers? The Phu My Bridge to span the Saigon River, under construction.

The submission, developed by Professor Chris Fell AM FTSE and Dr John Bell FTSE, noted that Australia trained substantially more scientists than engineers, and both disciplines drew from the limited pool of secondary students leaving school with adequate competencies in mathematics and science.

By contrast, nations with a strong engineering capacity and an adequate supply of engineers – like Japan and Korea – trained many more engineers than scientists.

ATSE told the Senate Education, Employment and Workplace Relations Committees the issue had been of concern for at least two decades and causes included too low an uptake of maths and science in school; negative perceptions of engineering courses and careers; university course changes based on the “Melbourne Model”; lack of collaboration between universities and industry; and Government activities such as Excellence in Research Australia (ERA) initiative.

Too few school leavers were opting to study mathematics and science at school to a level necessary for university entrance, ATSE said. The problem of attracting secondary school students to study these subjects was closely related to the supply of engineering graduates and was a key target for its STELR program in Australian secondary schools.

Students making career choices may perceive engineering as a “hard” course that led to remote jobs, albeit well paid, ATSE said, noting HECS fees for four-year engineering courses were believed to be a significant deterrent.

Recent trends by some universities to introduce the “Melbourne Model” may exacerbate the situation, ATSE said, by extending the length of training by one year, noting the added HECS and fee

## Earth observations need stronger contribution

○ There is an urgent need for Australia to make clear its intention to contribute more strongly to the overall earth observation system (EOS) and Australia should build further strategic international links with EOS agencies, particularly in Asia, according to the Academy.

The proposed National EOS Advisory Council should play a key role in ensuring transparency of international links and enabling informed decision-making aligned with national priorities.

These are key suggestions from ATSE's recent submission in response to the call for submissions to the National Earth Observations from Space Strategic Infrastructure Plan (EOS-SIP), by Geoscience

Australia and the Bureau of Meteorology.

EOS were a key source of environmental information for Australia, supporting a range of essential services, ATSE said, noting the social and economic benefits of EOS were primarily associated with public-good applications.

Coordination and cooperation were fundamental to effective and efficient EOS activities, enabled by collaborative ventures between government, industry and research organisations.

ATSE suggested the governance structure proposed by the Framework for the EOS-SIP should include a National EOS Advisory Council, to ensure effective national cooperation and coordination and a broad

approach that would best recognise the continuing interactions and contributions of all parties, while promoting innovation.

It noted that coordination and cooperation was needed across all sectors to optimise the acquisition and archive of EOS. The national costs and benefits of cloud computing and storage for EOS needed to be assessed. A national strategic perspective was essential when investments were made in calibration and validation sites for satellite instruments. These sites were needed globally to ensure the quality of EOS products and formed an important part of Australia's contribution to the overall international observation system.

burden could deter rural and regional students (often those with the greatest geographical flexibility) from studying engineering.

There was little collaboration between industry and universities to offer high-level postgraduate training programs to ensure that Australia's engineers were kept at the cutting edge of their disciplines.

The ERA had pressured Australian universities' engineering departments to focus on publications in highly rated journals as a measure of excellence – and these favoured engineering science rather than heavy engineering practice.

Yet Australia was committing itself to massive resource projects which needed quality R&D that extended through to the applications level.

Engineering graduates frequently left Australian universities with little appreciation of the complexity of mega projects and required substantial on-the-job training.

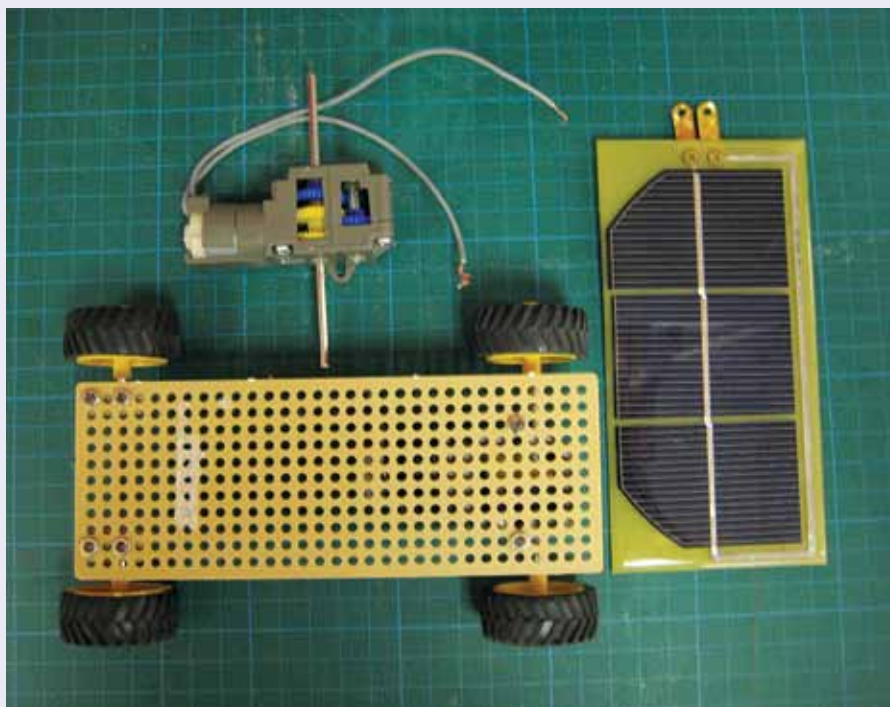
ATSE noted some promising recent developments. The Australian minerals industry had defined desirable training and in supported enabling initiatives and R&D and Australian Power Institute, recognising an imminent shortage in power engineers, had developed scholarships and training programs to encourage more students to choose this option.

The submission also noted the value of EOS depended on ready access to the data. The potential contributions of cloud computing, as well as the National Computational Infrastructure, in supporting EOS applications should be investigated to eliminate barriers to the application of EOS datasets.

A coordinated program of applications research funding was also needed to ensure Australia maintained the critical mass of expertise needed to lead the way in finding new approaches to the extraction of value from space observation.

The initial draft was prepared by Professor Michael Manton FTSE.

## STELR DEVELOPS SOLAR CAR KITS – WITH API SUPPORT



The basic elements of a solar car kit – geared motor, wheels, chassis (optional) and PV cell.

○ The Australian Power Institute (API) has provided \$25,000 to produce re-usable solar car class sets for up to 60 STELR schools in 2012.

The solar car sets have been developed by STELR Project Officer Rod Dunstan. Each class set will contain equipment to build 15 solar cars. Each car has a chassis, two sets of wheels, a motor, a gear box and two solar panels.

The solar car activity will be a culminating activity where students apply the knowledge they gained from the STELR unit. They will test their cars against each other.

With API's support, the schools receive the kits free of charge and the firm will also provide \$5000 worth of prizes for the best cars in a variety of categories. The cars will be judged by API bursary holders who will also talk about their careers in the renewable power industry.

The kits have been trialled in schools around Australia with great success.

Louise McFarlane, Head of Science at Box Hill Senior Secondary College, Melbourne, said she had not previously seen such across-the-board enthusiasm for science classes. The eight classes that developed the solar cars were unanimous in their praise for the project. Louise

said that even those students who had shown almost no interest in science as a subject were keen to get to class and get started on their cars.

The students in the fashion and design stream at BHSSC were particularly keen, which Louise said was a first in her experience.

Sue Perkins at Mt Gravatt State High School, Brisbane, said that students chose to come in at lunchtime to work on their cars.

Year 8, 9 and 10 students at Dongara District High School, 400km north of Perth, took part in the solar car activity as part of the School's "Science Challenge" week. Jane Ganfield, the teacher running the program, said she also had students coming in during their lunch break.

There is a strong emphasis on experimental design and interpretation in the STELR course and interpreting data and drawing conclusions are aspects of the course students engage with.

But teacher experience indicates that students also enjoy activities where they have the chance to "personalise" their learning – so they produce something unique and about themselves in response to a challenge. The solar car challenge is certainly this kind of activity.

## NEW GOVERNMENT FOCUS ON SCIENCE WELCOME

○ The Australian Government's focus on scientific and technological solutions to major issues facing the nation should be enhanced with the reformation and repositioning of the Prime Minister's Science, Engineering and Innovation Council (PMSEIC), according to ATSE.

The application of science and innovation were critical to Australia's future, ATSE said in a media released responding to the announcement.

Having the support and involvement of two ministers and the Prime Minister would help get this all-important message across and help to focus new initiatives for the nation, ATSE said, and the new approach to PMSEIC should help enable an environment in which science and technology could help energise better initiatives on national issues.

The Academy said the Government's description of the revised PMSEIC as having a "more dynamic and contemporary focus" was encouraging and the more regular meetings planned (three a year) could lead to greater input from policy leaders like ATSE.

It welcomed the role of the Chief Scientist, Professor Ian Chubb, leading the revitalised PMSEIC, and the value of the input from the ARC and NHMRC CEOs and the individual members, who it expected would contribute strongly to PMSEIC's work. These included two ATSE Fellows – Dr Megan Clark FTSE, CEO

of CSIRO, and Dr Cathy Foley PSM, Head of CSIRO's Materials Science and Engineering Division.

The Prime Minister's announcement said PMSEIC would continue to provide essential advice to Government on issues facing Australia's long-term future, looking five to 30 years ahead and said the changes reflected the Government's confidence in science and innovation as key drivers to improve Australia's living standards, health, productivity and environment.

The Council would be able to refer long-term issues, five to 30 years ahead – requiring a scientific response – to the Australian Council of Learned Academies to undertake in-depth, interdisciplinary research and report to Government through the Chief Scientist.

The Prime Minister announced \$1.95 million over four years to 2014-15 for in-depth and evidence-based research to support the work of the Learned Academies, which ATSE welcomed.

She said PMSEIC would be in a stronger position to discuss topics such as technology, health and communications issues that have implications across Government and that

Professor Chubb would consult with business, universities, state chief scientists and other stakeholders on Council projects and priorities.

### PMSEIC'S REVISED MEMBERSHIP

- Prime Minister (chair);
- Minister for Tertiary Education, Skills, Science and Research (alternate chair);
- Minister for Industry and Innovation
- Other Ministers relevant to the meeting, at the invitation of the Prime Minister;
- Australia's Chief Scientist;
- CEO of the Australian Research Council;
- CEO of the National Health and Medical Research Council; and
- Six individual standing members, chosen for their contributions to science and research: Dr Clark, Dr Foley, Dr Ben Greene, Professor Robert Saint, Professor Fiona Stanley and Professor Graeme Turner.



Ian Chubb

## National maths adviser needed

○ The Government should appoint a national mathematical sciences advisor and run a five-year awareness campaign to increase participation and achievement in mathematics and statistics in Australia.

These were the key recommendations from a national forum, *Maths for the future: Keep Australia competitive*, held recently in Canberra.

"This forum has shown everyone the need for intervention at multiple points on the educational pipeline. We are seeing both awareness and a willingness to act in the

statements of the key players, so now we are holding our collective breath", said Professor Geoff Prince, Director of the Australian Mathematical Sciences Institute.

The extensive range of careers pursued by mathematical sciences graduates remained unknown to school students and their parents, as did the critical utility of school mathematics in trades and professions.

Professor Brian Schmidt, winner of the 2011 Nobel Prize for Physics, told the forum: "Most people who have skilled jobs in Australia

have maths at the core of their job".

Chief Scientist Ian Chubb said that mathematical scientists needed to work together to communicate the importance of the discipline to the Australian public.

"An education in science and maths is a very valuable thing to have. You know about evidence, you know how to analyse, you know how to articulate it... If you're working in the general workforce you will be applying those analytical and integrated skills in a very professional way", Professor Chubb said.

Sampling party off to work on an earlier research visit in 2005.

## Nuclear science on Antarctic mission

Two ANSTO scientists spent nine days in Antarctica in February working to discover whether an historical relationship exists between solar activity on the sun, and climate change on Earth.

They sought ice samples for analysis by ANSTO at the atomic level using tools that detect individual beryllium-7 and beryllium-10 atoms, created when cosmic rays (thought to originate from distant supernovas) lose energy in Earth's atmosphere.

While solar activity is widely accepted to have only had a minor role in climate change over the past century, over longer periods it's possible it had a much more significant role.

"The key to predicting future climate change is understanding the factors that impacted on past climate change," said Senior Principal Research Scientist Dr Andrew Smith, who was making his third trip to Antarctica to research the historical relationship between solar activity and climate change.

"There is some speculation that over the past thousands of years, solar activity may have had a significant impact on the climate of Earth, and that's what we are researching. Research of isotopes over long timescales can help us understand whether there was a relationship, and whether the variability of the sun has a direct effect on global temperatures.

"Satellites and neutron monitors can provide data on solar activity for the past 50 years or so, and prior to that we have the sunspot record that began after Galileo invented the telescope. But it's through going to Antarctica and bringing back samples of beryllium that we can get a real indication of how solar activity has affected Earth's climate."

## TOXIC RISKS IN CLIMATE CHANGE

The effects of climate change could expose Australians to greater risks from toxic contamination, according to the director of the CRC for Contamination Assessment and Remediation of the Environment,

Professor Ravi Naidu. He said recently that increased flooding could release contaminants previously regarded as secure into groundwater, rivers, oceans, the food supply and atmosphere.

"Most of our urban landfills contain highly toxic substances from past decades – and were designed for the climatic conditions at the time. These have now changed, with the risk of bigger and more frequent floods, droughts, heat and acidity releasing substances we thought were gone for good."

Professor Naidu is inviting Federal and State governments and environment protection agencies to rethink nationwide contamination and cleanup policy in the light of the risk that yesterday's poisons could be remobilised into our environment.

"The floods in Queensland and northern NSW illustrate how things are changing – and how we can no longer count on toxic disposal systems designed half a century or more ago to work as well in future under changed climate conditions," he said.

"From now on all landfills and contaminated sites will need better flood protection upstream and high-tech contamination barriers downstream to filter the groundwater that leaches out of them, and remove the heavy metals, pesticides, hydrocarbons and organic toxins it contains."

Professor Naidu said climate change also brought increased urgency to the task of rehabilitating contaminated lands and acidification.

These issues illustrated how climate change could affect the total toxic load delivered to society in its food, water and environment, and the importance of acting in a timely fashion to prevent this happening.

Australian industries, including the mining, energy and agriculture sectors, were world leaders in developing and implementing environmentally friendly and cost-effective solutions to contamination issues, he said. "If Australia makes an early start in overcoming these unforeseen impacts of climate change it will also position us as a world leader and exporter of clean, green solutions for a changing world. It will not only be healthy – it will also be profitable and create jobs."

## BIG TREES BOOST CITY BIRD LIFE

New ANU research has revealed the role large trees play in sustaining biodiversity and bird life in urban environments.

The study, led by Karen Stagoll, a PhD candidate in the ANU Fenner School of Environment and Society, examined large eucalypt trees in small suburban parks across Canberra. The study shows that large trees in urban environments provide habitat resources crucial for wildlife.

"Large trees are considered 'keystone structures' – ones that provide resources like food, nest sites and shelter for wildlife – in agricultural and forestry production landscapes, but research demonstrating this in urban landscapes was urgently needed," said Ms Stagoll.

"We found that parks with more large eucalypts had more bird species and higher bird numbers.

"We also found that if parks had really large, old trees they had more birds than parks with only smaller trees."

# State of the Climate 2012 long-term trend

○ Australia's land and oceans have continued to warm in response to rising CO<sub>2</sub> emissions from the burning of fossil fuels, according to *State of the Climate 2012*, an updated summary of Australia's long-term climate trends released in March by CSIRO and the Bureau of Meteorology (BoM).

CSIRO Chief Executive Dr Megan Clark FTSE said the latest analysis painted a clear decade-to-decade picture of Australia's climate, while at the same time noting its highly variable nature from one year to the next.

