



# FOCUS

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## THE SCRAMBLE FOR NATURAL RESOURCES

### MORE FOOD FROM LESS LAND

Contributors discuss how research, development and policy change can help ensure the competitors for the globe's natural resources all get a fair go.

# Resources / Watching what we eat: key to food security?

1 December 2012 / 1 / Jody Harris



The recent droughts in the US and the protests by farmers over milk prices in the UK have brought the issue of urban food security into the spotlight. My research leads me to think that existing approaches to food security are flawed because they fail to get to grips with a fundamental issue: what do people eat and why, and how might that be changed?

Food security is about the availability, accessibility and utilisation of food. So, for example, if a city can't physically get enough supplies of a particular food, then its food security is threatened. Similarly, if people can't afford to buy that food or can't use it to create nourishing meals, then the supply isn't secure.

It used to be assumed that availability was the main barrier to food security, grow more food and you improve security. However, work in the 1980s by Nobel Laureate Amartya Sen brought accessibility into focus as the key barrier; people were still going hungry despite an abundance of food in the world. This still holds and a rise in the number of people accessing charity run food banks in the UK and North America shows this is not just a problem for the developing world.

It's estimated that a combination of increasing populations and increasing appetites could result in a 70% increase in demand for food by 2050. This demand will have to be met despite global drivers of change like depleted resources and climate change, which make it harder to produce enough food.

In response, some governments and cities are developing food security strategies. Cities in particular have a vital role to play because they will soon be home to 70% of the world's population. Cities are focusing on agricultural yields, supply chain resilience, distribution within a city, promoting healthy foods and affordability.

In the US and Canada, food policy councils have been created to promote sustainable food systems at a city scale. US cities are assessing their food systems, while London and a few other UK cities now have a food strategy. A lot of the strategies involve things like promoting urban agriculture, supporting farmers' markets and helping people to access healthy foods.

But although these initiatives address the availability and accessibility of food, they don't address the fundamental issue – what foods we eat and why. Why secure a supply of a product people won't eat; why encourage consumption of a product that cannot be secured long term?

Havana is often held up as an example of good practice in urban food security... *Read the rest of the article @ <http://thoughts.arup.com/post/details/238/watching-what-we-eat-key-to-food-security>*

Contributor /  
Jody Harris



My role as a member of Arup's Environment and Sustainability team covers everything from sustainability appraisals to environmental assessments to delivering carbon management projects for clients in both the public and private sectors.

I'm currently undertaking doctoral research on how cities engage with the food security agenda. I'm specifically interested in the role that cities might (and do) play in affecting change in our food system in the face of drivers such as population growth, urbanisation, climate change, and changing dietary preferences.

## Thoughts /

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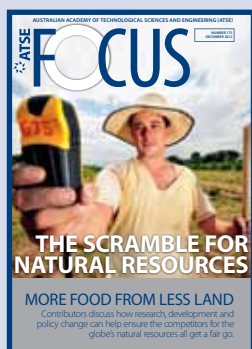
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PHOTO: CGIAR



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# FOCUS

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# He's helping improve the world's food security.

What would you like to achieve?

Professor Neil Turner  
UWA Institute of Agriculture

As one of the world's leading agronomists, The University of Western Australia's Professor Neil Turner has a clear focus.

*"My interest is in dryland agriculture and helping farmers increase production and income from the precipitation on their farms."*

Professor Turner's successes have been recognised nationally and internationally and he has recently received the prestigious 2012 national Friendship Award, China's highest award for 'foreign experts who have made outstanding contributions to the country's economic and social progress'.

The beneficiaries of Professor Turner's regular overseas work to improve crop yields and water-use extend beyond China's students, researchers and farmers.

The ATSE Fellow and former Chief Research Scientist at CSIRO has also recently begun working in South Sudan to improve that nation's food security.

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# A global land rush? Look at the facts

Australia is the only high-income country among the top 10 countries with apparent potential to increase cultivated area.



By Derek Byerlee  
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**G**rowing food demand from a rising and more affluent global population and increasing use of land for non-food purposes such as biofuels have translated into higher commodity prices and increased competition for land.

This has led to a surge of investments in farmland in recent years, many transcending national borders. Such investments are badly needed to overcome the legacy of underinvestment in agriculture. However, where local institutions are not well developed, especially land rights, they need to be carefully managed to secure positive development outcomes.

Globally, cultivated area – at around 1550 million hectares (M ha) – is increasing very slowly and is actually declining in developed and transitional economies, reflecting success in increasing crop yields. However, since 1990, developing countries have brought an additional 54 M ha into production, mainly in Latin America, sub-Saharan Africa and South-East Asia. By 2030, the demand for additional cropland is estimated to be 160 M ha to 340 M ha, depending on productivity growth, expansion of biofuels, and losses of cropland to urbanisation and degradation.

On the supply side, global analysis indicates that about 450 M ha of non-forested land suited to cropping is available to bring into cultivation. At first glance it would thus seem that land demand (even the higher estimates) can be accommodated by available uncultivated land. However, most of this uncultivated land is concentrated in 10 countries: Sudan, Democratic Republic of Congo, Madagascar, Mozambique, Chad and Zambia in sub-Saharan Africa; Brazil and Argentina in Latin America; Russia; and Australia. Much of it is far from ports and roads and will require major investments in infrastructure to gain access to markets.

While there are major uncertainties in the above projections, they hint at growing land scarcity, with remaining land suited to bring into cultivation concentrated in a few countries. Further, expansion of farm area could have significant environmental costs, even in the non-forested areas considered here, as well as social costs – uncultivated land almost everywhere provides some form of livelihood, especially to pastoralists or to farmers using extensive agricultural systems with long fallows.

## Rising investment

Improved returns in farming and relatively cheap land in some countries have translated into a sharp rise in domestic and foreign investment into farmland, largely focused on the same countries with uncultivated land.

Three broad groups of investors can be distinguished:

- 1** Agribusiness operations seek farmland to either expand the scale of operations or to integrate forward or backward to production of raw materials.
  - 2** Financial entities such as pension funds and equity funds find it attractive to invest in farmland for its potential appreciation over the long term and to diversify their portfolios, especially given recent poor performance in other financial assets.
  - 3** Governments through sovereign wealth funds or state-owned companies from countries facing growing food shortages due to land and water scarcity seek to augment food supplies by investing abroad.
- Although hyped in the media, this last category accounts for less than 10 per cent of investments in farmland.
- Surges in private investment in farmland, often across national borders,

PHOTO: ISTOCK



A California celery crop.

have been observed in the past in periods of steep commodity price increases. However, the magnitude of the interest in land acquisition following the 2008 commodity price spike seems unprecedented.

United Nations Conference on Trade and Development (UNCTAD) data point towards a jump in foreign investment in farming from some \$1.5 billion in 2001–06 to more than \$5 billion in 2008, nearly all of it directed toward developing countries. Some claim – based largely on media reports – that more than 200 M ha of land (equivalent to 14 per cent of total cultivated area) has been transferred to investors globally since 2000. In practice much less land seems to have been transferred and only a fraction of what has been transferred is actually used. Indeed, field verification generally finds much lower estimates of investments being implemented on the ground, especially in Africa.

### Rise of 'superfarms'

Associated with growing investment in farming has been a dramatic rise in the size of some farming operations. The largest crop-based farms in the world are now in developing and transitional countries of Latin America and Eastern Europe.

Operational units that often exceed 10,000 ha are further horizontally integrated into 'superfarms' that control hundreds of thousands of hectares, with the largest now approaching a million hectares of good crop land and sales above \$1 billion annually.

Business models generally depart substantially from that of family farming, often separating ownership, management and labour, and vertically integrating with processing, marketing and export logistics. The largest companies, although home-grown, are traded publicly in international equity markets and operate across countries within a region and increasingly at a global level.

The recent interest by corporate investors and investment funds in very large farms reflects a number of factors. Developments in technology – such as large machinery, zero tillage, genetically modified organisms (GMOs), and information and satellite technology – have made it easier for companies to manage very large farms.

The experience of Latin America has shown that, with advances in technology and new business models, large farms can be globally competitive. But true 'superfarms' have emerged only

where imperfections in other markets, especially marketing and access to finance, provided advantages to large operations well beyond the production stage. In an undistorted policy environment, owner-operated farms continue to be the pillar of production agriculture, as in Australia.

### Opportunity or risk?

The growing private sector interest in agriculture presents a major opportunity for developing countries to capture much-needed access to capital, modern technology and new markets to spur agricultural growth and employment. However, despite this potential, development outcomes have often been much less favorable. Neglect of social and environmental norms is widespread, implying a danger of a 'race to the bottom' to attract investors.

Where land tenure is not well defined or land governance is weak, investments have often infringed on the rights of traditional users, without compensation. Large land transactions are often not well recorded, lack transparency and do not adequately consult with local communities. These problems are most severe in sub-Saharan Africa where formal land markets and land titling are generally absent. There, such transfers often reduce tenure security to local communities, threaten local livelihoods and increase the likelihood of conflict.

Emphasis on large farms also risks growing inequality in land ownership, with negative consequences for broad-based rural development and future growth. Farmland ownership and operation is now highly concentrated in several countries of Eastern Europe and central Brazil.

Environmental concerns have also surfaced especially where land expansion occurs at the expense of tropical forests, as with pastures in Latin America and oil palm in South-East Asia.

Finally, even economic benefits are often compromised by lack of technology and land speculation – especially where land is provided through government channels free or at very low prices. For all these reasons investments in Africa often fail, with lasting damage to communities and the environment.

### Land governance

Higher global interest in farmland demands clear responses from governments, private sector and the global community to

support improvements in land governance and policies. These changes include recognition of local rights, transparent mechanisms to transfer rights voluntarily – instead of having them expropriated by the state – and public institutions with clear mandates and sufficient capacity to prevent negative social or environmental effects.

Additional provisions for local employment content, training and technology transfer would help spread the benefits to local smallholders. In all cases, there is a clear need for greater transparency in processing such investments and the monitoring of outcomes.

Although this appears a daunting list, there are good examples to draw from which indicate that the benefits from implementing these reforms could be high. Economically viable investments can:

- provide benefits through capital for physical and social infrastructure;
- generate jobs;
- provide access to new markets and technology for local producers; and
- raise local or national tax revenue.

As expected, outcomes are best where investments are made in situations where property rights are already well defined and land markets work well.

### Should Australia be concerned?

Australia is the only high-income country among the top 10 countries with apparent potential to increase cultivated area. With well-developed institutions and markets, Australian agriculture, as elsewhere in the developed world, is overwhelmingly dominated by family farms. However, there have historically been considerable large-scale investments in the tropical north, especially in the cattle industry.