"Much of Australia may have lurched from drought to floods since the previous *State of the Climate* (2010), but this has occurred against a backdrop of steadily increasing air and ocean temperatures and rising sea levels. What's more, the rate of change is increasing.

BoM Acting Director Dr Rob Vertessy said this updated summary was based on improved understanding drawn from detailed analysis of our national climate record, which goes back more than 100 years.

"Ground, ocean and satellite-based observations are giving us highly consistent observations of this warming trend. *State of the Climate 2012* confirms that each decade has been warmer than the previous decade since the 1950s, with an increase in the number of warm nights, and more monthly maximum temperature records being broken."

*State of the Climate 2012* showed a general trend toward increased spring and summer monsoonal rainfall across Australia's north, and a decline in late autumn and winter rainfall across southern Australia. Sea levels had risen around Australia at rates equal to or greater than the global average, and sea-surface temperatures in the region had increased faster than the global average.

The 12-page report is available at [www.csiro.au/en/Outcomes/Climate/Understanding/State-of-the-Climite-2012.aspx](http://www.csiro.au/en/Outcomes/Climate/Understanding/State-of-the-Climite-2012.aspx)

## WE 'WANT TO RE-USE STORMWATER'

○ Recent surveys indicate Australians may strongly support the recycling of stormwater for non-drinking purposes and are keen to learn how to keep urban runoff clean.

The surveys – by a scientific team from the National Centre for Groundwater Research and Training and The University of South Australia – found that residents in Salisbury and Charles Sturt in SA and the Gold Coast local government areas were mainly supportive of using stormwater.

They indicated potential to initially implement stormwater-harvesting projects for non-drinking uses, which would provide relief for many cities from the threat of water scarcity, according to Professor Jennifer McKay who led the team.

"Stormwater harvesting has become an important option for many Australian cities as the nation faces increasing pressure to its freshwater supplies," she said.

"Out of 320 respondents, an average of 60 per cent supported the use of stormwater. Although the remaining people were unsure, they were rarely negative as long as the water quality was guaranteed and it was not at this stage intended to be used for drinking purposes."

While 36 per cent of the respondents weren't sure how much they were willing to pay for treated stormwater, a significant number in all cities were willing to pay half the current local fresh water price, Professor McKay said.

The team found that respondents' attitudes towards stormwater use were closely related to how much contact would be needed. Given a choice of end uses including personal washing, pet washing, toilet flushing, clothes washing, watering vegetables and lawns, and car washing, personal washing was the least preferred use.

The view and value on stormwater was also affected by gender, age, education and income level, Professor McKay said. For instance, respondents above 45 years were more likely to agree that stormwater reuse is essential to manage future water shortages, while those aged 18 to 24 were less likely to agree.

The National Centre for Groundwater Research and Training is an Australian Government initiative supported by the Australian Research Council and the National Water Commission.

## NWC BACKS WA'S DIVERSIFIED SOURCES

○ The National Water Commission (NWC) Chair, Ms Chloe Munro, has commended Western Australia's water source diversification.

"WA is to be commended for the work it has done to diversify supply options in the face of a drying climate and mounting pressure on scarce water resources, especially its groundwater aquifers," she said during an NWC visit to Perth.

NWC members visited the Groundwater Replenishment Trial at the Beenyup Wastewater Treatment Plant, near Perth, as well as having discussions with the Acting Director-General of the Department of Water, Ms Maree DeLacey, the CEO of the Water Corporation, Ms Sue Murphy FTSE, and the Chairman of Harvey Water, Mr Ian Eckersley.

The Beenyup facility "leads the way in demonstrating how Australia can use innovative technology to bring treated wastewater into play to recharge dwindling aquifers and potentially boost drinking water supplies," Ms Munro said. "The NWC has long argued that water recycling – including for drinking purposes – can provide a significantly greater proportion of Australia's future urban water supplies when considered objectively against the full range of supply options.

"Greater use of recycled water not only offers the prospect of more secure, less climate-vulnerable supplies, it also offers broader environmental and public amenity benefits. Given recent technological advances and improved regulatory practices, the NWC considers that the risks associated with water recycling can be effectively and safely managed.

"It is just as crucial that governments and researchers work to build public understanding and confidence in all aspects of water recycling."

# Biofuels and biosequestration in perspective

Why won't biofuels or biosequestration be significant? The answer lies in a combination of cost, scale and inefficiency.



By Graeme Pearman

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Concerns about the security of supply and cost of domestic and imported oil – and the desire to move towards a “carbon constrained” world – have raised interest in biofuels as alternatives to conventional (fossil) coal, oil and natural gas.

They have fostered the emergence of entrepreneurial biofuel companies and government interventions to support them.

The Australian Government's clean energy plan, *Securing a Clean Energy Future*, includes the need for land-use practices to be part of a multi-pronged approach to reducing net greenhouse-gas emissions. The national Liberal Party's policy *Direct action on the environment and climate change*, claims bio-sequestration to be “the single largest opportunity for CO<sub>2</sub> emissions reduction in Australia”.

There are many factors to be considered before committing to biofuels or bio-sequestration. However, such developments have been plagued by sectoral myopia, limiting the level of rigorous and holistic evaluation afforded to these options in terms of potential co-benefits or dis-benefits for the wider community. In some cases, even technical advisers appear to have overlooked this need.

This article in no way tackles this issue comprehensively, even though such an analysis is warranted. It considers only the fundamental question: ‘Can the use of biofuels or biosequestration be a significant component in Australia's energy futures and carbon dioxide emissions reduction?’

And the short answer is ‘no’.

This does not mean that there should be no biofuel or biosequestration industries – they need to be part of our portfolio of actions – but their potential impact on Australia's energy demand or emissions-reduction strategies are likely to be only a few per cent.

Why won't biofuels or biosequestration be significant? The answer lies in a combination of cost, scale and inefficiency.

The net annual carbon stored by all Australian photosynthesis (natural and agricultural systems) is about 2000 megatonnes (Mt) (7300 Mt CO<sub>2</sub>) while our annual emis-

Photosynthetic activity of natural vegetation, pastures and crops, captures energy from sunlight and carbon dioxide from the atmosphere to form biomass. By burning biomass we can utilise some of this energy (as biofuels) releasing the embodied carbon back to the atmosphere. Alternatively, by the long-term storage of biomass, we can retrieve carbon dioxide from the atmosphere (biosequestration). Opportunities for biofuels and biosequestration are strongly coupled as there is a relatively fixed relationship between the amount of energy and carbon trapped by the photosynthetic process – between 17 to 20 gigajoules (GJ) of solar energy is captured for every tonne of carbon, depending on the chemical nature of the final biomass.

sions from the combustion of fuels is about 97 Mt, or five per cent of that captured by plants.

In energy terms, Australian photosynthesis annually captures about 72 exajoules (EJ), approximately 0.1 per cent of the 62,000 EJ of solar radiation that falls annually on the continent, and we use, in the combustion of fuels, about 5.8 EJ.

To fully offset our emissions or, alternatively, displace current sources of energy using biofuels we would need a five per cent enhancement of natural biosequestration, or divert this amount to biofuels. These comparisons are generous as they fail to account for inefficiencies in the collection, conversion, transportation and distribution of biomass to usable fuels or storage.

Also the carbon and energy captured in net primary production drives all of the heterotrophic organisms (bacteria, protozoa, viruses, fungi, invertebrates, vertebrates – including us) and processes within ecosystems. A balance must be struck between the primary productivity diverted off-site and that left to support ecosystem function and ongoing capacity for production. Not all of this energy/carbon could be so converted without diminishing, to some extent, the ecosystems and their biodiversity.

Thus, five per cent of natural carbon capture required to offset our emissions (stored for example as biochar) or replace our fossil fuel usage is likely to be an unachievable upper limit.

An alternative way of envisaging the magnitude of the effort that might be involved to achieve significant biosequestration or biofuel production is to compare the carbon and energy content of the annually traded Australian wheat, sugar and exported wood products.

These comparisons are made only to indicate the magnitude of the effort that would be required to use biological materials in this way and not to suggest these products be diverted to this purpose.

These products contain approximately 0.32, 0.074 and 0.017 EJ respectively. Alternatively, their carbon contents are 8.1, 1.8 and 0.38 Mt respectively. The carbon and energy contents are therefore equivalent to 8.3, 1.9 and 0.4 per cent respectively of Australia's carbon dioxide emissions or national primary energy demand (Figure 1).

The energy captured in the currently traded wheat crop, converted with 100 per cent efficiency to fuels, would provide only about half of the energy needed to run our cars or about twice that needed to fuel our aircraft. A reflection on the infrastructure, human resources and land area investment in the wheat industry indicates the magnitude of the challenge of providing biofuel production on this scale and in a reasonable time frame.

Sugar and exported forest products show an even

greater shortfall in terms of their potential to provide for our energy needs.

Using wheat or similar plant species and ignoring the inefficiencies of conversion to fuels, meeting Australia's energy needs would require an area of 38 million hectares (Mha) ( $\sim 1.5$  times the area of Victoria), or about 24 times that of the existing areas of wheat production. Using sugar, an area of 24 Mha would be required, about 80 times the current area of sugar farming.

Clearly solar energy and carbon is captured inefficiently (less than one per cent) by photosynthesis into tradable products. Solar absorbers or algal cultures may achieve efficiencies of carbon/energy capture 10-100 times those described for these crops, thus requiring proportionately less area, but the areas required to make substantial national contributions are still considerable.

For example:

- To replace a 500 MW coal-fired power station would require an area of 2.2, 22 or 220 km<sup>2</sup> at conversion efficiencies (capture, conversion and transport) of 100, 10 or 1 per cent respectively;
- To fuel an average motor car for a year would require the energy captured by a 0.64 ha of crop with a overall conversion efficiency of one per cent; and
- To fuel to US Navy's annual oil requirement (about 0.2 EJ) would require the energy content of two-thirds of our annual wheat crop or the approximate equivalent of our aviation needs at an overall conversion efficiency of one per cent.

Biofuels can be generated from the waste products of existing enterprises, such as forestry. However the energy content of these systems is relatively small compared with demand and may be even more so for the waste components. Further, the levels of inefficiencies/costs involved in the collection and sorting of the waste, its conversion into usable energy, its distribution and the sustainability of supply need to be considered in a comprehensive evaluation.

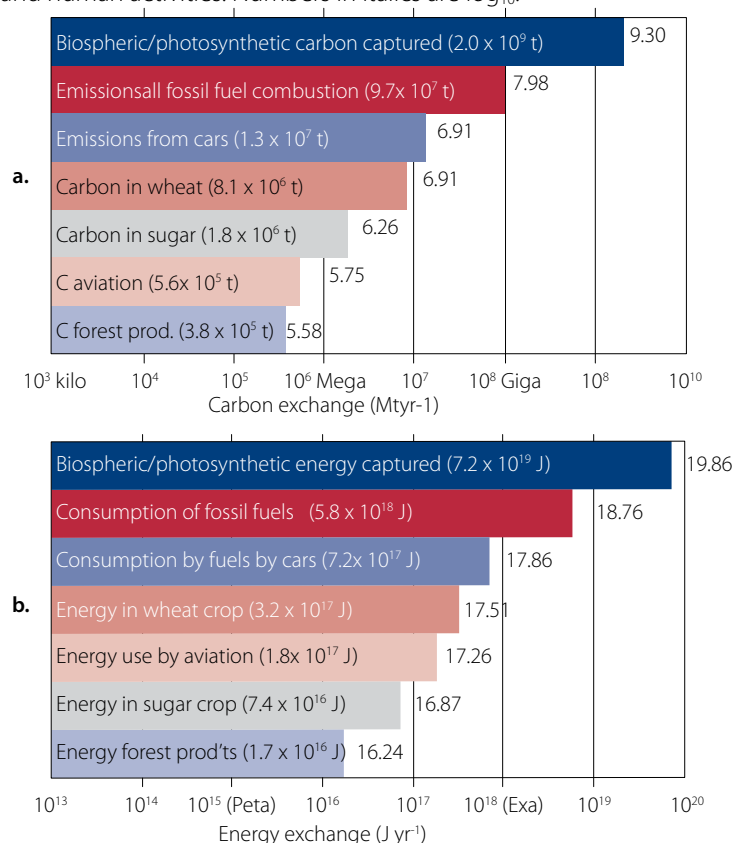
Similar arguments to those above apply to the provision of carbon storage opportunities.

These comparisons indicate the enormous, largely unrealistic, national effort required for biota to be used as a major energy source or carbon sequestration option. This does not mean that there should be no biofuel or biosequestration industries – they need to be part of our portfolio of actions.

But it does mean that the potential for such approaches to impact significantly on Australia's energy demand or emissions-reduction strategies will likely be of the order of a few per cent – not the impression one gains from some pronouncements about these options.

It also means that the relevant niches for biofuels

Figure 1 A comparison of the approximate quantities of (a) carbon (Mt yr<sup>-1</sup>) and (b) energy (J yr<sup>-1</sup>) exchanged in key natural and human activities. Numbers in italics are log<sub>10</sub>.



should be identified and prioritised early. For example, biofuels may not have a major role for base-power provision, but might be best reserved for aviation and/or country motor-vehicle usage, where alternative fuels or power systems might be less amenable to change.

We need a much more holistic examination of these options in case today's decisions and diversion of public and private dollars creates currently unidentified problems for the future.

It should include an assessment of not only these physical constraints, but also:

- the rate at which change can take place;
- the potential for other environmental impacts (for example, net carbon loss from land clearing, nitrogen emissions, biodiversity impacts, improved agricultural soils);
- co-benefits such as human health, jobs and community coherence;
- the potential impact of a changing climate;
- balance of payments;
- security of energy supply;
- education, training and community acceptance; and
- the likely economic costs.

Currently the dollar value of energy in traded wheat or sugar is about 1.4 cents per MJ and this compares with the

retail cost of energy in petroleum or electricity of about 4 and 5 cents per MJ respectively.

Like many other areas of decision making, this is not just about engineering feasibility, economics, sectoral or societal interests – or the environment – but a combination of all of these things.

More generally, the long-term outcomes of research and innovation are largely unpredictable. But innovation based on a narrow focus is more likely to deliver unanticipated, if not undesirable, outcomes. ◀

**DR GRAEME PEARMAN AM FAA FTSE was Chief of CSIRO**

**Atmospheric Research, 1992–2002. He has published more than 150 journal papers primarily on the global carbon budget. Now a consultant, he has an Adjunct position at Monash University and has provided more than 450 briefings on climate change science. His current interests include climate science, holistic/resilient strategies for energy futures; transport technologies; and climate-change aspects of human behaviour/societal institutions. He serves on many boards/science advisory panels including: START International (Washington); The Climate Institute (Sydney); Singapore National Research Foundation (Singapore); German Council of Science and Humanities (Berlin); Greenfleet Australia, South East Australian Climate Initiative, Goyder Institute Climate Change Project; and the National Climate Change Adaptation Research Fund.**

## CLIMATE CHANGE HISTORY REVEALS HUMAN THREATS

○ The historical record foreshadows a grim picture for a future threatened by even greater climate change according to a study from The Australian National University.

Professor Tony McMichael AO FTSE from the ANU National Centre for Epidemiology and Population Health looked at climate changes and their impacts over the past 6000 to 7000 years, as documented in historical, archaeological and fossil records. His study has been published online in the journal *PNAS (Proceedings of National Academy of Sciences)*.

Professor McMichael said that his study showed that time and time again weather extremes and climatic changes had posed a threat to human health, safety and survival.

"Currently, a lot of debate and research about climate change focuses on the short-

term impacts like the effect it will have on the economy," said Professor McMichael.

"Unfortunately the long-term impacts to human health, safety and wellbeing are overlooked. I wanted to go back over the historical record to see how the factors crucial to our survival were affected by climate change. And history tells us some very alarming things.

"Firstly, long-term climate changes have often destabilised civilisations through food shortages, consequent hunger, infectious disease and unrest. Medium-term climatic adversity – including, floods, drought and plague – have caused similar health, social and sometimes political consequences.

"On top of this when the world has gone through brief episodes of temperature shifts, there have been outbreaks of infectious



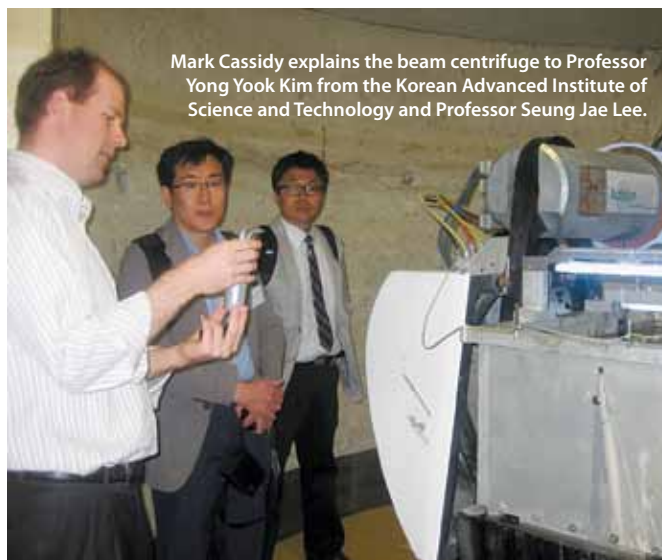
PHOTO: JAMES GIGGACHER

Tony McMichael

diseases which have been compounded by food shortages, social disruption and impoverishment.

"Global climate change poses many risks to human health, safety and survival. Most environmental systems that sustain human population health, including food yields, water supply natural constraints on human disease and protection against weather extremes, are sensitive to climate change."

Professor McMichael added that it was time we examined history to help us look forward and meet the challenge of contemporary climate change.



Mark Cassidy explains the beam centrifuge to Professor Yong Yook Kim from the Korean Advanced Institute of Science and Technology and Professor Seung Jae Lee.

## UWA and Korea link on oil and gas

University of Western Australia equipment and expertise are helping to build strong ties Korea, with a recent group of visiting Korean academics and company directors impressed by facilities at UWA's Centre for Offshore Foundation Systems (COFS). Thirty-seven workshop participants developed plans for further cooperation and joint research projects.

Korea Maritime University Professor Seung Jae Lee said the visit had enormous ongoing benefits for participants and Korean students.

"As academics this workshop helps our research because we can observe results being achieved through the use of UWA's sophisticated laboratory facilities – COFS houses the only centrifuge modelling facility in Australia."

COFS facilities are used for specialised lab and model testing to investigate soil structure for preliminary knowledge in the construction of strong oil and gas structures.

COFS Director, Winthrop Professor Mark Cassidy FTSE, said UWA was building on several important agreements with Korea, including collaborative arrangements with the Korea Research Institute of Bioscience and Biotechnology, Korea University and Seoul National University.

Korea's top 10 resource universities were strengthening ties with UWA to develop a global talent in mineral and energy resources development.

## NICTA LEADS GEOTHERMAL ANALYTICS INITIATIVE

NICTA is leading a multi-million dollar ICT-enabled geothermal energy initiative announced by the Australian Centre for Renewable Energy (ACRE).

NICTA's robust research capabilities in machine learning and in the increasingly significant area of big data analytics will be used to locate geothermal energy sources deep beneath the surface of the Earth.

NICTA is leading a team of university experts from four states to find better, automated ways to define geothermal targets, using machine learning techniques and advanced data analytics instead of drills. The ACRE initiative, Data Fusion and Machine Learning for Geothermal Target Exploration and Characterisation, is a two-year, \$5 million program. The ACRE Emerging Renewables Program will fund \$1.9 million of this total.

"Australia has a wealth of geothermal energy resources, but they are difficult to locate and access," said NICTA CEO, Hugh Durrant-Whyte FRS FAA FTSE. "We will apply NICTA's considerable expertise in machine learning and big data analytics to create software to address these challenges."

NICTA will work closely with the School of Information Technologies at the University of Sydney to develop machine learning algorithms, and the Schools of Earth Science at ANU and the universities of Melbourne and Adelaide to apply these methods to the problem of geothermal target characterisation and exploration. The project teams will also work with ASX-listed geothermal exploration and development companies GeoDynamics and Petratherm, as well as GeoScience Australia and the SA Department of Manufacturing, Innovation, Trade, Resources and Energy, which will provide geothermal sensor datasets and expertise in discovery and characterisation of geothermal targets.

This is the first project to be funded under the Australian Government's \$126 million Emerging Renewables Program, which has been established to provide support for the development of renewable energy and enabling technologies across the innovation chain.

*Geothermal energy comes from the intense heat generated by rocks located several kilometres underground. It is abundant, renewable and has zero carbon output. Locating suitable 'hot rocks' is a manual, expensive drilling exercise.*

## FELLOWS OUT FRONT AT PACIFIC 2012

Several ATSE Fellows were prominent at the recent Pacific 2012 Maritime Conference in Sydney, which provided a forum for the latest developments in design, naval architecture, engineering, science and technology.

Dr Susan Pond AM FTSE, Adjunct Professor of the Dow Sustainability Program at the United States Studies Centre at Sydney University, chaired a forum on sustainable maritime fuels co-sponsored by the US Studies Centre and Maritime Australia Ltd, which included Australian and International speakers.

Topics included drivers and demand for fuel diversification, advanced maritime biofuels and maritime fuel infrastructure.

Professor Thomas Maschmeyer FAA FTSE, from the Department Chemistry, University of Sydney, spoke of Sources, Generation and Properties of Current and Future Maritime Fuels. Professor Mary O'Kane FTSE, NSW Chief Scientist and Engineer, contributed a presentation on State and Federal Government Perspectives.

There were a number of international speakers including Mr Thomas Hicks, Deputy Assistant Secretary for Energy, US Department of the Navy.

# \$100m CCS investment for Latrobe Valley

○ The Australian and Victorian governments will provide \$100 million towards the development of CarbonNet, Victoria's first carbon capture and storage (CCS) project, which aims to capture carbon emissions from power plants, industrial processes and new coal-based industries in the Latrobe Valley and store it in geological basins.

CarbonNet is the second project selected for funding under the Australian Government's Carbon Capture and Storage Flagships program. The combined funding (\$70 million from the Commonwealth and \$30 million from the Victorian Government) will support feasibility work as part of the \$1 billion plus CarbonNet project to demonstrate low-emission brown coal electricity generation in the region.

The Victorian Department of Primary Industries manages the CarbonNet Project. The feasibility work will include modelling and testing of potential CO<sub>2</sub> storage sites. Resources and Energy Minister Martin Ferguson and Victorian Energy and Resources Minister Michael O'Brien made the announcement in Morwell, Victoria.

The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) welcomed the project, with Dr Richard Aldous, Chief Executive, saying: "Victoria's combination of high CO<sub>2</sub> emissions from brown coal and the first-class storage geology in Bass Strait mean that the CarbonNet project is one of the best opportunities around the world to demonstrate significant cuts to greenhouse gas emissions using CCS."

CO2CRC has been active in Victoria for many years, including running world-leading demonstration projects such as the CO2CRC Otway Project and a CO<sub>2</sub> capture projects in the Latrobe Valley.



**Richard Aldous**

■ CCS involves capturing the emissions before they reach the atmosphere, compressing the gas and storing it safely and permanently deep underground.

"The practical experience gained at the Otway Project, for example, where we have injected, safely stored and monitored 65,000 tonnes of CO<sub>2</sub> since 2008, will be an invaluable contribution to CarbonNet," said Dr Aldous.



**FETI Director, John Curtin Distinguished Professor Chun-Zhu Li, and Minister Ferguson at the launch.**

## CURTIN LAUNCHES FETI

○ Curtin University has launched its Fuels and Energy Technology Institute (FETI), which will carry out fundamental research and technology development to provide solutions to the energy and environmental issues facing Australia.

The Institute will have a network of research collaboration with researchers from around Australia, China, Japan, Korea, Europe and USA. The key research areas include bioenergy science and engineering, fuel cell technology, energy storage, coal science and technology, natural gas conversion engineering, interdisciplinary energy science and engineering, and environmental impacts of energy processes.

The Federal Minister for Resources and Energy, Martin Ferguson, launched FETI in February, along with the Institute's Biofuel Research and Development Facility, which involves researchers at Curtin, WA Department of Environment and Conservation, CSIRO and the Future Farm Industries CRC and is jointly funded by Federal Department of Resources, Energy and Tourism, the Western Australian Government, Curtin University and project participants.

## UQ AND KOREA LINK ON NEW-GENERATION SOLAR

○ Researchers from The University of Queensland (UQ) and Korea have combined their expertise in polymer patterning and materials science in a bid to develop new-generation solar cells.

UQ's Australian Institute for Bioengineering and Nanotechnology (AIBN) Director, Professor Peter Gray FTSE, an ATSE Director, has signed a memorandum of understanding with Yonsei University in Seoul, Korea.

It will allow AIBN Professor Ajayan Vinu's research group to work closely with Professor Eunkyong Kim, Yonsei Department of Chemical and Biomolecular Engineering, and Professor Cheolmin Park, School of Advanced Materials Science and Engineering.

Professor Vinu said the collaboration would encourage "the creation of new science and new products", including efforts to improve the efficiency of solar cells. He said AIBN would bring expertise in materials science. Yonsei researchers would match this expertise with their knowledge of polymer patterning and fabrication.

# \$20 million for JCU advanced biofuels

○ The Australian advanced biofuels industry is gathering momentum, with the Australian Government's announcement of a \$5 million grant to James Cook University (JCU) to develop a macro-algae to biofuels project and the opening of applications under a new \$15 million Advanced Biofuels Investment Readiness (ABIR) Program.

The Government will provide \$5 million to JCU to research, develop and demonstrate Australia's first freshwater and marine macro-algae to biofuels project.

The project will also leverage a further \$6 million from MBD Energy and the Advanced Manufacturing CRC, taking total funding to around \$11 million.

The \$15 million ABIR Program is designed to support the investment case of scalable, pre-commercial advanced biofuels demonstration projects in Australia. The program is open for applications until 30 April.

Funding for these announcements is provided through the Government's \$20 million Australian Biofuels Research Institute. From 1 July 2012, the Australian Renewable Energy Agency (ARENA) will assume responsibility for administering the program and overseeing the progress of the JCU project. ARENA forms part of the Government's \$3.2 billion commitment to develop a range of renewable energy technologies.

Both initiatives were announced by the Minister for Resources and Energy, Martin Ferguson, when he visited the MBD Energy pilot facility at JCU.

"Advanced biofuels have the potential to play a role in diversifying our liquid fuel sources while reducing carbon emissions," he said. "Advanced biofuels – particularly those that can integrate into existing liquid fuel supply chains and are compatible with existing engine technologies and infrastructure – could also become a significant source of regional employment."

MBD Energy Ltd Managing Director, Andrew Lawson, said macro-algae offer exceptional opportunities for the supply of biomass feedstock for the production of biocrude likely to be well suited to refining a comprehensive range of conventional transport fuels.

The initial focus of the project was on delivery of R&D underpinning

optimised biomass productivity and critically, biomass organic yields for biocrude production using hydrothermal processes. A second stage of the program would enable MBD Energy Ltd to demonstrate commercial-scale production and processing of macro algal biomass and provide the blueprint to support and implement cost-effective, large-scale macro-algal production and for its development as a viable feedstock.

The macro-algae project R&D leaders, Professor Rocky de Nys and Dr Nicholas Paul from JCU, bring a strong background in algal biology and chemistry and biomass production and related key research spanning more than 35 years. Professors Thomas Maschmeyer FAA FTSE and Brian Haynes from the University of Sydney – together covering more than 30 years in the chemical process engineering and hydrothermal conversion space – will lead the biocrude research. MBD's Scott Grierson and his team will provide engineering expertise for the projects.

## LOWER ENERGY COSTS FOR DEVICES?

○ New and better ways of measuring high-tech energy consumption could lead to significant environmental and economic gains, a study from The Australian National University has found.

Researchers from ANU, the University of Texas at Austin and the University of Washington have completed the first systematic profile of microprocessors – the integrated computer chips that act as a central processing unit in electronic devices like smart phones, computers and giant data centres.

Dr Steve Blackburn from the ANU College of Engineering and Computer Science, who led the study with Professor Kathryn McKinley from the University of Texas at Austin, said the findings could help lower the energy costs of electronic devices ranging from small mobile devices, supercomputers to massive server farms.

"We looked at the power profiles of different software and different chip architectures, as well as application power, performance and energy on a wide variety of hardware. These were measurements that no one had ever looked at before.

"We found that different software have really different power usages. This is really important because as technology and processors are getting smaller and smaller it has stopped yielding exponential gains in power and performance.

"These findings could be used by companies like Google, Intel, Apple and Microsoft to develop software and hardware which will lower energy costs in electronic devices as well as their IT infrastructure. It could even be used to make sure that your GPS works a lot better by optimising how often and quickly it locates you for less battery power.

"For companies which use massive data centres to run their programs and applications, there are real incentives to find ways to conserve power. It's also beneficial for the hardware. For example, the less power a mobile phone draws from its battery, the longer the battery will last."

Dr Blackburn added that in the future power profiles will become a key consideration of every stage of software and hardware design.



**Professor Rocky de Nys shows Martin Ferguson some of the macro algae already being produced at MBD's Townsville Pilot Facility at JCU.**

# Deakin's Favimat measures up

Deakin University's march towards leadership in developing carbon fibre composites – the building materials of the 21st century – has continued with its acquisition of a Favimat (AI) Robot2, the only one in Australia and one of just 15 in the world.

"The Favimat machine allows us to simultaneously measure the linear density and tensile properties of individual carbon fibres which are less than a tenth of the diameter of a human hair and very difficult to handle," said Associate Professor Bronwyn Fox, who heads the carbon fibre composites group at Deakin. "It is the gold standard for testing carbon fibres. It robot-automatically loads and tests up to 500 samples, which means we can be very confident with our measurements."

Manual single-fibre tests were labour-intensive and required a high level of both skill and patience, which the Favimat eliminated

"This and a number of other characteristics of the Favimat result in a significant reduction in both operator input and associated costs, as well as a reduction in possible fibre damage, which means that the results are highly reliable. Combined with the arrival of the new Surface Energy Analyser in February, this will give us a unique capability to characterise carbon fibres," she said.

Deakin and the Geelong region was now a leading player in the field of carbon fibre composites, which were the materials of the future with, for example, huge applications in the aerospace industry, Professor Fox said.

"The Boeing 787 Dreamliner is 50 per cent composite materials by weight and the new Airbus A350 XWB will be 53 per cent composite by weight. These materials play an enormous role in making aircraft more lightweight so that they are more fuel efficient and produce fewer environmental emissions."

Carbon fibre composites have a huge impact on energy use, particularly in blades for wind turbines and reducing the weight of motor vehicles.

Deakin has also reached agreement with Despatch Industries to build a carbon fibre production line on the Waurin Ponds campus, as part of the Australian Carbon Fibre Research Facility (ACFRF), the only one of its type in the world. This will be housed within the Australian Future Fibres Research and Innovation Centre (AFFRIC) – a partnership between

Deakin University, CSIRO and the Geelong-based Victorian Centre for Advanced Materials Manufacturing (VCAMM). The ACFRF is expected to be operational in 2013.