An Australian Bureau of Statistics survey in 2010 estimated some 44 M ha of land with full or partial foreign ownership. Our review of the size and location of these properties acquired indicates that all but about 1 M ha was for extensive grazing.

In the past investors have also tried to establish large-scale crop production in the north. Difficult soils and unreliable rainfall often led to failure of such ventures, for example in the state-led Peak Downs Scheme in Queensland in the 1940s and at least three private projects in the Northern Territory in the 1960s and 1970s, each targeting more than 100,000 ha. With high commodity prices, there has

been a resurgence of investor interest in northern crop agriculture, this time with emphasis on irrigated farming.

In Australia's main cropping areas, investors are seeking properties that they consider are significantly undervalued relative to production potential given available technology and the market outlook.

Since product, financial and land markets work well in Australia, and its highly skilled farmers have access to a world-class R&D system, opportunities for finding undervalued properties are not likely to be plentiful. Some investors may see opportunities in vertically integrated industries such as sugar, dairy and cattle feedlots, where they have the capital to apply state-of-the-art technologies across the value chain.

Concerns about foreign investment in Australia centre on speculation, land concentration and national security.

On speculation, it is possible that investors with deep pockets looking to diversify their portfolios could bid the price of land above its use value for the short to medium term, making it difficult for family farmers to profitably expand.

Over the long term, a large number

of such investments could also lead to significant concentration of land ownership that could change the face of Australia's rural communities. However, given the current level of activity and more profitable opportunities elsewhere, these concerns are unlikely to materialise.

National security concerns are sometimes raised about the potential for foreign investors to buy up assets in a strategic sector such as food production, especially if the investor is a sovereign wealth fund or state-owned company with close links to a potentially hostile government. However, these concerns are more likely to be relevant to the agricultural inputs, processing and trading sectors where purchase of one or a few large companies could secure significant market power, than for farmland purchases.

The immediate priority is to establish a more transparent system for monitoring foreign investment in farmland to provide up-to-date and reliable information on who is investing where, both individually as well as in aggregate. This could follow the US system that requires foreigners to report holdings of agricultural and forest land to the US Secretary of Agriculture,

although no prior approval is needed.

Transparency of this type seems to have gone a long way toward reducing fears of foreign ownership of farmland in the US.

Australia has been a world leader in arguing for free trade and investment in agriculture and is one of the very few countries to practise what it preaches. Australia has been a beneficiary of moves toward freer trade and investment, and indeed some Australian companies invest in farmland abroad. In an increasingly globalised world Australia needs to maintain this open-door spirit.

**DEREK BYERLEE** from Ororoo, South Australia, is an adviser and consultant to a number of international organisations. Formerly he was Rural Strategy Adviser for the World Bank and Co-Director of the 2008 *World Development Report: Agriculture for Development*. Before joining the World Bank he was Director of Economics at the International Maize and Wheat Improvement Center, Mexico, and Associate Professor at Michigan State University. He has worked extensively in Africa, Asia and Latin America, and published widely in several fields of agricultural development. He is a co-author of the recent book *Rising Global Interest in Farm Land: Can it Yield Sustainable and Equitable Benefits?*

## Crawford tackles the scramble for natural resources

The Crawford Fund's annual Parliamentary Conference in Canberra focused on global food security under the title *The Scramble for Natural Resources – more food from less land*.

A stellar panel of international experts surveyed the key challenge of how best to feed an extra 2 to 3 billion people over coming decades.

Professor Andrew Campbell, Director of the Research Institute for Environment and Livelihoods at Charles Darwin University, reported that delegates heard from Professor Jonathon Foley, University of Minnesota, that the world probably has enough land, nutrients and water in aggregate. But major distributional and degradation problems needed to be fixed if widespread famine and inequity were to be averted, he said. Recent food price spikes seemed likely to recur. Expert consensus was that the era of declining real food prices is over.

The conference heard that about 40 per cent of global food is grown not for people, but for animals and for fuel and – of the food produced for humans – up to 40 per cent was wasted.

Changing consumption patterns (increasing meat consumption with rising wealth in developing countries) was probably a bigger driver of food insecurity than population growth, but there were real limits to agriculture expanding its footprint, and the "scramble for natural resources" was an apt title.

Delegates heard that false dichotomies – urban vs rural, organic vs GM, food vs energy and forested vs cleared lands – were not helpful. With more than half the world's population now living in cities, the world

needed much more integrated approaches across whole landscapes and regions that sought to optimise multiple objectives.

The conference was opened by Senator Bob Carr, Minister for

Foreign Affairs. Sir John Beddington, UK Government Chief Scientific Adviser, presented the Sir John Crawford Memorial Lecture, titled 'Agriculture: the challenges of the 21st century'.

**Theme authors of this edition of Focus were among the presenters at the 2012 Crawford Fund Parliamentary Conference.**





# World-class environmentally sustainable research delivering positive outcomes.

In an era where environmental concerns surround the development and improvement of sustainable and just societies, the Zero Waste SA Research Centre for Sustainable Design and Behaviour (sd+b) at the University of South Australia is at the forefront of research and innovation to develop solutions and improve decision making in environmental sustainability.

Led by Professor Steffen Lehmann, the sd+b Centre's varied research programs and projects encourages local, national and international partnerships with government, industry, business and the community to promote environmental sustainability and the concept of waste as a valuable resource. With collaborative projects that span across the Asia-Pacific region the Centre aims to narrow the performance gap between what is technologically and behaviourally feasible in sustainable urban development and design to what actually happens on the ground.

One exciting project currently sees the Centre successfully collaborate with local South Australian government to produce food within a civic region. Here the goal is to ensure there is less waste of resources, which includes, using less water and pesticides and avoiding unnecessary transportation and packaging while mitigating the urban heat island effect.

The results from this project demonstrate how the use of left-over spaces for urban farming can reduce the creation of waste, avoid wasteful consumption and optimise material flows.

This project and the work of the sd+b highlight how research at the University of South Australia is continuing to transform and sustain communities by introducing intelligent, holistic solutions that helps society to make better use of natural resources.

The sb+d Centre's research in food production and sustainable living is directly providing real results that have a positive impact on society today and for future generations.

For more information about research at the University of South Australia visit [unisa.edu.au/research](http://unisa.edu.au/research)

*"Research into the use of unused urban spaces to create food production in the city, as pictured here, is helping to improve the use of resources and provide a positive impact on society today."*



**University of  
South Australia**



# The scramble for natural resources: how science can help

Science now needs to find a way to increase food productivity by about 50 per cent over the next four decades – without using more land and water.



By Frank Rijsberman  
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**T**oday, we are facing humanity's greatest challenge. The food price spikes that began in 2008, along with the ensuing scramble for natural resources that these sparked, have served as a massive wake-up call.

Declining agricultural yields, a drop in support for agricultural research, depleted natural resources and climatic changes are just some of the factors that have brought us to the brink of disaster.

If we are to feed future populations without destroying the environment further, we are going to have to learn how to do much more with much less.

The Food and Agriculture Organization of the United Nations (FAO) tells us that our world population is likely to grow from seven billion to more than nine billion by 2050, requiring about a 70 per cent increase in food production. Another FAO estimate indicates that at least 75 per cent of that increase will have to come from land already being used for agricultural purposes.

Science now needs to find a way to increase food productivity by about 50 per cent over the next four decades – without using more land and water. Such an increase is likely to come from the people who currently experience low yields: small-scale farmers in developing countries, the majority of whom are women. And science needs to help them achieve those increases in a climate-smart way.

So this is the focus and mandate of publicly funded agricultural research, and the largest group of researchers in that arena come from the Consultative Group on International Agricultural Research (CGIAR).

So is it possible?

Absolute yields of key cereals have increased steadily over the past five

decades, but since these increases have to feed an ever-increasing population, the percentage increase has actually gone down from about three per cent to slightly more than one per cent. And that's not enough to sustain future populations.

In addition, there is every indication that the yields for rice, wheat and maize are beginning to level off, posing a far greater challenge for us if we aim to build on and increase that productivity.

These relative decreases in productivity can be traced back to the Green Revolution of the 1960s and 1970s. By working with researchers from the International Maize and Wheat Improvement Center (CIMMYT), Norman Borlaug helped develop semi-dwarf, high-yielding varieties of cereal grains which, together with increased fertiliser use and massive investments in irrigation, led to the doubling of yields and abundant supplies

of cheap food in Asia, Latin America, the Near East and the Middle East. Billions of people escaped starvation, but the increased yields also led to complacency, neglect and a drop in support for agriculture.

But we can improve these productivities.

## Closing yield gaps

If we look at some of the results coming out of the International Water Management Institute (IWMI), a CGIAR member centre, and the work it is undertaking with the CGIAR Challenge Program on Water and Food in a number of major river basins, we will see that water productivity is very low in these areas. The current cereal productivity in almost all of these basins, which together are home to more than a billion people and more than 50 per cent of the poorest people in the world, is between 0.2 to 0.5 kilograms against a potential of 1 to 2 kilograms per cubic metre of water

PHOTO: IRRI



A Filipina farmer with heirloom variety rice.

used. As such, there is a huge potential to intensify agriculture in these areas.

CGIAR has the scientific know-how to close some of these yield gaps, and not just in terms of water. For example, the International Rice Research Institute (IRRI), another CGIAR member centre headquartered in the Philippines, has paddy fields on its extensive campus that have been producing three crops of rice a year, with each crop yielding about seven tonnes, for a total of 21 tonnes of rice per hectare from the same piece of land. Of course these crops are cultivated under ideal conditions – fertile soils and plenty of water, coupled with a meticulous crop-management strategy.

Outside the gates of IRRI, farmers get only two crops of about four tonnes each per hectare per year, which means eight tonnes rather than 21.

In Africa, the smallholders who grow rice in rain-fed upland valleys might get as little as one crop of two tonnes per hectare per year. However, such a situation does have potential.

Those farmers might have problem

soils, no access to fertiliser, or no money to buy fertiliser. They might not have seed companies bringing them new seeds, or roads to take their product to market. Their governments might not have extension policies that can help them be part of the value chain that could enable them to process their rice. But this does mean that there is a whole series of things that we can do to help, none of them necessarily easy.

Of course, just because the yields are only two tonnes doesn't mean that we know how to increase them immediately. Many of the low yields in Africa are caused by disease. So we need to use science to help develop new crop varieties that are disease resistant. This will require a constant effort, but we do take hope from knowing that there is a crop yield gap, and that there is tremendous potential in science today to help us close it.