## ENGINEERS SHORTAGE AN ONGOING CONCERN

The effects of Australia's engineering skills shortage have been highlighted in the latest edition of the Engineers Australia Salary and Benefits Survey. Covering almost 100,000 employees across 429 engineering employers, the survey reveals that the recruitment and retention of qualified engineers continues to be a major challenge.

Engineers Australia new CEO, Stephen Durkin, said that the survey results clearly showed that engineering employers were struggling to find suitably skilled people to fill vacancies, and were increasingly having to offer higher salaries and salary packages to attract and retain appropriately skilled engineers.

"The survey is a barometer for understanding engineering recruitment confidence levels and remuneration in both public and private sectors. What we're now seeing is an overall increase in engineering salaries and salary packages flowing from the engineering skills shortage. Professional engineers, across both the public and private sectors, saw an average base salary increase of nine per cent in 2011," he said.

"The engineering labour force sits at about 250,000 people. Within this context, almost two-thirds of employers had difficulties hiring engineers over the past 12 months, and almost one-third of employers could not fill vacancies at all. Shortages were evident across all engineering specialisations, but civil engineering continued to pose the most recruiting difficulties for employers.

"Engineering employers reported that recruitment difficulties resulted in delays and budget overruns in a staggering 28 per cent of major projects. Employers also reported that six per cent of engineering projects did not proceed at all."

## QUEEN ELIZABETH PRIZE NOW OPEN

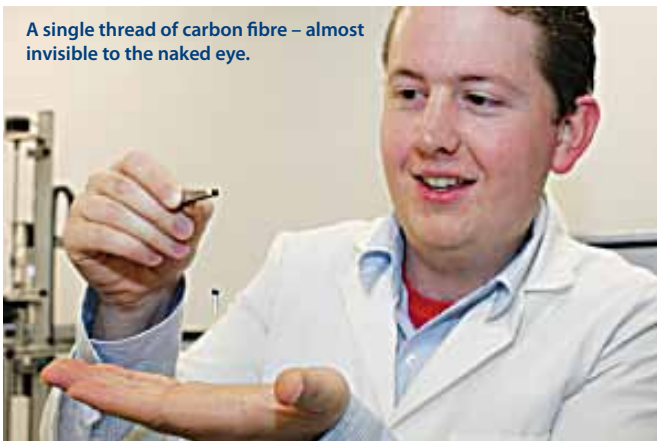
Applications are now open for the new, biennial £1 million The Queen Elizabeth Prize for Engineering and close 14 September.

This global award for engineering, to be administered by the Royal Academy of Engineering, has been established to celebrate outstanding advances in engineering that have created significant benefit to humanity.

The Queen Elizabeth Prize for Engineering aims to attain the stature of the Nobel Prizes and joins a small group of international prizes with similar aims: the Millennium Technology Prize (€800,000 to the winner), run by the Technology Academy, Finland, and the Charles Stark Draper Prize (\$500,000), run by the US National Academy of Engineering.

The first award will be announced in December 2012 and presented in early 2013. Self-nominations will not be accepted.

A single thread of carbon fibre – almost invisible to the naked eye.





The 'G-Wagon' – the ADF's future vehicle.

PHOTO: ADF

## Defence 'G-wagons' bring \$196m in local manufacture

Two Australian manufacturers will take on contracts worth \$196 million in fitting out the Australian Defence Force's 2100 Daimler/Mercedes tactical training vehicles, starting this July.

The 'G-wagons' and trailers – described as "unprotected lightweight vehicles" – will be used for a range of operations, as well as activities like supporting disaster relief and securing Australia's coastline, and will be rolled out to Defence units as part of Project Overlander, a \$7.5 billion program providing more than 7500 new protected and unprotected vehicles to the ADF over the next decade.

The then Minister for Defence Materiel, Senator Kim Carr, announced the completion of contract negotiations to acquire 2146 'G-Wagon' 4-wheel drives and 1799 trailers, which will primarily replace the Land Rover 4x4 and 6x6 vehicles. The G-Wagon vehicles are being manufactured for Daimler AG, and then supplied to Mercedes-Benz Australia/Pacific Pty Ltd in Mulgrave, Victoria, to fit Australian-made modules and tray bodies.

"The modules and tray bodies for these vehicles, as well as the trailers, will be designed and manufactured by Australian companies – Varley and Haulmark – in contracts worth approximately \$196 million," Senator Carr said.

About 540 body modules and 810 tray bodies are being designed and manufactured by G. H. Varley Pty Ltd in Newcastle, in a contract worth about \$100 million. Queensland-based Haulmark Trailers (Australia) is designing and manufacturing 1799 trailers, valued at \$96 million, including initial support.

ADF is negotiating with Rheinmetall MAN Military Vehicles to supply up to 2700 medium/heavy vehicle variants in both protected and unprotected configurations, including semi-trailers, tow trucks, integrated load-handling systems and flatbeds. Haulmark Trailers is the preferred tenderer to supply up to 2500 trailers for these vehicles.

The Government also announced it would spend more than \$15.5 million to manufacture components of the next tranche of Bushmaster vehicles from Thales Australia's Bendigo factory. The contract is for components of the Bushmaster, which have long lead times for manufacturing. Last December, the Government announced it would explore the purchase of additional Bushmaster vehicles to retain critical skills in Bendigo.

## HERCULES CONTRACT WORTH \$75M

The Australian advanced materials company, Quickstep Holdings Ltd, has secured its second major aerospace manufacturing program, winning the tender to manufacture carbon fibre wing flaps for the C-130J Hercules military transport aircraft at its Bankstown, Sydney, facility.

Quickstep was selected as sole-source supplier for the C-130J flaps following an international commercial tender program by Lockheed Martin, which attracted bids from manufacturers around the world. The contract is worth between \$75 million and \$100 million and will create more than 60 new jobs at Bankstown.

Representatives of Lockheed Martin are scheduled to visit Quickstep's Australian headquarters in the second quarter of 2012 to finalise contract details, which are expected to include a multi-year term and will see Quickstep as sole-source global supplier for these part sets.

Last year Quickstep announced a 22-year contract with Northrop Grumman worth up to \$700 million to manufacture up to 16 different parts for the international F-35 Lightning II Joint Strike Fighter program, the world's largest military program.

Managing Director of Quickstep Philippe Odouard said the C130J contract demonstrated Quickstep's ability to win major aerospace manufacturing contracts and confirmed its international competitiveness.

"It is good news for manufacturing in Australia, demonstrating that we can keep manufacturing work in country through innovation and high-end capabilities," Mr Odouard said. "I would like to pay a particular tribute to the NSW Government that supported us in developing the Bankstown facility, which will become one of the most advanced in the world."

The C130 Hercules is a legendary aircraft. It has been in continuous production since 1954, with 2400 built to date and sold to 67 countries world-wide.

Quickstep is currently relocating its operations from Western Australia and establishing a state-of-the-art carbon fibre manufacturing facility at Bankstown Airport. Planning, tooling, training and project management work on the new C130J Hercules contract will start immediately, with the first carbon fibre wing flaps due for delivery in 2014.

The long-lived C130 in flight.





Australian cotton – benefits from the Cotton Breeding Australia venture.

PHOTO: CSIRO

## \$35 million extends cotton research

CSIRO and Cotton Seed Distributors, Australia's largest supplier of cotton seed, have announced a five-year, \$35 million extension to their existing agreement, to fund projects through the Cotton Breeding Australia joint venture, which has been running since 2007.

Cotton Breeding Australia funds research that is providing long-term benefits for the Australian cotton industry including improved quality, higher yields, drought and heat-tolerance, water use efficiency, and pest and disease resistance.

CSIRO Division of Plant Industry's Chief, Dr Jeremy Burdon FTSE, said the new agreement was building on the progress of the valuable research, which is already delivering results to cotton growers.

"The extension of the agreement is proof of the huge benefits Cotton Breeding Australia's research is having for the cotton industry," Dr Burdon said. "A clear example is the future development of cotton varieties with elevated resistance to mites and whitefly, which will reduce costs and reliance on pesticides."

"The Cotton Breeding Australia joint venture is a remarkable collaboration between breeders, biotechnology research, pathology and post-harvest processing that is ensuring the best performance in our new varieties."

The new agreement was announced at the Cotton Breeding Australia Symposium in Narrabri, NSW, and extends the collaboration for a further five years, from its current termination date of 2017 to 2022. The \$35 million comprises funding from CSIRO and Cotton Seed Distributors.



Jeremy Burdon

## SEVEN YOUNG WOMEN WIN SCIENCE AWARDS

Seven young women researchers were among 13 winners of the 2012 Science and Innovation Awards announced at the annual Outlook conference in Canberra.

The Minister for Agriculture, Fisheries and Forestry, Senator Joe Ludwig, presented the Awards, noting that they "encourage participation in science, innovation and technology in rural industries and help advance the careers of young scientists through national recognition of their research."

Dr Cedric Simon from Tasmania was awarded top honours for his project on rock lobsters. Dr Simon and his fellow recipients will receive grants of up to \$22,000 to conduct their scientific projects.

Young women researchers won the majority of the remaining 11 categories.

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) runs the Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry with the financial support of 11 industry partners.

The Australian Animal Welfare Strategy Award winner was Ms Robyn Terry (SA – 'Confinement free lactation housing for sows: towards maximising expression of natural behaviours and maintaining reproduction').

The Australian Meat Processor Corporation Award went to Dr Fiona Anderson (WA – 'The effect of genetic selection for yield using Australian Sheep Breeding Values on muscle metabolism and meat quality').

The Australian Pork Ltd Award went to Dr Sasha Jenkins (WA – 'The effect of antimicrobials on the anaerobic digestion of piggery waste').

Two young NSW researchers won the Cotton Research and Development Corporation Award – Dr Rebecca Haling ('Closing the yield gap on sodic soils – opportunities for improving input use efficiently') and Ms Katie Broughton ('Integrated effects of elevated CO<sub>2</sub>, increased temperature, VPD and water deficits of field-grown cotton in Australia and USA').

The Meat & Livestock Australia Award went to Ms Jody McNally (NSW – 'A diagnostic test for detecting *Fasciola hepatica* (liver fluke) in sheep faeces').

The Rural Industries Research and Development Corporation Award went to Ms Corrine de Mestre (NSW – 'Evaluating the effect of Australian seaweed extracts on Lucerne yellow disease; new plant products for crop disease').

**Robyn Terry**  
receives her award  
from the ABARES  
Chief Scientist  
Dr Kim Ritman  
(left) and Senator  
Ludwig.



# A new future for GPS technology?



PHOTO: ERIKA FISH

**QUT's Michael Milford works on his camera-based GPS system.**

○ Ditching satellites and complex, powerful computers and opting for camera technology inspired by small mammals may be the future of navigation systems.

Dr Michael Milford from Queensland University of Technology thinks his research into making more reliable Global Positioning Systems (GPS) using camera technology and mathematical algorithms would make navigating a far cheaper and simpler task.

"At the moment you need three satellites in order to get a decent GPS signal and even then it can take a minute or more to get a lock on your location," he said. "There are some places where you just can't get satellite signals and even in big cities we have issues with signals being scrambled because of tall buildings or losing them altogether in tunnels."

The world-first approach to visual navigation algorithms – dubbed SeqSLAM (Sequence Simultaneous Localisation and Mapping) – uses local best match and sequence recognition components to lock in locations.

"SeqSLAM uses the assumption that you are already in a specific location and tests that assumption over and over again," he said.

"For example, if I'm in a kitchen in an office block, the algorithm makes the assumption I'm in the office block, looks around and identifies signs that match a kitchen. Then, if I stepped out into the corridor it would test to see if the corridor matches the corridor in the existing data of the office block layout. If you keep moving around and repeat the sequence for long enough you are able to uniquely identify where in the world you are using those images and simple mathematical algorithms."

Dr Milford said the "revolution" of visual-based navigation came about when Google took photos of almost every street in the world for their street view project. However, the challenge was making those streets recognisable in a variety of different conditions and to differentiate between streets that were visually similar. The research, which utilises low resolution cameras, was inspired by Dr Milford's background in the navigational patterns of small mammals such as rats.

"My core background is based on how small mammals manage

incredible feats of navigation despite their eyesight being quite poor," he said. "As we develop more and more sophisticated navigation systems they depend on more and more maths and more powerful computers. But no one's actually stepped back and thought 'do we actually need all this stuff or can we use a very simple set of algorithms which don't require expensive cameras or satellites or big computers to achieve the same outcome?'"

Dr Milford will present his paper *SeqSLAM: Visual Route-Based Navigation for Sunny Summer Days and Stormy Winter Nights* at the International Conference on Robotics and Automation in the US later this year. The research has been funded for three years by an ARC Discovery Early Career Researcher Award (DECRA) fellowship.

## GRDC OFFERS 'UTE APP' TO IDENTIFY WEEDS

○ The Grains Research and Development Council has developed a *Weeds: Ute Guide* iPhone app for use in the paddock by growers to assist identify the most common weeds. It includes photographs of weeds at various growth stages to ensure correct identification. Each weed has a calendar to show which month/s the weed is likely to be present in the paddock. The application allows users to search, identify, compare and email photographs of weeds to their networks.

## SCIENCE AND SUPER: \$6.5 BILLION?

○ Strong investment in Australian science was key to driving higher productivity and forging a strong and sustainable economy, the Minister for Tertiary Education, Skills, Science and Research, Senator Chris Evans, said in a keynote address to the recent Science Meets Superannuation summit in Melbourne organised by Science and Technology Australia.

Senator Evans said it was important to create partnerships between the science and research industry, universities and the private sector.

"We have enormous potential sitting right here on our doorstep," Senator Evans said. "We need to encourage investment partnerships between business and the science and research communities. We need to make sure the innovative research and ideas coming from Australia are developed and capitalised here. Boosting investment in science and research will ensure opportunities created right here at home don't slip from our grasp."

Senator Evans said the Government was committed to ensuring world-class Australian science and research by encouraging greater investment across the board. "The superannuation sector provides a great model for further investment opportunities, given its strong track record of investing in privately-managed venture capital funds and commercialisation partnerships with universities.

"An investment of half a per cent of superannuation funds into science and research would amount to a staggering \$6.5 billion. That is a huge investment into furthering Australia's competitiveness in the knowledge-based economy of the 21st century," he told the summit.

# Australia's science output ranks well

○ Australia is a top performer when it comes to science output per capita and per scientist according to the *Nature Publishing Index 2011 Asia-Pacific*, released in March. According to the Index, Australia consolidated its position as the third most productive country for high-quality primary research in the rapidly developing Asia-Pacific region.

The top five research countries in Asia-Pacific and their rankings were the same as they were in 2010, with a dominant Japan leading a fast-growing China. But Australia's investment in science infrastructure and the industriousness of its research scientists seem to be paying off. Australia comfortably increased its lead over fourth-placed Korea and fifth-placed Singapore in 2011.

Singapore and Australia were first and second respectively in terms of GDP per capita in Asia-Pacific. They were also first and second for the numbers of articles per capita and per scientific researcher published in *Nature* research journals in 2011.

It listed the top-performing research institutions in Australia over the past three years as the University of Melbourne, the University of Queensland and the Australian National University. At 64, 86 and 97 respectively, these three were the only Australian institutions in the *Nature Publishing Index 2011 Global Top 100* (beta) rankings, also published. Among other Australian institutions, notable was the rapid rise of James Cook University to number 10 in the national rankings.

The *Nature Publishing Index 2011 Asia-Pacific* measures the output of research articles from nations and institutions in terms of publications in 2011 in the *Nature* research journals. The index, which provides a unique insight into the quality and impact of Australian and Asia-Pacific science, is published as a supplement to *Nature*. (More information at [www.natureasia.com/en/publishing-index](http://www.natureasia.com/en/publishing-index)).