#### The potential?

Two trends are having a big impact on science for tomorrow's agriculture.

First, there is the life science revolution that is being propelled by

molecular biology, which has, over the past decade, changed the way our scientists do business, both in their CGIAR centres and with their partners.

Then there is the IT revolution, which is relevant even today, not just to Australian farmers, but also to smallholder farmers. For example, laser land levelling, which offers great potential for water savings and higher grain yields, is becoming increasingly popular with farmers everywhere. More and more farmers are also using mobile phones to access extension services and market information.

With the help of countries such as Australia, which is supporting publicly funded research in agriculture, CGIAR is ready to take advantage of these and other scientific opportunities. IRRI, for example, has received a large grant from the Australian Centre for International Agricultural Research (ACIAR) to build new labs and buy new equipment.

CGIAR doesn't have a separate program on genetic research, but genetics certainly cut across all of our programs. Molecular breeding

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forms the basis of much of the work carried out today by our 15 centres.

In almost all of the centres, the application of molecular breeding to understand the genetic diversity in our gene banks was just a dream 10 years ago, but today it's a reality. Centres like IRRI are now not only breeding plants that have a higher productivity or are disease resistant, but they are also breeding plants that are resistant to abiotic stresses, which wasn't possible 10 years ago.

One of the key genes discovered by IRRI enables rice to be submergence tolerant. Almost all the hybrid rice varieties today have incorporated this gene and are available to farmers on a wide scale.

To date, CGIAR has developed more than 7000 improved varieties and released them as public goods. Worldwide, 60 per cent of all land planted with improved varieties includes varieties produced from CGIAR centres.

Australia, which ranks among the world's top 10 wheat-producing countries, devotes as much as 98 per cent of the area sown to wheat in the country to varieties developed by CIMMYT.

CGIAR is also the custodian of very large collections of plant genetic material with the necessary diversity on which we can build.

We also need more holistic approaches that span from the microscope to the marketplace – approaches that not only integrate the latest science and technology to breed better varieties, more quickly, but also use effective strategies to get those varieties to small-scale farmers.

### CGIAR research

CGIAR research puts real benefits into farmers' hands. And we are getting better at making sure that our innovations reach the farmers who need them.

We understand how to influence real people, and not just by increasing productivity. In recent years, for example, we have focused on growing more nutritional crops. Many of our impact stories can be found on the CGIAR website ([www.cgiar.org](http://www.cgiar.org)).

PHOTO: CGIAR/ILRI STEVIE MANN



Harvesting sorghum in India.

Although the food price spikes in recent years have led to a scramble for natural resources, they have also put food security back at the top of the agenda. We certainly feel that science can help grow more food using less land and less water, thereby limiting our natural resources footprint.

CGIAR has a promising agenda that harnesses the potential of science. We are also pleased that our work benefits Australia and are very grateful that Australia is a strong supporter of international research and agriculture through ACIAR and AusAID.

DR FRANK RIJSBERMAN has more than 30 years' experience as a researcher and consultant in natural resources management in developing, transition and developed economies. He is CEO of the CGIAR Consortium. He moved to the role in May 2012 from a position as the Director of the Water, Sanitation and Hygiene Division of the Bill & Melinda Gates Foundation. Prior to that he led Google's philanthropic team after serving as Director-General of the International Water Management Institute (IWMI) (one of the 15 CGIAR Consortium Research Centres) from 2000–07. At IWMI he initiated the comprehensive assessment of water management in agriculture and developed and led the Challenge Program on Water and Food.

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# The slumbering giant: land and water degradation

The dramatic growth in food production has largely been achieved by two billion small-scale farmers who feed themselves and produce surpluses for local markets.



By Andrew Noble  
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**T**his year – the Australian Year of the Farmer – is a year in which we acknowledge the contribution that our farming communities have made to putting food on the tables of Australians and others far from these shores.

Over the past 50 years, Australian farmers and other farmers, predominantly small-scale, have kept pace with global food demand and contributed to decreasing the proportion of people in the world that go hungry, despite a doubling of the total global population. This is an incredible achievement by any measure.

It is often not recognised that this dramatic growth in food production has largely been achieved by two billion small-scale farmers, who, in addition to feeding themselves, also produce surpluses for sale in local domestic markets. These domestic markets, along with the food consumed by the farmers and their families, constitute more than 70 per cent of the world's food consumption and are often overlooked in the food security debate. They are the current engine of global food production.

While the importance of farmers and their production systems to overall global food security is understood, the ability of these systems to continue to perform this function, along with increasing output to meet future demand, is questioned.

Yield stagnation and, in some cases, the decline in several of our grain-production systems, is a concern for those charged with ensuring future global food supplies. Human-induced land and water degradation and associated provisioning of ecosystem services (that is, benefits from a multitude of resources and processes that are supplied by natural ecosystems) threaten the integrity of both small and large farming systems and their ability to meet future food demand.

Soil erosion, nutrient depletion, desertification, groundwater and surface water pollution, and loss of biodiversity are just some of the challenges that have confronted agricultural and urban communities for decades. Yet, addressing these issues continues to elude us.

Why is land and water degradation

considered a 'slumbering giant'? As the significance of these problems and the challenges associated with reversing them are enormous, they receive little attention on the global agenda and have considerable implications for future food supplies.

Our goal as a global community should be to address these issues head-on and ensure that the 'slumbering giant' does not awaken.

## All is not well

There is clear evidence to suggest that human activities have pushed the Earth's systems outside their stable environmental state, with consequences that could lead to irreversible and, in some cases, abrupt environmental change. That, in turn, could lead to conditions that restrict global growth.

Indeed, recent evidence suggests that we have exceeded three of the nine 'planetary boundaries' that ensure our planet's survival. Climate change, rate of biodiversity loss and the nitrogen cycle, all of which have strong linkages to the agricultural sector, are now thought to be beyond the stable state for maintaining healthy ecosystems.

Sadly, the success of our agrarian sector has been a major player in contributing to the breaching of these boundaries. This has occurred through our insatiable consumption of nitrogenous fertilisers and the use of nitrogen-fixing legume species; a dependence on fossil fuels and the massive changes in vegetation cover associated with land clearing for agriculture, thereby contributing to increasing greenhouse gases in our atmosphere; and the loss of biodiversity and of mass species extinction.

The litany of issues that confront us with respect to land and water degradation, globally, are well documented and portray a dismal assessment of the impact of agriculture (Box 1).

### Box 1 The impacts of human-induced land and water degradation

Globally, approximately 25% of all land is classified as being highly degraded, with a mere 10% being classified with improving conditions.

More than one billion hectares is affected by water erosion.

Approximately 549 million hectares (M ha) of land suffer from wind erosion.

Approximately 34 M ha of the global irrigated area is affected by salinisation, representing a significant lost opportunity and underutilisation of investments in infrastructure.

It is estimated that 25% of the global freshwater storage capacity will be lost in the next 25 to 50 years, unless measures are taken to control sedimentation in reservoirs.

Approximately two million tonnes (M t) of waste is dumped into rivers, lakes and wetlands each day, causing eutrophication, and hypoxia and algal blooms.

It is estimated that there are now 12,000 cubic kilometres of polluted water on the planet, which is a volume greater than the contents of the world's 10 biggest river basins.



The degradation issues highlighted above are not exhaustive, but represent the major challenges that we face in land and water degradation as we move into an era where stability in the Earth's systems will be the exception rather than the rule. In short, the catalogue of land and water degradation issues that confront us all contribute to diminishing the ability of vital ecosystems and landscapes to support functions and services required to sustain mankind.

### A wicked problem

The issue of land, and we should include water, degradation has been described as a 'wicked problem' by the Australian Public Service. Wicked problems commonly have the following attributes, they:

- are difficult to define;
- have many inter-dependencies and are often multi-causal;
- often lead to unforeseen consequences when addressed;
- are often unstable;
- usually have no clear solution;
- are socially complex; and
- often involve changing of behaviour.

Climate change and obesity are similarly classified as wicked problems, and one could argue that the challenges in managing the Murray–Darling Basin would also fall into this category.

While the term 'wicked' conjures up in the mind a sense of hopelessness or despair in resolving the problem, as a community we should see the issues as a challenge that will require science, policy and politics to address them. We should not simply accept that there are no solutions because it is a wicked problem.

There is cause for cautious optimism that the tide may be slowly turning. An analysis of 40 projects and programs in 20 countries in Africa, where sustainable intensification was developed during the 1990s and 2000s, has revealed some interesting insights into the impact of these interventions.

By early 2010, these projects had produced documented benefits for more than 10 million farmers and their families and improvements on approximately 12.75 million hectares, an area 54 times the

PHOTO: NADIA MANNING, IWMI



Tomatoes on sale in a Uzbekistan market.

size of the Australian Capital Territory.

Food supplies from sustainable intensification have been multiplicative (that is, yields per hectare have increased by combining the use of new and improved varieties, and new agronomic/ agro-ecological management) – crop yields rose, on average, by 2.13-fold – and additive (diversification has resulted in the emergence of a range of new crops, livestock or fish that have added to the existing staple crops or vegetables already being cultivated).

Furthermore, there are opportunities to reverse the impacts of land and water degradation. Take, for example, salinisation of irrigated land. We, as land and irrigation managers, have resigned ourselves to the fact that an accepted consequence of irrigated agriculture is salinisation and, in extreme cases, land abandonment, particularly when practiced in semi-

arid and arid regions. However, there is significant potential in bringing these salinised areas back into production to contribute to meeting future food demand and to also prevent further salinisation.

To place this in perspective, one could theoretically estimate the foregone yield associated with land retirement in irrigated command areas due to salinisation. Assuming that the 34 million hectares of currently affected salinised land were brought back into production to yield a conservative annual production potential of four tonnes of grain per hectare, the potential production generated would be 136 million tonnes of grain annually – about 20 per cent of the global wheat yield in 2010–11.

At current wheat prices of US\$314 per tonne, the potential increase in production associated with rehabilitation of these

**CONTRIBUTIONS  
ARE WELCOME**

**Opinion pieces on technological science and related topics, preferably between 600 and 1400 words, will be considered for publication.**

**They must list the full name of the author, if a Fellow of the Academy. Other contributors should provide their full name, title/role and organisation (if relevant) and email address.**

**Please address to [editor@atse.org.au](mailto:editor@atse.org.au)**

lands would realise an economic windfall of US\$42.7 billion on an annual basis.

Finally, it makes sound economic sense to address this 'slumbering giant' of degradation. This can be achieved through the promotion of more conservation-oriented approaches to land and water degradation, which promotes sustainable intensification of our production systems, and the rehabilitation of land and water resources through investments.

In the latter case, the example of bringing irrigated salinised lands back into production makes sound economic sense that will contribute to meeting future global food demand.

Technologies, technology packages and management practices, which demonstrate

the practicalities of addressing these resource degradation issues, have been developed.

However, adoption of these interventions at scale has been disappointing.

The central challenge facing government institutions, and development and research organisations tasked with sustainably securing future food supplies, are developing greater insights into constraints inhibiting adoption of productivity-enhancing and conserving interventions, and identifying the drivers and relevant levers to address these constraints.

We should not leave it to these bodies to ensure that this happens. As a community, we should take responsibility in doing our bit to make it happen and ensure that the 'slumbering giant' does not awaken.

Senior Fellow with the International Water Management Institute (IWMI) based in Colombo, Sri Lanka, DR ANDREW NOBLE was formerly the Research Program Manager for the Land and Water Resources program of the Australian Centre for International Agricultural Research (ACIAR) and formerly Regional Director for IWMI for South-East and Central Asia. He has also held roles as Principal Research Scientist with CSIRO Land and Water; Project Leader and Principal Research Scientist with the Institute for Commercial Forestry Research; and lecturer in the department of Crop Science, University of KwaZulu Natal, South Africa. His research career in agriculture spans more than 30 years and includes research and academic assignments in South Africa, Australia and South-East and Central Asia.

## Australia should lead action on soil crisis

Australia should lead a renewed global effort to reverse the alarming degradation and contamination of the world's food-producing soils, according to soil scientist and soil science prize winner Professor Ravi Naidu.

The Managing Director of Australia's CRC for Contamination Assessment and Remediation of the Environment (CRC CARE) and this year's recipient of the International Soil Science Award, presented annually by the Soil Science Society of America (SSSA), Professor Naidu said global estimates of the amount of agricultural and pastoral soil lost each year range from 75 to 100 billion tonnes.

"That's over 10 tonnes a year for each person on Earth," Professor Naidu said. "Furthermore, a satellite study by the United Nations Food and Agriculture Organization (FAO) revealed about one per cent of the world's farm land has been lost every year for the past quarter century. Such rates of degradation are completely unsustainable and risk exhausting the world's food-producing soils within two to three generations."

Professor Naidu said soil loss and contamination was a 'sleeping giant' among various threats to global food security – and had suffered international neglect for decades.

"Millions of tonnes of soil can be lost in minutes in a bad storm or flood event, as we saw only last year in Australia – and as America has just experienced. Yet new soil takes from thousands to millions of years to form."

Professor Naidu said the FAO's most recent *State of the World's Land and Water Report* (SoLaW) had highlighted that more than half the Earth's land surface was now degraded – while only 10 per cent of it was improving.

"While Australia may have a food surplus, we can still be affected by very

high global food prices, by refugee floods, and trade and conflict issues which may arise out of the collapse of farming systems in other parts of the world.

"If we want to mitigate those risks, both to ourselves, to others and to global stability, we need to apply our high levels of skill and knowledge in managing soils to more international as well as to Australian challenges."

Professor Naidu said he was delighted at the recent announcement by Prime Minister Julia Gillard of an Australian Working Group on Water, Soil and Food headed by the former Governor-General, Major-General Michael Jeffery.

"I strongly commend the Government for this forward-looking move, which is part of the \$700 million 'sustainable agriculture' stream in the next phase of the Caring for our Country program. It shows real leadership regarding soils issues in Australia.

"Australia's soils are old, leached and low in organic matter and excessive cultivation can impact what's called the critical zone – the soil lying between the plant and the groundwater table. Once soils in this zone are depleted, it is not possible to replenish them. Also, a significant proportion is now affected by salinity. All this is relevant to domestic food security.

"However, we must also recognise that Australia will not be secure if the world as a whole is food-insecure. We are connected to the world, especially to Asia, where soils face major pressures.

"There is an opportunity not only for Australia to help its neighbours deal with an seriously intractable problem, but also to generate substantial new export income around smart technologies for overcoming soil, water and environmental problems associated with agriculture."



Ravi Naidu getting into soils research.



# Helping farmers innovate to harvest more from less

Our highest priority has to be to improve resources, systems and methods of extension around the world in order to make better use of what we already know.



By Trevor Nicholls  
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To feed a global population rising from seven billion now to nine billion by 2050 we must make the same level of agricultural productivity increase in the next 40 years as we have achieved in the previous 12,000.

This must be achieved in the face of a perfect storm of rising energy prices, dwindling mineral resources, a shortage of water and climate change.

Simply increasing the area of agricultural land is no longer an easy option, with increasing demands to use land for housing, mining, reservoirs, recreation or national parks. Nor are we working on a level playing field – rising incomes around the world increase the demand for meat and dairy products, requiring higher inputs of fodder and water per calorie or kilogram produced, while increasing overall greenhouse gas emissions.

Furthermore, yields from current varieties of rice, wheat and maize could decline significantly, particularly in the tropics, if the predicted rises in temperature materialise.

To achieve food security at household, community or national level we can seek to either produce more food or to buy more. In relation to producing more, there are two sides to the equation – to grow more and to lose less.

If farmers earn more they can improve their diet by buying a wider variety of food, and can also weather supply shocks. The focus of most research effort is on finding ways to grow more and this will be essential to meet the challenge, albeit that these gains will be in the longer term.

However, we lose an average of 40 per cent of what we already grow to pests, weeds and diseases – we already have much of the knowledge needed to reduce these losses and this can give us some valuable

quick wins in the war on hunger.

Biotechnology may, in the future, deliver crops with greater tolerance of heat and water stresses, resistance to pests or saline conditions or even enable the fundamental re-engineering of nutrient content, nitrogen fixation and photosynthetic efficiency in some crops.

Recent advances and cost reduction in sequencing now make it possible to accelerate the introduction of desirable traits through traditional plant breeding techniques that have been used for hundreds of years. Instead of patiently making crosses and waiting to see if the resulting plants have the desired characteristics when they grow, we can now identify the genes responsible for the desired traits and check whether they have been brought together in the breeding process by using molecular markers.

Work by the World Vegetable Centre (AVRDC) on products such as tomato and eggplant show how many of the desired characteristics of stress tolerance, nutritional quality, flavour

and appearance can be achieved through more conventional breeding approaches.

In seeking to reduce crop losses, it is essential to take a systematic approach, taking into account the soil conditions, environment, pests and weeds around a crop, as well as site selection, crop husbandry, storage and transport to market. Integrated crop management practices must be rooted in a good understanding of interactions between

PHOTO: SVEN TORENN, PANOS PICTURES



Plantwise plant clinic during market day in the village of Wangigi, in the Kikuyu district of Kenya.

Plantwise disseminates and gathers knowledge in two ways: locally, via a network of plant clinics in the developing world, to help the poorest farmers by diagnosing plant health problems and giving them a suitable 'prescription'; and globally, via a knowledge bank of data and information ... Plantwise has already trained more than 1000 plant doctors, supporting 354 plant clinics in 24 countries.

biology, land management and the broader landscape to ensure that agricultural practices are sustainable and serve as a foundation for future generations.

CABI is one of nine organisations forming the Association of Independent Research and Development Centers for Agriculture (AIRCA), which seeks to develop and promulgate approaches to the creation of healthy landscapes.

In much of Africa and Asia there are large gaps between actual and optimum yields for most crops. In closing these, we need to use water as a very precious resource, promote better soil health and reduce the losses due to pests and diseases.

There are already many well-known technologies and approaches in all of these areas:

- mulching, drip irrigation, greywater and alternate wetting and drying (for rice) to reduce water usage;
- micro-fertilisation, manure, composting, crop rotation and use of legumes to promote better soil health; and
- integrated pest management, cultural techniques and biological control to minimise the use of chemical pesticides.

Despite this, many farmers in the developing world are not aware of these techniques or have not adopted them. If we are to meet the food security challenge over the next 50 years our highest priority has to be to improve resources, systems and methods of extension around the world in order to make better use of what we already know.

### Effective technology adoption

Extension in the developing world often takes the form of a face-to-face farm visit by an extension worker or relies on the use of mass media channels such as advertising in newspapers. The former has high impact but limited reach since the number of extension workers is low and farms may be far apart, while newspaper or radio campaigns can reach a lot of people but tend to be non-specific and have low impact.

CABI and others have been looking

at ways to increase the reach of extension services whilst still maintaining the impact of their messages.

In Bangladesh, we have used community videos, made by the women of the villages themselves, to spread the word of best practices and new techniques for identifying quality seed, drying it and storing it for future harvests.

In Africa, with funding from the Bill and Melinda Gates Foundation, we have set up the African Soil Health Consortium as a communication platform to make knowledge on soil health available to extension workers, agro-dealers and farmers.

In India, in a partnership with the leading mobile network operator (Airtel) and fertiliser supplier (IFFCO), we have supported a mobile agro-advisory network serving four million subscribing farmers with voicemail messages on a variety of relevant topics including weather, market information, pest alerts and crop management advice.

Plantwise is a major initiative, led by CABI with financial support from donors in the UK (DFID), Switzerland (SDC) and Australia (ACIAR), to bring better knowledge and advice to farmers on pests and diseases to reduce losses and improve quality. Plantwise is disseminating and gathering knowledge in two ways:

- locally, via a network of plant clinics in the developing world, to help the poorest farmers by diagnosing plant health problems and giving them a suitable 'prescription'; and
- globally, via a knowledge bank of data and information that supports the clinics but also aggregates and analyses their observations.

The clinics are run by local extension staff, so they use existing resources but are able to have high-impact interactions with many more farmers. Plantwise has already trained more than 1000 plant doctors, supporting 354 plant clinics in 24 countries. By 2016 CABI is targeting to expand coverage to more than 40 countries and 1000 clinics.

### Supporting farmers

Farming is sustainable when the farmers make a living that motivates them to stay and farm rather than seeking their fortune in the cities. Improving smallholder productivity is essential for increasing food supply, but we must also enable them to farm as a business.

We help connect farmers to markets and get a fairer share of the value they create. For example, in Tanzania we have helped tomato growers implement integrated pest management (IPM) techniques to reduce pesticide residues, develop branding for their produce and establish producer clubs so as to sell into higher value markets.

In the implementation of innovation, partnerships with the private sector will be essential. At the simplest level, new seeds, inputs or technology must be available to farmers through local agro-dealers at reasonable prices and in appropriate package sizes. Even then the initial cash outlay and financial risk may seem too much for a small farmer.