## MELBOURNE KICKS OFF NECTAR RESEARCH CLOUD

○ Computing and computer power has long been an important part of an Australian researcher's way of working – and now an Australian national research cloud is under way to provide cloud computing at a national-scale, accessible to all researchers.

The National eResearch Collaboration Tools and Resources (NeCTAR) project is partnering with Australian research institutions to create a national research cloud purpose built for Australian researchers and the University of Melbourne commissioned the first node of the NeCTAR research cloud in January. Further nodes will be commissioned by other research institutions throughout 2012.

The NeCTAR research cloud will empower researchers with

new self-service abilities to publish research data, share knowledge, rapidly deploy and access software applications without the burden of operating their own computer servers. NeCTAR's cloud will enable Australian researchers to respond rapidly to new developments by providing instant access to scalable computing resources and applications. Computational results will be able to be easily shared with national and international collaboration partners.

"The research cloud provides Australian researchers with many efficiencies and benefits, such as reducing barriers to the rapid sharing of innovative research applications and computer power from a single server to thousands of servers," said NeCTAR Director, Associate Professor Glenn Moloney.

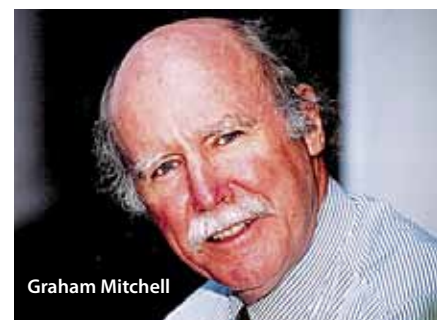
"Researchers can easily put their great ideas, tools, research applications and data online, instantly."

"NeCTAR's national research cloud is an Australian first, providing flexible and scalable computer power at any time, accessible to all Australian researchers. As an Australian secure platform to share access to research applications, the NeCTAR cloud supports the increasingly collaborative nature of Australian research."

The national research cloud is one of four program areas of the NeCTAR project – a \$47 million project funded from the Australian Government's Super Science Initiative to create specialist research infrastructure to serve the needs of Australian researchers – located at the University of Melbourne, which is the lead agent.

The others are:

- NeCTAR's Virtual Laboratories – creating a new era of digital connectivity for Australian researchers, supporting collaborative research workflows which span research institutions and facilities, and supporting the "connected researcher" who at the desktop or benchtop has access to digitally enabled data, analytic and modeling resources, specifically relevant to their research;
- NeCTAR's eResearch Tools – enhancing research applications and tools to make them more collaborative, accessible and to support research workflows; and
- The National Servers Program – providing a robust hosting service for applications and services supporting the Australian research community on a national scale. The initial service has been built by the University of Melbourne and is available to be used now.



Graham Mitchell

Dr Graham Mitchell AO FTSE is Chair of the NeCTAR Board and is recognised as one of Australia's leading biological scientists. An author of more than 350 publications, he is Chief Scientist Victoria and Principal of Foursight Associates Pty Ltd. University of Queensland Deputy Vice Chancellor Professor Max Lu FTSE is a Board member.



**Svetha Venkatesh and her team.**

## Svetha's iPad app tackles autism

○ A new interactive iPad app is set to change for the better and forever the way parents interact with their autistic children.

Developed by Professor Svetha Venkatesh FTSE and her research team, now based at Deakin University's Warrnambool campus, the 'Toby Playpad' is a high-performance early intervention app. By empowering parents to deliver therapy outcomes at home, the app addresses a critical gap – the time parents have to wait to access therapy after their child has been diagnosed with autism. "So this will have a profound impact on the lives of families," Professor Venkatesh said.

Typically, an autistic child needs about 30 hours of therapy a week, she said.

"In order to prepare the materials for therapy, the parents have to spend another 30 hours. Toby Playpad allows a parent to do the early intervention learning with the child at home. It enables learning both on and off the iPad in a principled way. It also saves therapists and parents the time they have to spend manually evaluating and recording a child's progress.

"Simply, Toby Playpad does that for them. It adjusts lessons and

customises learning to the child's preferences. If you are in a classroom and the teacher is teaching 30 kids, they are basically gearing the lesson to the average in the class, but Toby is geared to you. The potential for this is far beyond autism, really. It affords a platform for all early learning – in numeracy and literacy – and there are exciting opportunities ahead."

Details at <http://tobyplaypad.com>.

## SPIDER VENOM MAY EASE PAIN

○ The University of Queensland's main research commercialisation company, UniQuest, has announced that researchers at the Institute for Molecular Bioscience (IMB) have entered into an agreement for a focused funding grant and collaborative research project with Johnson & Johnson and some Janssen affiliates, to develop components of spider venom that may be effective as a treatment for pain.

The grant funding will support a 12-month project to characterise novel spider venom peptides (proteins comprising fewer than 50 amino acids) that were discovered in a proprietary IMB assay to inhibit a human ion channel, critical for sensing pain.

The long-term goal is to develop these peptides for the therapeutic treatment of chronic pain, which occurs when the nervous system continues issuing pain signals despite the lack of a pain stimulus. Chronic pain is experienced at some point in the lives of 1 in 5 Australians. In the US an estimated \$560 billion annually is lost due to healthcare costs and reduced productivity.

## FIGHTING INFECTIOUS DISEASES TOGETHER

○ Two leading Australian research organisations, the Queensland Institute of Medical Research and The University of Queensland, have announced a joint research partnership to tackle global problems in infectious diseases

# Korean connection makes 8000km telescope

○ Australian and Korean radio telescopes have been linked for the first time, forming a system acting as a gigantic telescope more than 8000 kilometres across and with 100 times the resolving power of the Hubble Space Telescope.

Australia has been making similar linkups with Japan and China for many years and is now also doing initial tests with telescopes in India. Combining signals from

widely separated telescopes in this way is the technique that will underlie the coming international mega-scope, the Square Kilometre Array (SKA).

"This is another step in Australia's ongoing collaboration with Asia in the field of radio astronomy," said CSIRO's Astronomy and Space Science Chief, Dr Philip Diamond.

The telescopes involved in the linkup were two CSIRO dishes near Coonabarabran and

Narrabri in NSW, a telescope of the University of Tasmania near Hobart, and two telescopes operated by the Korean Astronomy and Space Science Institute: one in Seoul (at Yonsei University) and one in south-east Korea near Ulsan (at Ulsan University).

The telescopes observed the same target simultaneously for five hours and their data was streamed in real time over optical fibre links to Curtin University in Perth, WA, where it

research. The Australian Infectious Diseases Research Centre will bring together researchers from these two organisations to support research into diseases such as malaria, dengue fever and schistosomiasis. Both organisations have pledged funds to support joint PhD scholarships and to nurture collaborations in infectious diseases research.

## \$10M BRISBANE BRAIN RESEARCH CENTRE

○ A new multi-million dollar Asia-Pacific Centre for Neuromodulation (APCN) in Brisbane is poised to become a world leader in research to revolutionise the diagnosis and treatment of neurological disease. The APCN is a joint initiative of The University of Queensland (UQ) and St Andrew's War Memorial Hospital, with funding commitments of approximately \$10 million over five years.

APCN will integrate research, education and clinical care, and aims to become the data hub for the region, linking to an international research and clinical database on neuromodulation technology and procedures. It will build on two decades of ground-breaking clinical research in the application of Deep Brain Stimulation (DBS), a neuromodulation procedure to treat Parkinson's disease, dystonia, essential tremor, post-stroke disorders, Tourette's syndrome, intractable pain and epilepsy.

Central to the APCN's establishment are world DBS leaders neurologist and Professor of Clinical Neuroscience at UQ Professor Peter Silburn and neurosurgeon Dr Terry Coyne, both of whom are based at St Andrew's.

## MELBOURNE UNI AND BIONICS INSTITUTE

○ The Bionics Institute has strengthened its relationship with The University of Melbourne through an Enhanced Research Collaboration Agreement, through which a Medical Bionics Department has been created within the

Faculty of Medicine, Dentistry and Health Sciences, and will be located at the Bionics Institute to conduct research and research training. Professor Rob Shepherd, Bionics Institute Director, will head of the new department.

Professor Shepherd was a member of an ATSE delegation, led by Professor Greg Tegart AM FTSE, to the Australia-EU workshop Smart Technology for Healthy Longevity in Paris in October 2009. He wrote an article on medical bionic technologies in *Focus* 160.

## JANSSEN BACKS UQ RA THERAPY

○ UniQuest, The University of Queensland's research commercialisation arm, has facilitated a strategic research collaboration agreement with Janssen-Cilag Pty in Australia to develop a promising treatment for a devastating immunological disease that affects millions of people around the world.

Under the agreement, Dendright Pty Ltd, wholly owned by UniQuest, receives an up-front seed grant to fund pre-clinical development of its treatment for rheumatoid arthritis (RA). The seed grant will help Professor Ranjeny Thomas and her team at the UQ Diamantina Institute pursue a new treatment for RA, which may also apply to other autoimmune diseases such as type 1 diabetes and multiple sclerosis.

Professor Thomas was a finalist in the Health category of the 2011 *The Australian Innovation Challenge* for her research towards a vaccine for RA.

RA is caused by immune system dysfunction and affects millions of people worldwide, destroying joints and causing cardiovascular complications that can reduce life spans by 10 years. Professor Thomas' innovation targets the underlying cause of the disease.



Ranjeny Thomas

The radio telescope at Ulsan.



was processed 'on the fly' at the International Centre for Radio Astronomy Research. The data was sent from each telescope at the rate of 64Mb per second – equivalent to filling a CD every 10 seconds.

The high-speed data links for the observations were provided by the Australian Academic Research Network (AARNet) and its Korean counterpart, Kreonet, and are part of the region's existing research and education infrastructure.

The astronomers targeted a galaxy that emits strongly in radio waves – a source called

J0854+2006, which was chosen because it was suitable for the tests. It is located 3.5 billion light-years away, and is thought to house a pair of supermassive black holes at its centre. One of these is among the largest black holes known, with a mass more than 18 billion times that of the Sun, which is orbited once every 11 to 12 years by a smaller black hole with a mass 100 million times that of the Sun. The two black holes are spiralling together and are expected to merge in less than 10,000 years' time – an event that would release huge amounts of radiation.

# UNSW's single- atom transistor "perfect"

○ In a remarkable feat of micro-engineering, UNSW physicists have created a working transistor consisting of a single atom placed precisely in a silicon crystal – unprecedented accuracy that may yield the elementary building block for a future quantum computer with unparalleled computational efficiency.

The tiny electronic device uses as its active component an individual phosphorus atom patterned between atomic-scale electrodes and electrostatic control gates.

Until now, single-atom transistors have been realised only by chance, where researchers have either had to search through many devices or tune multi-atom devices to isolate one that works.

"But this device is perfect", said Professor Michelle Simmons, group leader and director of the ARC Centre of Quantum Computation and Communication Technology at UNSW. "This is the first time anyone has shown control of a single atom in a substrate with this level of precise accuracy."

The UNSW team used a scanning tunnelling microscope (STM) to see and manipulate atoms at the surface of the crystal inside an ultra-high vacuum chamber. Using a lithographic process, they patterned phosphorus atoms into functional devices on the crystal then covered them with a non-reactive layer of hydrogen.

Hydrogen atoms were removed selectively in precisely defined regions with the super-fine metal tip of the STM. A controlled chemical reaction then incorporated phosphorus atoms into the silicon surface.

Finally, the structure was encapsulated with a silicon layer and the device contacted electrically using an intricate system of alignment markers on the silicon chip to align metallic connects. The electronic properties of the device were in excellent agreement with theoretical predictions for a single phosphorus atom transistor.

It is predicted that transistors will reach the single-atom level by about 2020 to keep pace with Moore's Law, which describes an ongoing trend in computer hardware that sees the number of chip components double every 18 months. Professor Simmons said this was now possible well ahead of schedule and the device gave valuable insights to manufacturers into how devices would behave once they reached the atomic limit.

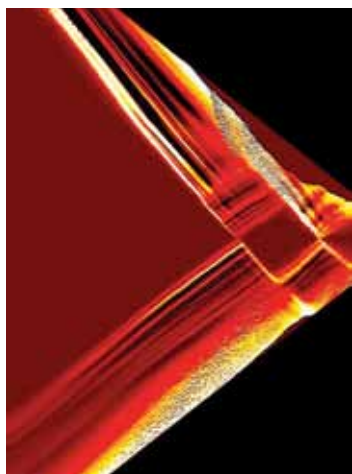


PHOTO: UNSW

**Electronic signature of a single-atom transistor based on an individual phosphorus atom patterned with atomic precision in a silicon crystal using scanning tunnelling microscope lithography. The image depicts the transistor's source-drain conductance at milliKelvin temperatures as a function of bias and gate voltages.**

## WELL ... PERHAPS BIAS ISN'T THE RIGHT WORD

○ Why do sports fans get so worked up when they think the referee/umpire has wrongly called their team's pass forward, their player offside, the tackle not legitimate or their serve as a fault?

Research from The University of Queensland's School of Psychology and the Queensland Brain Institute has found people actually see their team's actions as better than those of other teams.

The recently published study randomly divided volunteers into two teams and let them judge the relative speeds of hand actions performed by "their" team and its opponents, in a competitive situation.

Lead researcher Dr Pascal Molenberghs said results showed the brain responded differently when people saw actions of their team members compared to the opposing side, but that this was not as simple as a bias in opinion.

"Our study found that people quickly identified with their group and that they consistently judged their own team's actions as being a fraction of a second faster than those of non-team members, when in reality the actions were identical," Dr Molenberghs said.



The research team then used functional magnetic resonance imaging (fMRI) technology to assess each participant's brain activity during the experiments. "We explored two possible explanations for the bias: either people actually see their team's actions differently, or people see the actions as the same but make a conscious decision that their own team was faster," he said.

"We found that the people who showed a bias in favour of their own team had a different brain response when they were watching the actions of team members compared to the actions of non-team members. But crucially, we found no difference in brain response during the conscious decision making part of the experiments.

"What this suggests is that we unconsciously perceive the actions of teams we are affiliated with differently than those performed by other teams. So contrary to common belief, people seem to be unaware that they are biased towards their own team. It's not simply that we decide to favour the actions of our team because we think they are the best. Rather, because we feel an affiliation with the team, our brain processes the actions of own team members more favourably.

"Our findings could help explain discrimination between all kinds of groups – including those of race, gender and nationality – because our study suggests that we see the actions of non-group members differently and what we see is what we believe."

PHOTO: JUSTIN MARSHALL



The cuttlefish – a new look at the way it looks.

# Polarisation enables animal kingdom language

○ Australian and UK researchers have made new findings about a form of secret language in the animal kingdom using polarisation, a type of light that humans cannot see.

Researchers at the Queensland Brain Institute at the University of Queensland and the University of Bristol in the UK have examined polarisation vision and its significance in biological signalling.

They focused on a type of cuttlefish (close relative to octopus and squid) to demonstrate how polarisation could be used as an important kind of communication in the animal kingdom.

In a paper published in *Current Biology*, they report that cephalopods such as cuttlefish have the ability to see in many more directions of polarised light than previously thought. Co-author Professor Justin Marshall, from QBI, said humans had not yet developed the language to describe all the roles of polarisation in nature.

Professor Marshall said most people would be familiar with the concept of polarisation through the use of polarised sunglasses, but polarisation also had an important application in the detection of skin cancer in humans, as a viewing scope containing polarised light was a technology currently used to detect melanomas.

It has been known for years that many animals have better colour vision than humans and also many have polarisation vision (P-vision), so they literally see things that we can't. The polarisation of light is a dimension of reality invisible to most people without specialised instruments.