By reducing acquisition and transaction costs, as well as offering novel methods of payments – such as m-PESA, a mobile money transfer service ('pesa' is Swahili for money) – mobile technologies are stimulating innovation by making novel offerings of micro-credit and crop micro-insurance possible.

Meeting the challenge of feeding a growing population will require farmers to produce more from less. This is not just about funding agricultural research focused on growing more. If we are to succeed we must enable innovation through better methods of disseminating technology, learn what works and what does not and integrate this within a framework of supportive economic and environmental policies.

DR TREVOR NICHOLLS has been Chief Executive Officer of CABI since 2005, during which time CABI has developed a strategic focus on providing knowledge to enable poor rural farmers in the developing world to grow more, raise quality and increase income. CABI is leading Plantwise, a global initiative to increase food security by reducing losses to pests and diseases. Previously, his career covered experience of building international businesses in the genomics and life science industries serving major pharmaceutical, biotech and academic clients. He has broad experience of initiating change and restructuring organisations, ranging from start-ups to quoted companies.



# More than one way to view urban impact on agriculture

Blaming urban planning for urban sprawl, or expecting it to solve the problem alone, might be missing the root cause of the symptom.



By Xuemei Bai

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**W**hen the term urbanisation appears in the agriculture and food security debate it is almost always as a problem or culprit, due to the fact that urbanisation often entails a spatial extension of urban land use, and this often comes from agricultural land.

In reality, the interaction between cities and agriculture is far more nuanced and complicated, with both negative and positive aspects, and requires an integrated approach instead of the current urban-rural divide in our research and policy making.

We are experiencing an unprecedented transition in human settlement through rapid urbanisation. Already more than half of the world population is living in cities. UN projections show that by 2030 an increase in urban population of 1.35 billion is expected, and if we extend that to 2050, almost all of the additional population on Earth, which is about 3 billion, will translate directly into additional urban population.

Currently, about one per cent of Earth's surface is urban and some forecast this will triple by 2030. Much of this newly established urban land might come from agricultural land, due to the co-location of cities and agricultural production.

Most of the fast-growing cities are located in the developing world and there are several 'hot spot' regions in terms of rapid urban growth – China, India and sub-Saharan Africa. This means there will be a very strong pressure on food production concentrated in these most populated and often vulnerable regions.

In China, for example, up to 80 per cent of agricultural land loss over the past decade is due to conversion into urban areas. Between 1997 and 2006, more than 12,000 square kilometres of land was converted into urban built-up area. This is of strong concern as China is currently supporting

its population on less than one-third of the world's average per capita arable land.

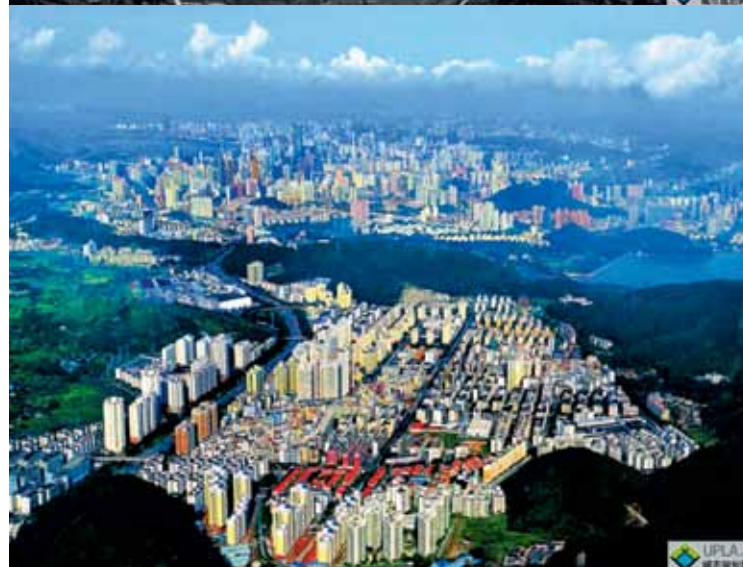
Considering the fact that cities are often located in some of the most fertile agricultural area in the world, the impact on agriculture can be larger than the amount of arable land loss might indicate.

Addressing the issue of urban land expansion and preserving agricultural land is not an easy task. Our research shows

that in China, urban land expansion is not only the consequence of economic growth in cities, but also a driver of such growth.

It might be very difficult for China to try to control urban land expansion without sacrificing economic growth. This also means China's policy of stopping the loss of agriculture land for food security might be seriously challenged by its own policy of trying to promote economic

PHOTOS: URBAN PLANNING NET, CHINA



Urbanisation in China – the difference 25 years makes – in Shenzhen.

development through urbanisation.

With the presence of such a fundamental mechanism and high-level policy conflict, blaming urban planning for urban sprawl, or expecting it to solve the problem alone, might be missing the root cause of the symptom.

In addition to direct impact on arable land, urbanisation brings about various indirect impacts on agriculture and rural communities. The social impact of landscape urbanisation is mixed. Land-use changes associated with urbanisation in developing countries are found to increase social vulnerability in traditional farming communities in peri-urban areas. In other areas, where the locals could seize the opportunity of a growing major city, they have achieved a tremendous increase in social and economic capital in peri-urban areas.

Sansheng County, which is a peri-urban county near the rapidly growing city of Chengdu in China, has transformed itself from one of the poorest and most vulnerable areas into a prosperous peri-urban hobby agricultural and eco-tourism centre, achieving more than a doubling in per capita income and a 24-fold increase in local tax revenue from 2002–06.

Urbanisation often entails an increase and change in food demand. Dietary changes, manifested by the rapid expansion of fast food industry in cities, has increased the demand for meat, fish and dairy products. This in turn drives a structural shift in food production, such as the need for increased animal feed. Lifestyle change in some cities has brought about significant increase in hobby farming demand in peri-urban areas, an incentive for farmers to shift away from crop production.

Our recent research suggests that urbanisation might contribute to an enhanced productivity, although this remains as a hypothesis that needs to be tested through more rigorous research.

In short, what happens in agriculture might actually largely be driven and determined by what happens in cities. Most of the literature on food security without fail blames cities as one of the culprits for affecting food security, but simply blaming cities for food security doesn't work or help.

Despite the strong and multipronged linkages, cities are largely ignored in sustainable food production research and policy making. Such a siloed approach is reciprocated – within the urban

development sector barely any attention is paid to agriculture or food security concerns.

Clearly there are opportunities as well as challenges brought about by urbanisation. The question then becomes: how can we harness and maximise the positive effects of urbanisation and avoid and/or compensate for the negative impacts? The first step towards effectively answering this question might be abandoning the dichotomised approach in urban-rural or urban-agriculture research and policy making. ▀

**PROFESSOR XUEMEI BAI** is Professor in Urban Environment and Human Ecology, Fenner School of Environment and Society, ANU. Her work focuses on urbanisation and the environment, urban system function and processes, urban environmental governance, cities and climate change, and innovative urban practices and urban sustainability transition, mostly in Asia. She is Vice Chair of the Scientific Committee of the International Human Dimensional Program for Global Environmental Change; Board Member of Sustainable Urban Systems Chapter in the International Society of Industrial Ecology; and a Foreign Expert Member of the Task Force for Western Region Development under the China Council for International Cooperation for Environment and Development.

## CSIRO and Google boost land management data

Detailed satellite imagery about Australian landscapes will soon be only a button push away for land managers in community and non-profit sectors through a partnership between Australian scientists and Google.

According to CSIRO Principal Research Scientist Dr Alex Held, Director of the Terrestrial Ecosystem Research Network's (TERN) AusCover facility, the partnership aims to provide greater access to and international reach of Australian science.

"CSIRO and TERN researchers will be able to use Google's enormous cloud computing power to contribute their expertise and environmental data to deliver easy-to-use maps and tools for millions of users world-wide," Dr Held says.

One of the tools to be made available in Google's Earth Engine will be a vegetation monitoring tool. It will enable land managers to see if vegetation is in a healthy condition or being impacted by pests, diseases, fire or feral animals.

"For land managers to manage landscapes effectively, they need to be able to monitor, measure and understand changes," Dr Held says.

"For decades Australian researchers have

been refining the use of satellites for observing the Earth and have combined this with expert field data and environmental models to contribute to landscape management. Similar vegetation-mapping tools and satellite data are already in use, for example by the Australian forestry industry, and now through this partnership with Google we can make them more widely available to non-profit and community groups world-wide.

"This really is about making people's jobs easier as they can access and process data in a matter of minutes to pinpoint potential issues and figure out the best action to take to investigate and respond without having to spend time and money with random surveys of huge tracts of land."

The first of the new data tools are being tested in Google Earth Engine and are due out early next year. Combined with data already freely available via CSIRO and the TERN data portal, over the coming months and years, Google Earth Engine will provide unprecedented capability in use of satellite observations for all sorts of environmental management, conservation and landscape science projects.



Dr Kasper Johansen (right), AusCover Science Coordinator at UQ, prepares a terrestrial laser scanner to measure vegetation structure at a rainforest site in north Queensland.

PHOTO: SUZANNE LONG, TERN



## Fellow helps launch BoardLinks

Telstra Chair Ms Catherine Livingstone AO FTSE was a key speaker at the launch in Sydney in November of BoardLinks, a network being established to form better connections between the Australian Government and women seeking board positions. Launched by the Finance Minister, Senator Penny Wong, BoardLinks is particularly focusing on board-ready women seeking their first board appointment.

It plans to address one of the most significant hurdles to female representation – that many boards require prior board experience as a prerequisite for appointment and, with women holding so few board positions, this situation is self-perpetuating.

BoardLinks will focus on strategies to ensure women, who are otherwise skilled and experienced, gain their first board appointment and also provides links to affiliated organisations that are working to assist women to move into leadership roles at the board level.

Ms Livingstone is one of five BoardLinks Champions along with company director David Gonski AC, Westpac CEO Gail Kelly, ASX CEO Elmer Funke Kupper and business and community leader Carol Schwartz AM.

Ms Livingstone has been a Fellow since 2002 and delivered the keynote address at the 2012 ATSE Clunies Ross Awards.

## PARTNERS TO SEEK MORE WOMEN ENGINEERS

The University of Queensland is appointing a new staffer dedicated to improving gender balance in engineering studies.

A partnership between UQ, Rio Tinto, the Australian Power Institute (API) and the Australian Petroleum and Exploration Association (APPEA) will address the shortage of female students enrolling in engineering programs at UQ through the establishment of a new UQ position – the Women in Engineering Development and Communications Manager.

UQ Faculty of Engineering, Architecture and IT Executive Dean Professor Graham Schaffer FTSE said both the university and the engineering profession would benefit greatly from a more equitable gender balance of qualified engineers.

Rio Tinto, API and APPEA have each invested \$250,000 over five years to provide UQ with financial support to increase female enrolments.

The national average for female students commencing study within engineering is 12 to 14 per cent, while the UQ figure is 19 to 20 per cent.

“Although UQ is already above the national average for undergraduate female engineering enrolments, we know that we are not at world’s best practice and that there is still much to be done,” Professor Schaffer said.

“Our data shows that female students, on average, have higher retention rates once they have commenced their engineering degrees in comparison to their male peers. The challenge we face as an educational institution is therefore the recruitment of women into

engineering programs, not retention.”

Rio Tinto Energy Vice President Human Resources, Rosemary Fagen, said diversity and inclusion were great attributes to pursue in any organisation. “Rio Tinto has a global target to increase the number of female professional engineers across the Group. We look forward to seeing improvement in the gender balance of qualified engineers as a result of this initiative with UQ,” she said.

APPEA COO Eastern Region, Rick Wilkinson, said the proportion of degree-qualified female engineers in the Australian labour force last year was just 12.7 per cent. “That figure needs to rise. Female engineers are an essential part of any technical team if it is to have the full depth required to compete in today’s globally competitive markets,” he said.

Chief Executive Officer of API, Michael Griffin, said the partnership with UQ would provide the ‘best practice model’ for other universities, both nationally and internationally, to follow. “The university will share its processes and resources developed through this program with other universities, in order to promote engineering to young females, with the objective of increasing the proportion of women in engineering on a national basis,” she said.

**Applications for the \$71,000 to \$78,000 positions closed 5 November.**

## ‘BEST OF THE WEST’ WINNERS NAMED

Women in engineering, science, mathematics and technology were recognised at the Arrow Energy Best of the WEST (Go Women in Engineering Science and Technology) awards held at the University of Southern Queensland. The awards highlight and showcase female achievement in areas that are typically male-dominated, with nominations from industry, business, school and university sectors.

“The awards are an opportunity for schools, business and industry to promote high-achieving females and their equity programs and provide role models of women who are or have the potential to be high-achievers,” said Go WEST project leader Dr Petrea Redmond.

Guest speaker was Jo Kirby, Chair of Women for Engineering Queensland and Ambassador and Mentor Program Coordinator on the Power of Engineering Committee, a program for female students in Years 9 and 10 to experience first-hand what an engineering career is like.

An industry sponsor – Arrow Energy – supported this year’s awards and a new award was added – the Arrow Energy Brighter Futures Award. The award aims to encourage women with children to return to study in the fields of science, technology, engineering and mathematics (STEM) and was won by Maryborough resident Claire Barsby.

Award categories included secondary school and USQ students, professional and business groups, partnerships and a USQ Indigenous award.



At the Best of the WEST awards (from left) guest speaker Jo Kirby, Skills and Training. Coordinator for Arrow Energy, Julie Lockyer, and USQ staff member and Go WEST executive member Jacqui McDonald.



Catherine Livingstone delivers the 2012 ATSE Clunies Ross keynote address.

# ACOLA projects a real opportunity for ATSE



Gas mining at Moomba, South Australia.

PHOTO: ISTOCK

One of the Academy's most exciting challenges has resulted from the developments associated with the announcement by the Australian Government in June of an ARC LASP grant of \$10 million to the Australian Council of Learned Academies (ACOLA).

The purpose of the grant was to give the Chief Scientist and the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) a strong evidence base on which to recommend new policies aimed at securing a strong, fair and productive future for Australia.

Since the inaugural briefing by the Chief Scientist, the Presidents of the four Learned Academies have established a Program Steering

Committee (PSC) – chaired by incoming ATSE President Dr Alan Finkel AM FTSE – to guide the program, titled *Securing Australia's Future*.

The PSC includes several Fellows – Professor Michael Barber FTSE, Dr Margaret Hartley FTSE, Dr Graham Mitchell AO FAA FTSE, Dr Jim Peacock AC FRS FAA FTSE and Professor Susan Pond AM FTSE.

This work will be valuable to Government and demonstrates the combined strength of the Learned Academies and the substantial public good that can flow from their working more closely together.

Dr Finkel says a major challenge for

Government is to identify mechanisms that will move Australia to a future that maximises the development and application of resources and capabilities in areas where the country has (or can rapidly develop) competitive advantage and minimises its effort in areas where other countries do better.

"Government has a crucial role in providing for the future by developing policy frameworks that promote creativity, avoid unhelpful constraints, and encourage Australians and their institutions to be bold, innovative and adaptive in preparing for the wide variety of changes in both domestic and global environments that we will face as a nation.

"ACOLA is particularly well-placed to draw on expertise and networks of the Learned Academy Fellows to consider how these complex and diverse challenges can be addressed, and ensure the nation's decision-making system is properly informed by the best available research."

The work will be conducted across six projects, each headed by an Expert Working Group (EWG). Each will report progressively across the next three years, with the first interim report due in November and the last in July 2015. Our Fellows provide a strong representation on these EWGs.

Mr Peter Laver is Deputy Chair of **Project #1 Australia's comparative advantage** and Mr David Hind is a member of the EWG for **Project #2 STEM: Country comparisons**. Professor Chennupati Jagadish is Deputy Chair of **Project #3 Asia literacy – language and beyond**, with Professor Mark Wainwright as a member.

ATSE is more heavily involved in the final three projects. **Project #4 The role of science, research and technology in lifting Australian productivity** is chaired by Dr John Bell, with Dr Bob Frater as deputy and Professor Tom Spurling as a member. **Project #5 New technologies and their role in our security, cultural, democratic, social and economic systems** is chaired by Professor Rob Evans with Fellows Professor John O'Callaghan and Professor Ron Johnston as members. **Project #6 Engineering energy: unconventional gas production** is chaired Professor Peter Cook with Dr Vaughan Beck as deputy and Fellows Dr John Williams and Mr John Toomey as members.

ATSE is fortunate that such a wide selection of Fellows has volunteered to guide these projects and ensure ATSE's continued participation in one of the most important interfaces between the Learned Academies and the Government in many years.



# Australia needs a healthcare 'assistive technology' network

Australia needs to establish a network of people working in health care on 'assistive technologies' – or emerging assistive and medical technologies (EAMTs) – to address the disconnect between assistive technology research and its translation into commercialisation and practice.

An EAMT network could help remove barriers to the effective adoption of EAMTs, provide access to information and expertise, analyse and advise on regulations and standards and promote collaboration between researchers, industry government and users.

Social networking tools could provide an important mechanism for identifying and engaging a wider audience for the potential of the application of EAMTs.

These were key recommendations to come from the Enabling Assistive Technologies Network Workshop organised by ATSE in Sydney in October, supported by the Federal Department of Innovation, Industry, Science and Tertiary Education (DIISRTE) and the NSW Government's Trade and Investment Division.

The workshop was part of a project driven by ATSE's Health Technology Forum, which seeks to bring to market and general use assistive technologies and address the disconnect between assistive-technology research and its translation into commercialisation and practice.

The Academy says EAMTs can reduce healthcare costs and maintain healthcare standards in Australia by, for example, allowing

the elderly to live at home longer rather than using more expensive forms of care, such as hospitalisation.

The Forum's campaign is driven by its belief that as Australia's population ages, the nation will face increased healthcare costs and a risk of lower standards of healthcare – unless EAMTs are developed.

Professor Greg Tegart AM FTSE, Chair of the ATSE Health and Technology Forum, says to address the challenges associated with an ageing population there is a need for an increased focus on research and development, commercialisation and implementation of these assistive technologies.

"This will need to engage a wide range of stakeholders – including researchers, investors, the medical sector, community organisations, governments, carers and consumers," he says.

"Currently, there are only very limited structures for bringing together these stakeholders to work together on the development and deployment of smart technologies that are needed by the nation.

"The multidisciplinary nature of aged care services across ICT, health and medical care, housing and other services means that many stakeholders and agencies need to work together to fully implement the vision for aged care in the future."

ATSE's work on assistive technologies in aged care has also confirmed the strong interest among a wide range of players for the establishment of a multidisciplinary



Greg Tegart addresses the workshop.

network facilitating research, innovation, technology and its translation into practice and commercialisation in Australia.

The workshop agreed a network would have to be self-sustaining model that generated the revenue necessary for the network to operate as an independent and authoritative body.

ATSE undertook to develop a value proposition and draft business plan for such a network to assist the 'start-up' phase of an EATM Network in 2013.

## ATSE BACKS SCIENCE TEACHER TRAINING

All practising science teachers in schools should receive in-service training in inquiry-based science education techniques, according to the Academy. Inquiry-based methods for science teaching should also be part of the curriculum for pre-service primary and secondary teachers.

ATSE also recommends that science and mathematics teachers, and those with responsibilities to provide career advice to students, are well briefed on the contemporary and prospective roles and opportunities in science, technology, engineering and mathematics.

These are key points made in the Academy's submission in October to the Senate Education, Employment and Workplace Relations Committee inquiry into Teaching and Learning: Maximising our Investment in Australian Schools.

The Academy submission notes that a major challenge for Australia is to be prepared for the knowledge economy and that a scientifically literate and capable society is needed now more than ever to give

citizens/voters the science understanding and skills necessary to make informed, evidence-based decisions when evaluating new, emerging or contentious science issues.

This meant an enhanced uptake of STEM studies, ATSE said.

The submission noted that many students did not see science as being relevant to their lives and the Academy's flagship in-curriculum program, Science and Technology Education Leveraging Relevance (STELR) program which had been developed to inspire interest in science, technology, engineering and mathematics (STEM) in students in Years 7 to 10 – initially through the highly relevant context of Global Warming, Climate Change and Renewable Energy Resources, and lately through the context of Sustainable Living Through Science and Technology.

The submission noted that, as recognition of STELR's work, 13 Australian universities currently used STELR as an example of a high-quality inquiry-based science resource in their teacher education programs.

# Fresh Science brings out another 12

Now in its 15th year, Fresh Science is a national event that brings together scientists, the media and the public.

A selection of 12 bright young scientists are chosen and supported to be ambassadors for science in Australia.

Fresh Science is supported by the Department of Innovation, Industry, Science, Research and Tertiary Education through the Inspiring Australia initiative, Museum Victoria, CSL Ltd and *New Scientist* magazine. State finals were also supported by the University of Queensland, ANSTO and the South Australian Department of Further Education, Employment, Science and Technology.

*Focus* brings you a quick look at the work of two of these young scientists.

## BLACK CARROTS KEY TO GUT HEALTH

Black carrots have revealed how fruit and vegetables help maintain gut health and reduce the risk of developing cancer.