"Mammals and some other groups don't appear to have P-vision, although many parts of the animal kingdom do," Professor Marshall said, noting other studies had found that animals such as ants and bees and even fish may use polarisation to navigate.

"Polarisation in animals has previously just been categorised as just an unusual and interesting phenomenon, but the work we've done in the past few years shows that animals use P-vision in the same way we use colour – to communicate with each other."

Professor Marshall said animals such as cephalopods (cuttlefish,

squid and octopuses) and many crustaceans were colour blind. Instead they had concentrated on polarisation vision.

"They have evolved perfectly to see light we cannot see and also use polarised skin patterns to camouflage into their backgrounds, giving them an advantage over some predators who do not have P-vision."

## INVESTIGATOR NOW BEING BUILT

○ Construction of Australia's new \$120 million Marine National Facility research vessel *Investigator* has begun in Singapore, heralding a new era in Australian marine and atmospheric research.

Australia's ocean territory is the third largest in the world and the 93.6-metre vessel will be capable of conducting marine research in our coastal waters from the Antarctic ice edge to northern tropical waters.

The vessel will be capable of mapping the seafloor six kilometres below the surface, conducting deep-water coring to 24 metres and will have the latest satellite communications technology. *Investigator* will be operated by CSIRO and be available to all Australian marine scientists. It replaces the existing Marine National Facility ship, *Southern Surveyor*, which is 40 years old.

An impression of the *Investigator*.

## CSIRO LAUNCHES COASTAL RESEARCH

○ A new CSIRO-developed website will enable councils and other coastal stakeholders to easily find research at a national level, and then focus on regional and local research projects.

The website has short, plain-English research summaries and provides further links to freely available data and research under the Creative Commons licence. The webportal, which uses a Google Maps interface, was developed in cooperation with the Terrestrial Ecosystem Research Network (TERN), which will now manage the website.

This is an Australian Coastal Ecosystem Facility (ACEF) project under TERN, funded by ACEF and CSIRO. TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative.

The webportal can be found at <http://coastalresearch.csiro.au>.

# Mineral deposits stem from supercontinents

The McDonald Ranges in the Arunta region of central Australia.

PHOTO: GEOSCIENCE AUSTRALIA

○ Scientists investigating Australia's significant mineral deposits believe they may be linked to the formation and break-up of supercontinents.

Geoscience Australia geologist Dr David Huston says the history of supercontinents could indicate where large mineral, petroleum and coal deposits may be found in the future. The evaluation of Australia's geology and geochronology, along with analysis of various data from seismic, airborne, electromagnetic, radiometric, magnetotelluric and gravity surveys, has revealed a complex geological history over four billion years.

"This research indicates that much of Australia's geology, along with its mineral deposits, are the consequence of the amalgamation and break-up of the supercontinents Vaalbara, Kenorland, Nuna, Rodinia, Pangea and, finally, Gondwana," Dr Huston said. "There is a strong clustering of resources associated with the coming together and break-up of these supercontinents and they include some of Australia's most significant mineral and hydrocarbon deposits."

The research indicates that one of Australia's most important gold provinces, centred on Kalgoorlie in Western Australia, may be the product of the formation of Kenorland about 2.7 to 2.6 billion years ago.

Dr Huston said it was also evident that the major zinc-lead-silver and copper deposits in Broken Hill and north-west Queensland and the giant Olympic Dam iron-oxide-copper-gold deposit in South Australia formed as Nuna broke up about 1.7 to 1.5 billion years ago. "It is also likely that most of Australia's hydrocarbon resources are a result of the break-up of Pangea and Gondwana between 250 and 35 million years ago."

"This supercontinent history has been a significant influence on the distribution of minerals, petroleum and coal and understanding this could lead to the location of further large deposits of resource in the future."

## TECHNOLOGY BRINGS MINING BENEFITS

○ World-first technology in the mining industry is contributing to better health and safety for miners, production efficiencies and improved energy consumption and environmental benefits, according to new research.

A BAEconomics report, commissioned by Rio Tinto to look into the benefits and costs of autonomous technology, concludes that investment in mining technology and innovation should sustain long-term competitiveness while also providing the broader economic benefits likely to flow from a strong mining industry.

The report, titled *Autonomous and remote operation technologies in the mining industry: benefits and costs*, examines the advances in new technology, showing that while the costs and challenges of automation in the mining sector are substantial, they are potentially far outweighed by the benefits they can deliver.

The report also concludes that as automated systems allow workers to communicate with and control machinery remotely, this removes their exposure to hazardous mining environments, reduces or eliminates health and safety risks, and makes for a more attractive workplace. The appeal of these new roles, and the potential for them to be located in more desirable locations will broaden employment opportunities and attract more talent to the mining industry.

Rio Tinto head of innovation John McGagh said "The BAEconomics report highlights the increasingly complex challenges being faced by the mining industry. Our industry is facing maturing ore bodies, fewer tier-one deposits, increasingly complex geographies and labour shortages and the report details how innovation in autonomous technologies can play an important role in addressing these challenges."

"In Iron Ore (Pilbara operations), we're introducing automated trucks, blast-hole drill rigs, sorting machines and trains, all of which are capable of being controlled by our Operations Centre in Perth, which already integrates our port, rail and mine logistics."

## DRIVERLESS TRAINS IN PILBARA BY 2014

○ Rio Tinto plans to run the world's first automated, long-distance, heavy-haul rail network from 2014, with its AutoHaul™ automated train program scheduled for completion a year later.

AutoHaul™ is being pioneered as part of the automation component of Rio Tinto's 'Mine of the Future' initiative that also includes driverless trucks and autonomous drills. On its 1500-kilometre Pilbara rail network, Rio Tinto currently runs 41 trains from mines to ports, comprising 148 locomotives and 9400 iron ore cars.

The US\$518 million investment in driverless trains is expected to enable Rio Tinto to expand Pilbara production capacity without needing

to make a substantial investment in additional trains. It will also drive productivity improvements, with greater flexibility in train scheduling and the removal of driver changeover times creating extra capacity in the rail network. Other benefits include more efficient fuel use, resulting in lower energy costs and a reduction of CO<sub>2</sub> emissions for each tonne of iron ore produced. AutoHaul™ and the overall expansion of rail operations are subject to a number of WA Government and other approvals.

"Rio Tinto is leading the way in large-scale use of automation, with plans to deploy 150 driverless trucks and our plans for AutoHaul™," said Rio Tinto Chief Executive Australia and Iron Ore, Sam Walsh.

# Read this book and look forward to the next

By Ian Rae

ianrae@bigpond.com

Everybody knows that blokes start at the back of the paper so they see the sporting news first. It's not a bad way to start an expository book, either, so I started at the back of this book (*The Genome Generation* by Elizabeth Finkel) and I knew what to expect when I encountered "the age of dogmas is over".

Elizabeth Finkel cites Aristotle on "knowing what to ask". Her hope is that "this book will empower the reader to *know what to ask*" (her italics).

The development of grand simplifying theories like inheritance and the genetic code often involves discrimination against minor variants or denial of what seems like apostasy, only to find that they creep back in once the theory is firmly established. To paraphrase a psychologist friend, it's a poor theory that can't stand a littler apostasy.

Getting down to business, I started my review read

by asking whether the book covered the things that – as a non-specialist – I thought I knew and then moving on to the answers to questions that I never thought of asking.

I thought I knew, for example, that there was a clear link that went DNA → RNA → proteins, but that turned out to be a simple version of a much more complicated story, and part of the dogma to be abandoned or at least questioned.

I knew that there was a lot of DNA that didn't seem to be expressed anywhere, but its connection to RNA in its various guises, in a chapter entitled "Junk is telling us something" extended my knowledge considerably. And I was still only up to page 49.

The next chapter – "Lamarck returns" – dealt with feedback mechanisms that could change DNA or at least change the way in which it is expressed, and went some way to resurrect the concepts advanced by Jean Baptiste Lamarck. Before the chapter ends, Dr Finkel has dealt with methylation as a way of silencing genes, introduced

*The Genome Generation* By Elizabeth Finkel

(Melbourne University Press, 2012, paperback, 256 pages, \$32.95)

Elizabeth Finkel holds a PhD in biochemistry and spent 10 years as a professional research scientist before becoming an award-winning journalist. She has written for *Science*, *Lancet*, *Mature Medicine*, *New Scientist* and *The Age*, among others, and has broadcast for ABC Radio National. Her awards include finalist in the Eureka Award for Medical Journalism, winning the Michael Daley award for best radio feature broadcast and the Queensland Premier's Literary Award for her book, *Stem Cells: Controversy at the Frontiers of Science*. In 2011 she was named the National Press Club's Higher Education Journalist of the Year.



Elizabeth Finkel

LETTER

## Periodic climate changes: lessons from the past

The latest experimental data indicates that during the past 650,000 years the climate of our planet has undergone numerous cycles of Ice Ages, each lasting about 100,000 years, followed every time by the interglacial period of some 10,000 years.

At present Earth is reaching the end of its last interglacial period, as indicated by such eminent scientists as the mathematician and meteorologist Belgian Professor André Léon Georges Chevalier Berger and American Professor of oceanography John Imbrie.

If the current interglacial again lasts 10,000 years, as all the previous did during the past 650,000 years, then we are entering the period of a new

Ice Age. These cycles were obviously in no way affected by the human activities resulting in the emissions of greenhouse gases and those of CO<sub>2</sub> in particular. And so, if we are approaching new Ice Age, the increase of CO<sub>2</sub> can possibly postpone, but not prevent its imminent coming.

There was an increase in CO<sub>2</sub> content, as the percentage of total atmospheric gases, from 0.0315 per cent in 1960 to 0.0385 per cent in 2010. It must be noted that this minute content of carbon dioxide is essential for existence of all the organic life on Earth.

If on the other hand the current interglacial period, irrespective of human activity (as were the cases in the past), lasts much more than 10,000 years, then the abatement of CO<sub>2</sub> may, be it only marginally, reduce the rate of global warming.

– Professor Alek Samarin, FTSE

the ideas of epigenetics, and warned against do-it-yourself genetic programming via fad dieting.

The search of individual genomes, steadily growing cheaper and easier to obtain, for clues to susceptibility and resistance to disease, has not been crowned with great success, but it's not for want of trying. AIDS is a particular case in point. Having visited the global hotspot, Botswana, Dr Finkel writes about the science and the sufferers with particular poignancy.

There is an excellent chapter on food crops (we need another Green Revolution) and the book ends with the puzzle that grows deeper as we learn more about genomes. There is not a lot difference between ours and those of the simplest animals. Could evolution be a process of successive simplification?

With experience as a scientist (biochemistry) and journalist, Elizabeth Finkel writes well, getting the science right (as far as I could tell) and frequently using metaphors like mining, fishing or tinkering with the engine. A small selection of photographs and cartoons help, too.

This is a research field to which Australians have made significant contributions and Dr Finkel is generous with citations. It is clear that she has travelled and interviewed widely as she gathered her material and sought clarity of explanation. A number of Australians are mentioned. The one who stands out is John Mattick who recently moved from the University of Queensland to head the Garvan Institute of Medical Research. His struggle to gain acceptance for sometimes unorthodox ideas – well portrayed by Dr Finkel – was capped with the Chen Award for 2012 for Distinguished Academic Achievement in Human Genetic and Genomic Research.

What's missing? Well, bioinformatics is not covered explicitly but it lurks behind the trawling of genomes. I didn't find metabolomics or toxicogenomics or any of the other '-omics', nor the patent battles over 'junk DNA', now more reverently referred to as 'non-coding DNA'. Never mind, there's plenty without them.

Scientifically precise as to language, the text is written in popular style, with the heavy stuff consigned to end notes (50 pages) and there is an excellent index (10 pages).

I think I learned enough from this book to understand future accounts in news media and science magazines, at least until the 'ongoing explosion' creates a need for a sister volume. Read this one and look forward to the next. ◀

**PROFESSOR IAN RAE FTSE** is a former Technical Director of ATSE and Honorary Professorial Fellow, History and Philosophy of Science, University of Melbourne. He is member of the leadership group of ATSE's Climate Change Forum and former President of the Royal Australian Chemical Institute.

## Students question the point of science and maths

○ An unpopular image, perceptions of irrelevancy to everyday life and some uninspiring teaching are causing students to question the purpose of science and mathematics in the classroom, according to a recent Universities Australia report.

Less than half of those sampled totally agreed that science was central to maintaining Australia's way of life.

The report, commissioned by Australia's Chief Scientist, Professor Ian Chubb, highlights Australian students' growing lack of appreciation of the relevance and role of science in their lives and communities and of its potential for rewarding career opportunities.

Universities Australia CEO, Dr Glenn Withers, said: "This trend should be setting off alarm bells as it poses a risk to Australia's future as an innovative nation and an international leader in research."

The report's findings revealed that students are often disillusioned with science and maths, with many teachers displaying a lack of enthusiasm for the course content and preventing students from maintaining further interest. Other findings included that science and maths (in schools and universities) are often seen as being taught in an outdated and impractical manner, not befitting the hands-on nature of much scientific discovery and work; and that science and maths were often viewed as too hard with difficult career prospects.

A surveyed student said: "I feel like in science and maths classes, it's more the teacher talking at you ... When you're engaged in and doing projects, and maybe working with partners, that may be more of an engaging activity versus sitting in a room for 60 minutes and listening to someone talking at you."

Dr Withers believes such responses indicate a need to reinvigorate maths and science in the classroom. "It seems science and maths cannot be taught effectively in a static, textbook-focused environment. Only studying theoretical approaches cannot engage and stimulate students enough in the same way applied science can. For example, instead of just studying the composition of various metals, allowing students to see the role these metals play in car manufacturing illustrates the value of science and maths in a way they can immediately relate to.

"With the Government reviewing the funding and quality of higher education teaching (following the Base Funding Review), we have an opportunity to radically rethink the way we teach science and maths subjects in our schools to ensure commencement rates increase.

"We need to work hard at finding new and better ways to send the right signals to students about the social and economic value of science and maths. This includes working with employers to motivate students about careers that utilise their talents and skills to ensure the employers themselves are "graduate ready" to best use the training," Dr Withers said.

"If we cannot get students to move away from such negative stereotypes and get them interested in the art of scientific discovery, then we undermine an important foundation for Australia's future."

The report is at [www.universitiesaustralia.edu.au](http://www.universitiesaustralia.edu.au)

## Eight Fellows recognised in Australia Day honours

Eight ATSE Fellows were recognised in the Australia Day Honours.

Mr Bob Every and Professor David Skellern were appointed Officers of the Order of Australia (AO).

Mr Every AO FTSE, a Fellow since 1997 and Chairman of Wesfarmers, had a long career with the BHP group, culminating in his appointment as CEO of BHP Steel products. He was recognised for his services to business, particularly through leadership roles in the Australian steel industry as an advocate for corporate social responsibility.

Professor Skellern AO FTSE was recognised for services to science and engineering. A Fellow since 2004, Professor Skellern was until recently the CEO of National ICT Australia (NICTA), won an ATSE Clunies Ross Award in 2010 and delivered the ATSE Oration at the November 2010 AGM and Fellows Dinner.

Mr Simon Bartlett, Professor Rod Boswell, Professor Mike Dureau, Professor Laurie Faraone and Professor Martin Green were named as Members of the Order (AM). Professor Rod Tucker was awarded the Order's medal (OAM).

Mr Bartlett AM FTSE was honoured for his services to engineering. A Fellow since 2006, he is COO of Powerlink, which owns, operates, develops and maintains Queensland's high-voltage electricity transmission network, and was named 2009 Professional Engineer of the Year by Engineers Australia.

Professor Boswell AM FAA FTSE was recognised for service to science. A Fellow since 1999, he is Head of the Space Plasma and Plasma Processing group at ANU. He is co-inventor of the WEDGE, a walk-in virtual reality theatre.