Dr Anneline Padayachee from the University of Queensland has discovered the antioxidant compounds they contain combine with fibre to play an important role in protecting the colon from cancer.

The compounds, known as polyphenols, are released from plant cells during chewing. However, Anneline found that the majority of polyphenols are bound to fibre during this process and are not free for absorption until they reach the colon in the final stages of digestion.

Black carrots – which are actually a dark purple – are packed with polyphenols similar to those that give blueberries and red wine their vivid colour. Anneline's work showed that these compounds became bound to fibre during chewing and remained bound throughout digestion in the stomach and small intestine.

"We discovered that fibre not only works as a 'bowel scourer', but is also able to safely traffic polyphenols to the colon, where they are involved in gut health protective mechanisms," Anneline says.

Bacteria in the gut finally break down the fibre-bound polyphenols before the fibre itself is excreted. Products resulting from digested polyphenols then protect the colon from cancer.

"So, to gain the benefits of polyphenols, you need to consume everything – the whole vegetable or fruit, including the fibrous pulp if

PHOTO: KATHY GRUBE, UQ



you're juicing it. Not only will you have a clean gut, but a healthy gut full of protective polyphenols."

Anneline hopes her work might also help uncover medicinal uses for plant fibre in targeted treatments of dietary conditions. She worked on this research project with the ARC Centre of Excellence in Plant Cell Walls, the Centre for Nutrition and Food Sciences at the University of Queensland and CSIRO.

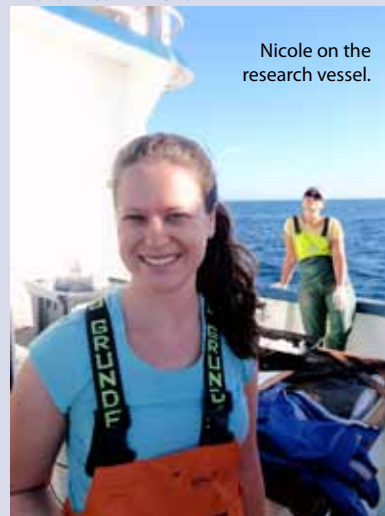
Anneline Padayachee at work.

## TUNA HAPPIER BEING FARMED OFFSHORE

Port Lincoln tuna are bigger, healthier and happier when they are kilometres offshore, according to a study by University of Tasmania researchers.

Southern bluefin tuna are usually farmed near the shore, but a study published in the international journal *PLoS ONE* found that the tuna thrive when raised further out to sea.

PHOTO: NICOLE KIRCHHOFF



Nicole on the research vessel.

The researchers collaborated on the world's first commercial-scale trial of offshore fish development, finding that tuna farmed in deep, turbulent waters gained weight twice as fast as fish reared closer in. They also had better survival rates and superior health.

Lead researcher Dr Nicole Kirchhoff says the research was the first study to show it was possible to produce fish offshore on a commercial scale.

"Our results indicate a promising economic future for offshore development," Nicole says. "The fish had fewer parasites and they were in overall better condition than fish maintained near the shore. As previous CSIRO research demonstrates, happy and healthy animals not only taste better, but are also better for you."

The waters at the study site were twice as deep as traditional near-shore farming zones, with stronger currents, winds and waves. Researchers monitored and sampled tuna reared offshore during a full five-month commercial season. The study included 15 measurements of health, stress and condition.

Nicole says there has been worldwide interest in the development of offshore waters for decades, but environmental and economic uncertainty prevented commercial expansion into the deeper ocean.

"We've found that farming further from shore actually has benefits beyond fish welfare and commercial success. Globally, moving aquaculture operations offshore may reduce interactions with urban populations and inshore environmental concerns."





Dr Edward Banks and Dr Jordi Batlle-Aguilar sample groundwater in the Willunga Basin, SA.

## Australia's vintage drop: million-year-old water

The most ancient water so far found in Australia is 1,100,000 years old and from a region of the Great Artesian Basin in northern South Australia.

According to the Deputy Director of the National Centre for Groundwater Research and Training (NCGRT) Professor Peter Cook, the age of Australia's water not only teaches us more about our ancient continent but also how we can better conserve and manage this precious resource.

"The fact that we have water of such an incredible antiquity also tells us how long it will take to recharge if we use it up quickly and unwisely. Our vintage water contains a warning from deep time," he says.

"On the other hand, much of our groundwater is quite young – only a few years or decades – and this means it is being recharged constantly, and is therefore at risk of being polluted by activities and industries on the surface."

Typically, water in the southern part of the Great Artesian Basin is aged from 100,000 to more than a million years, indicating it is not likely to be recharged any time soon and must therefore be extracted and used with great care and forethought, he says.

He notes that Perth depends for part of its water supply on groundwater. While some of this is quite young and is replenished regularly by rainfall, the deeper aquifers contain water up to 35,000 years old.

In contrast, groundwater beneath Darwin's outer rural suburbs is mostly less than 50 years old. Detailed measurements of its age have enabled scientists to predict its rate of recharge with precision, which has helped the city set sustainable extraction limits for householders and users.

"Dating groundwater is becoming a vital tool in managing the nation's water supply," Professor Cook explains. For example, since groundwater is connected to surface water, knowing its age can help in better planning and management of the waters of the Murray–Darling Basin, and allocate them sustainably among different uses such as agriculture, urban areas and the environment.

"Some water in the lower Murray Basin has been dated to around 200,000 years. Many of our best wine-growing regions are using groundwater, yet we have only a sketchy understanding of its age and sustainability – which is important for the future of the wine industry."

Since groundwater comprises around 90 per cent of the nation's reserves of fresh water, this knowledge is becoming increasingly vital, he adds, especially in cases where there is competition for its use, as is the case between coal-seam gas developers and farmers in some states.

Water is dated by analysing trace chemicals in it, Professor Cook explains. For instance, atom bomb tests in the Earth's atmosphere between 1945 and 1980 have left a distinct trace of tritium in all the world's waters, making it easy to date waters of this age by measuring this chemical signal. For more recent groundwater, scientists measure traces of chlorofluorocarbons – the chemicals used as spray-can propellants and refrigerants between about 1940 and their banning under the 1990 Montreal Protocol. Dissolved carbonates are used by researchers to date water between 2000 and 40,000 years old using carbon-14 dating methods. Chlorine-36, with a half-life of 300,000 years, can be used to date waters from 50,000 to two million years old by dating the dissolved salt.

There is currently no easy way to date water aged between 2000 years and 70 years old, "which is a gap we are currently working to fill," Professor Cook says.

## WATER INDUSTRY GOES TO SCHOOL

The Australian water industry has launched a new project that will support teachers in delivering water education in schools.

The Australian Curriculum Project Water Education in Schools aims to coordinate existing efforts in water education across Australia in order to update and develop new resources that are digital, interactive and aligned with the Australian Curriculum.

Australian Water Association Chief Executive Mr Tom Mollenkopf says the project – backed by 21 water organisations – will enable the water sector to pool funds to combine efforts and ensure quality water-education messages are delivered.

"This is an important opportunity for the water sector to ensure all students across Australia have access to the latest information on Australia's water issues, wherever they may be located. Educating the students of today will ensure that we are prepared for Australia's variable and volatile climate into the future," Mr Mollenkopf says.

## \$100M FIBRE RESEARCH CENTRE FOR GEELONG

The Australian Future Fibres Research and Innovation Centre (AFFRIC) at Deakin University is set to position the Geelong region as an international hub for research in advanced fibrous materials.

The new \$100 million research centre is a joint initiative between CSIRO, Deakin and the Victorian Centre for Advanced Materials Manufacturing.

"The centre will see CSIRO and Deakin University researchers working together on a series of projects aimed at increasing the research capacity of both organisations to service the textile and fibre industry," said Senator Chris Evans, Minister for Science and Research.

"The new centre will have a world-first, pilot-scale research plant able to produce commercial quantities of carbon fibre, which is at the core of a number of advanced materials used in aeronautical and other engineering applications."

Research and development partnerships already in place include: Quiksilver, to develop material for action sportswear; the Australian Defence Force to develop smart fibres for use in uniform fabrics; and the Cotton Research and Development Corporation to develop low-twist, fine-count yarns and fabrics from cotton.

# Smart software tackles social media

Responding earlier to bushfires and helping address mental health issues are just two of the benefits from the development of new social media software from CSIRO. The social media analysis software is helping organisations make sense of massive volumes of social media traffic, according to a services research specialist.

Mr Alan Dormer, CSIRO Services Science Leader, said that, with

PHOTO: CSIRO



Analysing social media.

millions of posts and countless conversations happening every minute, organisations trying to make sense of social media can easily find themselves overwhelmed.

"There are 11.5 million Facebook accounts in Australia and more than two million Twitter accounts, so analysing social media posts to

find relevant information is like looking for a needle in a haystack," Mr Dormer said.

"It's a classic big data problem. But with our research in data mining, textual analysis and data visualisation, we're well placed to tackle it."

So far, organisations are using the software for three main reasons: reputation management; exploring topics and issues important to the community; and early detection of emergencies or outbreaks.

The National Mental Health Commission is working with the software and plans to use it to gauge community response to their report cards on Australia's mental health issues and services. The first is due out later this year.

A CSIRO software tool to analyse Twitter posts recently gave Queensland fire services an extra 25 minutes warning that a grass fire was threatening an outback hospital. Tweets about the fire emerged well ahead of any official alerts and within minutes, details such as the fire's location and direction were appearing on Twitter, allowing emergency managers to evacuate the hospital safely.

Mr Dormer said the social media analysis tools were being developed with government. An 'early adopters group' of innovators in government was helping develop the social media tools beyond the prototype stage, trial them in real situations, and providing feedback to make them more useful.

## VICTORIA GETS NEXT RDSI NODE

The next node of the \$50 million Australian Government's Research Data Storage Infrastructure (RDSI) project to transform the storage of research data will be located in Victoria, with the University of Melbourne leading a

primary node within Melbourne on behalf of Victorian universities.

The University of Queensland (UQ) is leading the project on behalf of the Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE), which funds the project from the Education Investment Fund under the Super Science (Future Industries) initiative.

Dr Nick Tate, RDSI Project Director who is based at UQ, said the project would be a significant boost for researchers around Australia who were capturing and processing enormous data sets. Its storage capacity was expected to grow to more than 100 petabytes, which is significantly larger than existing research stores.

The RDSI project aims to develop a national network of distributed data stores where research data can be readily accessed, analysed and re-used and to support the retention and integration of nationally significant data assets. This will support enhanced research outcomes through greater access to, and sharing of, research data.