Professor Dureau AM FTSE was named



Simon Bartlett



Laurie Faraone



Martin Green

for his services to engineering. A Fellow since 2001, Professor Dureau is Chair of the Warren Centre, a former Managing Director of ALSTOM Power, past Chair of RedR and the Australian Water Association and has held a number of positions with Engineers Australia.

Winthrop Professor Faraone AM FAA FTSE was recognised for his services to science. A Fellow since 2004, He is Director of the WA Centre for Semiconductor Optoelectronics and Microsystems at UWA. Professor Faraone is also the Director of the UWA-based WA node of the Australian National Fabrication Facility.

Scientia Professor Green AM FAA FTSE was honoured for his service to science education. A Fellow since 1994, he is acknowledged as a world leader in photovoltaic research and founded the Photovoltaic Laboratory at UNSW (now the ARC Photovoltaics Centre of Excellence, which he heads) in the mid-1970s.

Laureate Professor Tucker OAM FAA FTSE was recognised for his service to the electrical and electronics industry, particularly as an academic and educator. A Fellow since 1993, he is Director of the Institute for a Broadband-Enabled Society at the University of Melbourne.

## Computer engineering medal for David Abramson

Monash University's Dr David Abramson FTSE has won a prestigious international medal in computer systems engineering for his significant and sustained contributions to the scalable computing community, and his outstanding record of high-quality and high-impact research.

Dr Abramson, a Professor within the University's Faculty of Information Technology, has won the Institute of Electrical and Electronics Engineers (IEEE) Technical Committee on Scalable Computing (TCSC) Award for Excellence in Scalable Computing.

The award will be presented in mid-May at an IEEE international symposium in Ottawa,

Canada, where Dr Abramson has been asked to present a keynote speech on cluster, cloud and grid computing.

Dr Abramson said the award was great recognition for both himself and Monash, and that

it is rewarding to receive peer support for his work on software tools for parallel supercomputers.

IEEE is the world's largest professional association for the advancement of technology, with offices in China, India, Japan, Singapore and the US.

Dr Abramson's win came after his recent appointment as the new Director of the University's eEducation Centre. He is also the Science Director of the Monash e-Research Centre and Director of the MeSSAGE Lab.



David Abramson

## Boas Medal to Ben Eggleton

Last year was a big one for Professor Ben Eggleton – marked by two major awards.

Professor Eggleton, from the University of Sydney, has won the 2011 AIP Walter Boas medal, awarded for excellence in physics research carried out in the previous five years.

Professor of Physics at the University of Sydney and founding director of the Australian Research Council's (ARC) Centre of Excellence for Ultrahigh-Bandwidth Devices for Optical Systems (CUDOS), Professor Eggleton is an internationally acclaimed optical physicist who has pioneered breakthroughs in the field of photonics (the science of light).

He and his team of more than 130 scientists are developing optical technologies that promise to change people's lives. In particular, the group is developing a photonic chip that is faster, smaller, more energy efficient and smarter than traditional electronics options. Using light beams, it is already contributing to new science and technology in a host of areas ranging from energy-efficient communications and quantum information processing to environmental monitoring and astronomy.

For his leadership in establishing CUDOS and for the vast body of research he continues to contribute to the field, Professor Eggleton also won the 2011 Eureka Prize for Leadership in Science, part of the Australian Museum Eureka Prizes (see *Focus* 168).



Ben Eggleton



Alex Zelinsky

## New DSTO boss in place

Dr Alexander Zelinsky FTSE has taken up the post of Chief Defence Scientist and head of the Defence Science and Technology Organisation (DSTO).

Dr Zelinsky has worked with private and public sector organisations at the senior executive level and was previously the Group Executive, Information Sciences Group in CSIRO. Dr Zelinsky is an internationally recognised scientist who has made substantive technical contributions in addition to providing leadership to the high technology community.

He was appointed to the position in December 2011.

## Trevor Bird wins Sargent Medal

Dr Trevor Bird FTSE, Principal of Antengenuity and a CSIRO Fellow, has won the 2012 MA Sargent Medal. The medal, awarded by Engineers



Trevor Bird

Australia's Electrical College, recognises "a highly significant contribution to the science of practice of electrical engineering". It is named for ATSE Fellow and former EA President Dr Mike Sargent AM

FTSE, a Fellow since 1992 and one of Australia's outstanding electrical engineers.

Announcing the award, EA said Dr Bird's expertise was in antennas and microwave systems for satellite communications as well as wireless and radio telescope systems.

He was awarded a lifetime achievement medal by the CSIRO last year, coinciding with his retirement from the position of Chief Scientist at the CSIRO ICT Centre. He is an adjunct professor at Macquarie University.

Dr Bird, a Fellow since 1988, has also been named President Elect of the IEEE Antennas & Propagation Society. This means that in 2013 he will be President of this international technical Society within IEEE (the Institute of Electrical and Electronics Engineers). The

Society has about 9000 members and is the largest organisation world-wide of specialists in electromagnetic antenna and propagation aspects. He was formerly Editor-in-Chief of its leading journal, *Transactions on Antennas & Propagation*, for six years.

## Forum leadership in place

Nominations for the positions of Chair and Deputy Chairs of the Academy's four activity Forums have been completed and the following Fellows have been elected:

### EDUCATION FORUM

**Chair:** Professor Archie Johnston FTSE

**Deputy Chair:** Emeritus Professor Robin King FTSE

**Deputy Chair:** Emeritus Professor David Beanland AO FTSE

### ENERGY FORUM

**Chair:** Mr Martin Thomas AM FTSE

**Deputy Chair:** Dr David Brockway FTSE

**Deputy Chair:** Dr John Söderbaum FTSE

### HEALTH & TECHNOLOGY FORUM

**Chair:** Professor Greg Tegart AM FTSE

**Deputy Chair:** Professor David Feng FTSE

**Deputy Chair:** Professor Karen Reynolds FTSE

### WATER FORUM

**Chair:** Dr John Radcliffe AM FTSE

**Deputy Chair:** Dr Brian Spies FTSE

**Deputy Chair:** Dr Tom Connor FTSE

ATSE congratulates

these Fellows and thanks the former Forum leaders for their contributions

– Emeritus Professor Lesley Parker AM FTSE, Mr David Hind FTSE, Dr Mike Sargent AM FTSE, Dr John Sligar FTSE, Dr Tony Basten AO FAA FTSE and Mr Keith Daniels FTSE.

The leadership includes two new Fellows, elected in 2011

– Professor King and Professor Reynolds.

Forum committees are being established following the election of Chairs and Deputy Chairs.



Karen Reynolds



Robin King



**State Councillor and Chinese Vice-Premier Liu Yandong congratulates Max Lu in Beijing.**

## Max Lu honoured in China

Chinese state leaders have presented The University of Queensland's Senior Deputy Vice-Chancellor and former ATSE Board member, Professor Max Lu FTSE, with a prestigious science and technology award.

Chinese President Hu Jintao, Premier Wen Jiao Bao Wen Jiao and vice premiers Li Kegiang and Liu Yandong presented Professor Lu with the accolade at a ceremony in the Great Hall of the People in Beijing in February.

Professor Lu – an international nanotechnology expert – and six other laureates won their awards for their “distinguished and sustained contributions to collaboration with China in science and technology”.

Professor Lu “has established long-term cooperative relations with many Chinese research institutes such as the Institute of Metal Research (IMR) of the Chinese Academy of Sciences,” his citation said.

“Since he joined the overseas innovation collaboration team of CAS in 2003 as a core member of the Shenyang Interface Materials R&D Centre and guest research fellow of IMR, he has worked closely with IMR in many research areas and completed a number of international cooperation projects.

“Those activities have greatly promoted the rapid development of CAS in materials for clean energy, such as solar photocatalysis,

energy storage and hydrogen storage.

“He has also made great efforts in the training of Chinese young professionals in the field of new energy materials, and promoting of cooperation between China and the Australian Academy of Science, as well as the Australian Academy of Technological Sciences and Engineering.”

Professor Lu came to UQ as a PhD scholarship student and spent three years in Singapore as Lecturer at Nanyang Technological University. Following his return to UQ in 1994, he held positions of Senior Lecturer, Associate Professor, Professor and Chair of Nanotechnology in Chemical Engineering. He won the prestigious ARC Federation Fellowship twice (2003 and 2008).

He was appointed Senior Deputy Vice-Chancellor in December 2011. He previously held positions of Deputy Vice-Chancellor (Research) from 2009, Acting Deputy Vice-Chancellor (Research) and Pro-Vice-Chancellor (Research Linkages) from October 2008 to June 2009. He was also the Foundation Director of the ARC Centre of Excellence for Functional Nanomaterials from 2003–09.

Professor Lu had formerly served on many government committees and advisory groups including the Prime Minister's Science, Engineering and Innovation Council (2004, 2005, 2009) and ARC College of Experts (2002–04). He is the past Chairman of the IChemE Australia Board and has served on the boards of Uniseed Pty Ltd, ARC Nanotechnology Network and Queensland China Council.

He is currently a Board member of the Australian Synchrotron, National Centre of Excellence for Desalination, National eResearch Collaboration Tools and Resources, and Research Data Storage Infrastructure. He also holds a ministerial appointment as Member of the National Emerging Technologies Forum.

He has received numerous prestigious awards nationally and internationally including the Chinese Academy of Sciences International Cooperation Award, Orica Award, RK Murphy Medal, Le Fevre Prize, ExxonMobil Award, Chemeca Medal (2011), Top 100 Most Influential Engineers in Australia (2004 and 2010) and Top 50 Most Influential Chinese in the World (2006).

## Five Fellows join ARC committees

Four Fellows are among 147 distinguished researchers will assess and report on the quality of research in Australia as part of the 2012 Excellence in Research for Australia (ERA) evaluations.

The researchers appointed across eight Research Evaluation Committees include Professor Michael Tobar FAA FTSE, Winthrop Professor and ARC Laureate Fellow with the School of Physics at the University of Western Australia and Professor Keith Watson FTSE, Honorary Fellow, Walter and Eliza Hall Institute and The University of Melbourne (Physical, Chemical and Earth Sciences); and Professor Suresh Bhatia FTSE, Professor of Chemical Engineering, The University of Queensland, Professor John Carter AM FTSE, Pro-Vice Chancellor, Faculty of Engineering

and Built Environment, The University of Newcastle, and Winthrop Professor Dongke Zhang FTSE, Director, Centre for Energy, UWA (Engineering and Environmental Sciences).

“These researchers are experts in their field and in research evaluation, and have been selected from a pool of more than 600 national and



**Suresh Bhatia**



**Michael Tobar**

international researchers,” ARC Chief Executive Officer Professor Margaret Sheil FTSE said.

Acknowledging the 600 plus nominations received by the ARC for the 2012 Committees, Professor Sheil said she was delighted with the response to the call for nominations and was pleased to have appointed such a strong group to undertake the 2012 ERA evaluations.

# Thomas Maschmeyer wins RACI Medal

For his work on catalysis and sustainable processes, including developing methods to create low-carbon crude and heavy fuel oil substitutes, Professor Thomas Maschmeyer FAA FTSE, from the University of Sydney, has been awarded the RACI's 2011 Applied Research Medal.

This medal is awarded annually by the Royal Australian Chemical Institute to a member who has contributed significantly towards applied research or industrial fields.

Professor Maschmeyer has developed ways to generate low-carbon crude and heavy fuel oil substitutes from renewable biomass and brown coal. Both processes are currently in the commercial demonstration phase.

Professor Maschmeyer is Professor of Chemistry and ARC Future Fellow at the University of Sydney. In 2011 he was elected



Thomas Maschmeyer at work.

Foreign Member of the Academia Europea as well as a Fellow of ATSE.

He serves on the editorial/advisory boards of eight international journals and is President of the Catalysis Society of Australia. He is co-founder of the Australian low carbon/renewables start-ups Ignite Energy Resources and Licella and was one of the founding Professors of Avantium, a Dutch hi-tech company.

"I am delighted to have received the prize as it represents recognition for activities whose value is sometime difficult to appreciate, as they are situated between clear-cut basic research and full commerciality – sometimes referred to as the professional 'Valley of Death'," he said.

"The recognition from the award will help to lift the profile of such activities, which are essential to keeping a modern economy and society robust and viable."

Outcomes of the research are job creation in the high-tech, manufacturing and utilities sector as well as a reduction of the carbon footprint of a range of activities associated with fossil fuels such as power generation and transport fuels.

"It will support a marked reduction in the reliance on imported crude oil, since biomass and previously 'dirty' brown coal can be substituted for crude oil in these applications. This will have very substantial positive impacts on Australia as a whole."

## Peter Cook's *Clean Energy, Climate and Carbon*

A new book by Dr Peter Cook CBE FTSE – *Clean Energy, Climate and Carbon* – outlines the global carbon emissions challenge. It covers the changing concentration of atmospheric CO<sub>2</sub> through time, before considering the promise and the limitations of a wide range of energy technologies.

The book also explores the political environment in which the discussion on clean energy technology options is occurring.

It was launched in March at the National Library in Canberra by Resources and Energy Minister Martin Ferguson.

Dr Cook, currently a Professorial Fellow at the University of Melbourne, initiated Australia's Cooperative Research Centre for

Greenhouse Gas Technologies (CO<sub>2</sub>CRC) in 2003, was its Chief Executive until his retirement at the end of last year and remains a Senior Adviser.

The CRC is a major research consortium of universities, industry and government institutions involving more than 100 researchers, aiming principally to develop CCS.

He first developed the concept of the Otway storage project in 2004 – which has become a world-leading project. From 1998 to 2003 he was Executive Director of the Australian Petroleum CRC, which conducted a series of major research programs including GEODISC, which has profoundly influenced Australia's approach to geosequestration.

Before that he was Executive Director of the British Geological Survey, an organisation of 850 staff active in 40 countries. He was a Coordinating Lead Author of the IPCC Special Volume on Carbon Dioxide Capture and Storage, and is the author and co-author of more than 130 publications.

Mr Ferguson said Australia had built up a strong base of Australian expertise in CCS, citing "the pioneering work and leadership of Peter Cook".

*Clean Energy, Climate and Carbon* outlined the global carbon emissions challenge, Mr Ferguson said.

"For people who are concerned about carbon emissions, or who want to learn more about clean energy technologies, including CCS, this is an authoritative view of the opportunities and the challenges we face," he added. "This book will further help improve public knowledge about carbon capture and storage — and contribute to what I hope will be a more informed debate."

*Clean Energy, Climate and Carbon* is a 232-page paperback available from CSIRO Publishing for \$39.95 (see review in Focus 172).



Martin Ferguson launches Peter Cook's new book.

# Mike Hirshorn was a leader in commercialisation

Dr Michael Hirshorn OAM FTSE, who died in Sydney on 18 November 2011, aged 61, was recognised internationally for his intense interest and international track record in the commercialisation of Australian technology.

A Fellow since 2005, he applied new and existing science and technology in a number of fields, principally medical technology and was perhaps best known for his role in the development of the Cochlear bionic ear.

He was a founding member of the Cochlear team, working on the product developed from the work at the University of Melbourne of Professor Graeme Clark AC FRS FAA FTSE, and in a number of senior executive roles made a major contribution in taking the device to international markets.

He was named BRW Businessman of the Year – Technology in 1988 and was subsequently involved in the international commercialisation of a number of medical devices. He was also responsible for filing about 60 individual patent families.

Earlier, he played a pivotal role in the development and commercialisation of a number of medical devices, including pacemaker cardiac electrodes, a bone growth stimulator for fracture treatment as well as US FDA approval of tachycardia control pacemakers.

A MBBS graduate from Melbourne University with an MBA from Macquarie University, he was a director of a number of companies, including Resmed (1989–92).

In his later career, as CEO of Nanyang Innovation Fund, Dr Hirshorn focused on commercialisation – contributing strongly to the development of hearing aids, microarrays for diagnostics, microbiological controls, drug development and water conservation, including commercialisation of products developed at Melbourne, Queensland and Macquarie universities.

Dr Hirshorn's citation, when he joined ATSE, noted that he had managed R&D, manufacturing, clinical trials and marketing.

"He has demonstrated high-quality

entrepreneurial activity in many areas of his work but most notably in the introduction of the Cochlear implant in the US, Europe and Japan from scratch, building clinical trial and marketing teams in these areas successfully and profitably."



**Mike Hirshorn**

## John Langford on gas and water committee

Professor John Langford AM FTSE has been appointed by Federal Environment and Water Minister Tony Burke to the interim committee pending the formal establishment of the Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining.

The committee will provide scientific advice to governments about relevant coal seam gas and large coal mining approvals where they have significant impacts on water, and will oversee research on impacts on water resources.

Professor Langford has had a 35-year career in the Australian water industry, serving as Chief Executive of the Rural Water Commission from 1989 to 1994. He is a Fellow, Institution of Engineers, Australia, and an ATSE Fellow since 1998.

Professor Langford has been the recipient of many awards including a Churchill Fellowship, and the Peter Hughes award for contribution to Australian water management.

The Committee is part of a new science-based framework announced by the Government last November, to provide more certainty for regional communities around coal seam gas and large coal mining

**John Langford**



developments, jobs and investment and the protection of water resources.

The interim Independent Expert Scientific Committee has had an initial meeting which endorsed the Terms of Reference and commenced development of a work plan.

ATSE has links with two other members.

The interim Independent Expert Scientific Committee Chair is Professor Craig Simmons, Professor of Hydrogeology at Flinders University and Director of the National Centre for Groundwater Research and Training, who wrote on groundwater issues in *Focus* 170 (page 28). He is a leading international authority in hydrogeology and is considered one of Australia's foremost groundwater academics. Professor Simmons has been a significant contributor to global advances in the science of hydrogeology for many years.

Another member is Professor Chris Moran, Director of the Sustainable Minerals Institute at the University of Queensland, Interim Director of the UQ Centre for Coal Seam Gas and a current member of the Expert Panel on Coal Seam Gas. He was previously the founding director of the Centre for Water in the Minerals Industry at UQ. Prior to that he worked as a natural resources and soil scientist in the CSIRO and has more than 20 years' experience in landscape and water research. Professor Moran was a speaker at the ATSE International Workshop Water and its Interdependencies in the Australian Economy in Sydney in June 2010 wrote on the interaction of mining and water in *Focus* 163 (page 21).

## Graeme Pearman

Dr Graeme Pearman AM AAS FTSE recently joined ATSE Foreign Fellow, Dr Ramesh Mashelkar FRS FTSE as a member of the Science Panel of the Singapore National Research Foundation. Over a three-day period they reviewed documents and presentations, and inspected research facilities undertaking major ongoing research projects in Singapore. They examined proposals for new research investments and provided assessments to the NRF. The Panel includes two Nobel laureates and is chaired by Sir Richard Friend, of Cambridge University.

# Graham Schaffer heads Smart Engineering State campaign

Professor Graham Schaffer FTSE, Executive Dean of the Faculty of Engineering, Architecture and Information Technology at The University of Queensland (UQ), has

been appointed as Special Advisor for the Queensland Government's new Smart Engineering State initiative.

His three-month role, from 6 February, will be to draft a vision and

a develop a plan

for positioning Queensland as a Smart Engineering State, in consultation with the minerals, energy, services, education and research communities.

He will provide a series of recommendations to the Government via the Smart State Council headed by Queensland Chief Scientist Dr Geoff Garrett AO FTSE.

In response to a letter of invitation from the then Queensland premier Anna Bligh, which said Queensland already had the highest concentration of engineers in Australia, ATSE is contributing to his consultations.

Ms Bligh said the current phase of the Queensland Smart State Strategy was focused on medical research and biotechnology, as well as design and tropical research.

"Engineering has now emerged as the field with significant potential and importance for Queensland as a result of the resources boom and population growth and the demand for infrastructure to support both."

Professor Schaffer has held appointments at both The University of WA and UQ, where he has served as Head of the Materials Division in the School of Engineering, Research Director for the School of Engineering, Physical Sciences and Architecture and head of the School of Engineering.



Graham Schaffer

## Zimmet study shows hips a key obesity risk

A research team led by Baker IDI Heart and Diabetes Institute has for the first time demonstrated that the effect of obesity on the risk of premature death is seriously underestimated unless a person's hip circumference is taken into account.

By looking at the relationship between waist and hip circumference in a 20-year study of almost 8000 Mauritians, the research is also the first ever study to link obesity to mortality in a South Asian population.

It developed from a study initiated in Mauritius almost 25 years ago by Professor Paul Zimmet AO FTSE, Director Emeritus and Director, International Research, at Baker IDI.

The latest research study, of which Professor Zimmet was an author, involved researchers from Australia, Sweden, Mauritius, Finland, the UK and Denmark, with the findings published in the *International Journal of Epidemiology*.

Good evidence now exists to show that the fat tissue in the hip has quite different metabolic properties in comparison with fat tissue around the waist and is in fact protective against metabolic disorders such as diabetes and cardiovascular disease. Higher hip circumference can also reflect greater muscle mass.

Lead author Dr Adrian Cameron, from Deakin University, said it was known that higher hip circumference was protective against metabolic diseases such as diabetes as well as death.



Paul Zimmet

"However, we did not know that taking waist and hip circumference into account separately (as opposed to using the waist-to-hip ratio) would reveal such a powerful association

between obesity and mortality," he said.

"In other words, a person with big hips and a small waist is at the lowest end of the risk scale and people with small hips and a large waist are at the highest risk."



Eric Wolanski

## Eric Wolanski edits major reference work

ATSE Fellow Professor Eric Wolanski, from James Cook University and the Australian Institute of Marine Science is joint Chief Editor (with Professor DS McLusky, of the University of Stirling, UK) of a major new reference work.

Elsevier's *Treatise on Estuarine and Coastal Science* examines the world's estuaries and coasts, from inland watersheds to the ocean shelf, with 24 volume editors contributing to the 6000-page, 12-volume series.

It covers the geography, geomorphology, hydrodynamics (including modelling), geology, geochemistry and biogeochemistry – as well ecology and modelling estuarine ecosystems. It also addresses the human impacts, practical measures of remediation and the ecological economics of estuaries and coasts.

"The Treatise provides a comprehensive scientific and technical resource for all professionals and students in the area of estuaries and coasts," says Dr Joe Baker AO OBE FTSE, describing the publication as "timely".

"Estuarine and coastal areas are among the most heavily impacted by human settlement and activities, and those impacts are likely to become significantly more adverse with projected population increases and due to increased severity of rainfall and coastal erosion.

"Realisation of the planning and publication of this Treatise is a wonderful achievement for an Australian scientist, and a measure of how well Australian marine and coastal science and technology is valued worldwide," he adds.

*Elsevier's Treatise on Estuarine and Coastal Science*, ISBN: 978-0-12-374711-2; Publication date: March 2012; list price \$4995.00, £2500.00, €3650.00.



(Right to left) Professor Cary Fowler, Executive Director of the Global Crop Diversity Trust, Tony Gregson (centre) and the Australian Ambassador to Norway, Mr James Choi, with the Australian seed consignment at Svalbard.

## Tim Fischer joins crop diversity group

Former Australian Deputy Prime Minister and Honorary Fellow Mr Tim Fischer AC FTSE will next year join the Executive Board of

the Global Crop Diversity Trust, which seeks to protect the world's food crop varieties.

Mr Fischer will bring to the Trust a wide array of experience in agriculture, trade, transportation and

international relations. He served for several years as the Chairman of the Crawford Fund and helped host key conferences in Australia to provide outreach and raise awareness on agricultural topics.

He also is a trusted figure in international diplomacy, having served as the leader of the official Australian Delegation that oversaw voting in East Timor in 1999 and as Chairman of the Australia Thailand Institute. Most recently he was Australia's Ambassador to the Holy See.

His appointment highlights the importance of global crop diversity for Australia. Australian farmers have suffered the effects of extreme weather in recent years and are particularly aware of the importance

of having crops that can withstand rapidly changing conditions.

In February 2011 Dr Tony Gregson AM FTSE took Australia's first shipment of grain seed to the Svalbard Global Seed Vault, an underground seed bank in the Arctic region of Norway that secures duplicates of the world's most important crops in case natural disasters, civil strife, extreme weather and other threats that could destroy a unique variety. The Vault's operations are funded by the Trust, which also supports developing countries to send seeds to the high profile facility.

The mission of the Trust is to ensure the conservation and availability of crop diversity for food security worldwide. Although crop diversity is fundamental to fighting hunger and to the very future of agriculture, funding is unreliable and diversity is being lost. The Trust is the only organisation working worldwide to solve this problem. The Trust is providing support for the ongoing operations of the seed vault, as well as organising and funding the preparation and shipment of seeds from developing countries to the facility.

Tim Fischer marked the end of his remarkable 40-year public career doing what he loves best – talking about trains. He addressed the National Press Club in February in his first major speaking engagement, upon return from his three-year posting in Rome as Australian Ambassador Holy See. His wide-ranging speech touched on everything from diplomacy and climate change to religious freedom and food security – and trains.

Mr Fischer has a legendary love of trains – even hosting radio shows and writing books on the topic – and has long been the country's leading advocate for a high-speed rail network.

## Don Aitken headed WA Main Roads for 22 years

Mr Don Aitken AO ISO FTSE, who died last September, aged 86, was the youngest engineer appointed Commissioner of Main

Roads in WA in 1965 – at 40 – and held the position until 1987.

A University of WA engineering graduate in 1945, he was prominent in road engineering for more than 40 years,



Don Aitken

joining the WA Main Roads Department in 1946.

A Fellow since 1987, Mr Aitken was Chancellor of The University of WA for nearly a decade, a Director of WMC Ltd, a WA Citizen of the Year in 1982 and winner of Engineers Australia's Peter Nicol Russel Memorial Medal in the same year.

His involvement in road development was extensive – Chair of the Australian State Road Authorities, Australian Road Research Board and WA Road Traffic Safety Authority. He was also the first Australian appointed President of the Road Engineering Association of Asia and Australasia.

He was a stalwart of Engineers Australia and was awarded Companion of the Imperial Service Order in 1977 and Officer of the Order of Australia in 1988 in recognition of his service.

His private interests were varied – former president of the Lake Karrinyup Country Club, former vice president of the Rotary Club of Perth a member of organisations involved in golf, scouting, hockey, cricket and horse racing.

He set a precedent for Main Road Commissioners in the Academy – his successors include Mr Menno Henneveld FTSE (since 2002) and Dr Ken Michael AC FTSE (1991–97) and later Governor of WA.

# Len Sciacca heads new Defence Science Institute

Professor Len Sciacca FTSE, who is currently Chief Operating Officer of the Defence Science and Technology Organisation (DSTO), has been appointed Director of the Defence Science Institute (DSI) at the University of Melbourne. Professor Bill Moran FAA has been appointed Research Director.

The institute is a joint initiative between DSTO and the University of Melbourne that aims to develop collaborative research networks between all Australian universities, industry and government agencies in technologies relevant to Defence and National Security.

Professor Sciacca said DSTO was looking at a national model that built on the institute that would encompass all Australian universities. To kick-start the Victorian engagement, the Victorian Department of Business and Innovation is providing funding of \$3 million over three years.

Professor Sciacca said he was delighted to take on the new role. He said he and Professor Moran had worked together for more than 20 years and they were pushing a new paradigm for collaboration and leveraging funding in an ever tighter research funding environment.

"The Institute is about building an Australian defence research network that will span industry, fundamental and applied research with direct application to solving defence problems," Professor Sciacca said.

"The Institute is also engaging with international defence research bodies and institutions.

"Many organisations are realising that collaboration and funding leverage is critical. Many challenges require the integration of multi-disciplinary research teams, something that many academic research funding



Len Sciacca

avenues aren't designed to develop.

"Moreover, we see the opportunity to align many research activities in Australian academia to defence needs. The close association with DSTO and industry means there will be the ability to have context for research problems and a better understanding of the scientific challenges facing defence and national security."

## Allan Paull wins aeronautics award

Professor Allan Paull FTSE is part of an international research team which will be honoured at the International Congress

on Aeronautics in Brisbane in September with the 2012 International Council on Aeronautics (ICAS) von Karman Award for international Co-operation in Aeronautics.



Allan Paull

The von Karman award recognises the Australian-US team's work in developing hypersonic flight technology.

Co-recipients of the award are The University of Queensland's (UQ) Professor in Hypersonic Propulsion, Michael Smart; Mr Doug Dolvin from the US Air Force Research Laboratory; and Dr Kevin Bowcutt from Boeing Research & Technology (US).

They will present a paper at the conference on the Hypersonics International Flight Research Experimentation (HIFIRE) Program, which is a series of nine experimental flights over eight years – some from Woomera in South Australia.

Professor Paull, Research Leader, Applied Hypersonics, Defence Science and Technology

Organisation (DSTO) and an adjunct professor at UQ, is known internationally for his achievements in advanced aeropropulsion, working on engines with supersonic combustion (scramjets) to achieve supersonic combustion in flight to demonstrate the possibility of affordable development of hypersonic technology.

He currently heads a \$50 million joint US/Australian flight program to develop technology for flight vehicles. He joined the Academy in 2011.

Professor Paull gained his PhD in applied mathematics at UQ and subsequently obtained a MEngSc at UQ. He has worked for 25 years in hypersonics, primarily in the field of supersonic combustion.

He has been employed at NASA Langley Research Center (US), DLR (Göttingen, Germany) and GASL (NY, US) and UQ where he held the position of an ARC Professor, an ARC Professorial Research Fellow and a UQ Research Professor.

## Neil Turner

Winthrop Professor Neil Turner FTSE has been awarded a University of WA Chancellor's Medal for his work with the UWA Institute of Agriculture. Professor Turner, a Fellow since 1992, helped establish the Cooperative Research Centre for Legumes in Mediterranean Agriculture at UWA and set up a research partnership between UWA and Lanzhou University in China.

## New Fellow Peter Meurs



Division Chair Peter Lilly presented a Fellowship certificate to new Fellow Peter Meurs at a recent WA Division New Fellows evening.

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# UQ SCIENTIST LEADING THE WAY

## Researcher making a significant contribution to the scientific community

The University of Queensland is home to some of the nation's leading female scientists, including Professor Jenny Martin from UQ's Institute for Molecular Bioscience.

Professor Martin established Queensland's first protein crystallography laboratory just three years after being awarded a PhD from Oxford University.

In 2009, Professor Martin was awarded one of the inaugural Australian Laureate Fellowships to support her research into developing a new class of antibacterial drugs that aims to overcome the problem of antibiotic resistance.

Professor Martin's significant and highly influential research contributions to oxidative folding proteins, structure-based drug design and high-throughput technologies was also recognised at the 2011 Women in Technology Awards receiving the Biotech Outstanding Achievement Award.

In addition to her achievements in research, Professor Martin has played a leadership role in the scientific

community, including supporting and mentoring others and promoting science to the general community.

The Federal Government's 2010 Excellence in Research for Australia (ERA) survey confirmed The University of Queensland as one of the nation's top two universities, measured on a combination of research quality and breadth. ERA reported that research at UQ is above world standard in more broad fields than at any other Australian university: this reflects UQ's leading global role in many areas of discovery. UQ's outstanding critical mass offers researchers significant interdisciplinary capability.

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