## NICTA WINS PART OF US CYBER-SECURITY PROJECT

A team of computer scientists from NICTA will be part of a multi-million-dollar contract with the US Government to develop a new breed of software to protect the critical systems in unmanned vehicles from cyber attack.

An international consortium, led by Rockwell Collins – with NICTA as a core member – won the US\$18 million project with the US Defense Advanced Research Projects Agency (DARPA), which promises to have far-reaching future applications protecting the critical systems in motor vehicles, medical devices and aircraft. The successful team also includes Boeing, Galois and the University of Minnesota.

As part of the program, the high-assurance systems built in the project will be subjected to 'white box' attacks by an expert 'red team' to test their robustness. White box attacks are pre-arranged attempts to penetrate a system by teams with complete knowledge of their target – their purpose is to expose any security flaws so they can be addressed.

The work will be undertaken by the same group of NICTA scientists that developed the highly robust seL4 operating system, named by the prestigious *MIT Technology Review* in 2011 as one of the top 10 technologies likely to change the world. The project is part of DARPA's High-Assurance Cyber Military Systems (HACMS) program, which aims to produce dependable systems that are resilient to emerging cyber threats.

In this project, the NICTA team will develop new approaches to address the many challenges involved in building high-assurance systems. The aim is to develop a complete, formally proven architecture to protect the control and communication systems of an aerial vehicle from compromise by faults and targeted attacks.

"As computers replace mechanical systems in many industries, we are increasingly dependent on the functionality implemented in software," said Dr Jodi Steel, Director of the Security and Environment Business Team at NICTA. "This project is all about making sure that such systems function as intended, even in the case of cyber attacks."

"NICTA's selection for this project reflects our status as world leaders in the verification of operating systems," said Scientia Professor Gernot Heiser, Leader of NICTA's Software Systems Research Group and the University of New South Wales John Lions Chair.

"NICTA's participation in this important international project demonstrates the power of world-class research to contribute directly to wealth creation opportunities," said Professor Hugh Durrant-Whyte FRS FAA FTSE, NICTA's Chief Executive Officer.





Profound change coming for universities.

## "Profound change" coming for universities

New technologies, increased competition and flat-lining government funding will force universities to fundamentally reinvent themselves in the decade ahead, according to a recently released Ernst & Young report – *University of the Future*.

The study included interviews with more than 40 leaders from universities, private providers and policy makers, including extended interviews with 15 Australian Vice-Chancellors.

"We've seen fundamental structural changes to industries including media, retail and entertainment in recent years – higher education is next. There's not a single Australian university that can survive to 2025 with its current business model," says report author Justin Bokor, Executive Director in Ernst & Young's Education practice.

"At a minimum, universities will need to get much leaner, both in terms of the way they run the back-office, and in use of assets."

As part of the study, Ernst & Young compared ratios of support staff to academic staff across a selection of 15 Australian universities, covering the Group of Eight (Go8), Australian Technology Network of Universities (ATN), the Innovative Research Universities (IRU), regional universities and non-aligned universities. Only one university in the sample – a Go8 university – had a ratio less than one. The rest had more support staff than academic staff: four had 50 per cent or more support staff and more than half had at least 20 per cent more support staff.

"Given increased market forces, including the switch to a demand-driven model in the domestic market and increased global competition in the international student market together with tight government funding, universities with these types of support structures will struggle to see out the next 10 years," Mr Bokor said.

The study highlighted five key drivers that are changing the world of universities: the democratisation of knowledge and access; contestability; new technologies; global mobility; and integration with industry. The sum total of these drivers of change will mean universities will be very different in 15 years from now and will need to:

- increasingly orient their strategies and organisations around particular student and industry segments;
- create new, leaner business models as competition increases for staff, students, funding and partners;
- innovate the higher education value chain, for example forming partnerships and areas of specialisation in particular areas of the value chain – content aggregation, mass distribution and certification;
- increasingly fund, conduct and commercialise research in partnership with industry; and
- face new competitors in Australia and internationally – both online and campus-based competitors, especially as emerging market universities move up the rankings and private providers develop successful segment-focused models.

The report argues that politicians and policy makers should present a clear case for the critical role of higher education in the nation's future – to build public support for the university sector and set the foundations for higher education public policy. Policy makers should develop

scenarios for how university business models might evolve and what this might mean for the 'public good' role of universities.

The Tertiary Education Quality and Standards Agency (TEQSA) will need to consider how new university models might fit into their regulatory frameworks, and what forms of regulation might be needed to enable innovation and new models to develop while maintaining overall standards of quality.

"This is a sector that, more than any other, will shape Australia's future as a high-performing knowledge economy," Mr Bokor said, "But, to succeed, Australian universities will need to forge new business models that are dynamic, modern and are fit for the decades ahead."

## CHIEF SCIENTIST PROPOSED FOR DEEWR

The Government has announced it will appoint a Chief Scientist within the Department of Education, Employment and Workplace Relations (DEEWR) to increase the role of social science research and evidence in future policy development.

The Minister for Employment and Workplace Relations, Bill Shorten, said the Chief Scientist would work collaboratively with the Australian and international scientific and research community, and other government agencies, to bring together the best research and evidence to tackle current and emerging policy challenges across the DEEWR portfolio.

DEEWR's portfolio includes early childhood education and childcare, school education, employment, workplace relations and social inclusion. It is also responsible for four of the Government's six Closing the Gap targets.

The Minister for School Education, Peter Garrett, said the Chief Scientist would play an important role in connecting research into what works in education to DEEWR's school reform agenda.

## 460,000 DOWNLOADS FOR ITUNES U COURSE

La Trobe University's second-year subject History of Children's Literature began its second teaching session as an iTunes U course in November, after gaining 20,000 subscribers and more than 460,000 downloads since its debut on iTunes U in February this year.

iTunes U Courses is a new delivery method from Apple Corporation that allows a worldwide audience to access teaching material through iTunes at the same time as students, regardless of location or enrolment.

Taught by David Beagley from the Bendigo campus, History of Children's Literature is one of four subjects he has taught on iTunes U.

"I am constantly being amazed by the reach of these lectures," he says. "I have had emails from listeners in the US, Britain, Canada, The Netherlands, Mexico, Turkey and even the New Guinea Highlands!"

La Trobe was the first Australian university to provide content on iTunes U Courses, having launched the initiative in February 2012. Other universities contributing include Stanford, Oxford and Yale.

La Trobe now has 12 subjects providing content for iTunes U.

Combined they had over 300,000 subscribers, more than 4 million downloads of lectures and material, and were widely promoted by Apple to its vast audience on the iTunes U platform.

"I'm delighted that La Trobe University continues to set an example for the rest of Australia in online digital education," says Senior Deputy Vice-Chancellor John Rosenberg FTSE.



John Rosenberg

PHOTO: CSIRO



CSIRO's solar mirror field in Newcastle – now CSIRO is studying the effects large solar arrays might have on the surrounding climate.

## Climate benefit from solar arrays?

A study to determine whether energy production can simultaneously be used to positively affect regional climates, including modifying rainfall patterns, has begun in CSIRO's weather and energy research unit.

In a collaboration between Game Changer Ventures and CSIRO, the study will initially focus upon what effects large solar arrays, used to generate renewable solar power, might have on the surrounding climate.

In a geo-engineering study with the potential to assist in the design and planning of extensive solar farms, CSIRO climate scientists Drs Alberto Troccoli and Jack Katzfey will investigate the possible changes to the local climate produced by massive solar farms.

The scientists will specifically evaluate whether such solar arrays can be engineered in such a way as to produce statistically significant rainfall in addition to electricity.

Dr Troccoli said the principle of solar arrays was that they absorbed energy from the sun and converted part of that energy to electricity which was then transferred via the electricity grid to remote locations. Thus less energy from the sun was available to heat the solar farm site.

"Local climate impact would depend significantly upon the location of the solar array relative to prevailing winds and atmospheric moisture, as well as the shape and orientation of the array.

"Solar power plants proposed under the Solar Flagships program in Australia are not designed with any consideration of their effect on weather but this should be determined, both positively and negatively, before they are built.

"For example, we will be trying to assess whether a large solar array can be engineered in such a way as to increase rainfall or induce rainfall in the vicinity of the array, preferentially downwind and not directly over the array," he said.

## COASTAL MANAGEMENT BOOK PUBLISHED

CSIRO Publishing has launched a new book, *Sustainable Coastal Management and Climate Adaptation: Global Lessons from Regional Approaches in Australia*, produced by the Coastal Collaboration Cluster, which includes researchers from CSIRO, Curtin University of Technology,

Deakin University, Flinders University, the University of Adelaide, University of the Sunshine Coast, University of Tasmania and University of Wollongong. The book was launched at the recent 'Coast to Coast' conference in Brisbane.

"This book explores the evolution of coastal management in Australia and provides critical insights into contemporary experience and understanding," said Dr Andy Steven, CSIRO's Our Resilient Coastal Australia Theme Leader. "It draws on current theory and lessons from case examples to highlight the roles of research and community engagement in coastal management. The book concludes with a chapter of recommendations, which can help guide coastal management and research around the world."

## UV LEVELS HAVE INCREASED

Recently published research, which for the first time examined changes in ultraviolet (UV) radiation in Australia over a period of 50 years, has found an overall annual increase in UV levels of two to six per cent since the 1990s for locations throughout Australia.

The data also shows seasonal variations in UV increases, with winter increases from 1970 to 1980 almost twice those recorded in summer, and higher average UV levels observed in more southerly latitudes.

"The data shows that during the 1970s and early 1980s, clear-sky UV Index levels for the three Australian regions (North, Central and South) were fairly stable," says Dr Lilia Lemus-Deschamps, Bureau of Meteorology scientist. "But over the past 20 years, there has been an overall annual increase in UV levels across the country from two per cent to six per cent above the 1970 to 1980 levels, corresponding to ozone depletion."

The study calculated clear-sky UV radiation over a 50-year period (1959 to 2009) for Australia using two long-term ozone data sets derived from surface and satellite measurements, a radiation code and atmospheric meteorological fields.

## 'TRAPDOORS' CAPTURE CARBON DIOXIDE

A team of researchers from the CRC for Greenhouse Gas Technologies (CO2CRC) based at the University of Melbourne have developed a new material with exceptional properties for separating CO<sub>2</sub> from other gases.

The chabazite zeolite synthesised by Professor Paul Webley and his team from the School of Engineering uses a molecular 'trapdoor' to separate molecules based on their properties rather than their size.

"Zeolite granules are highly porous, with one gram often containing as much surface area as a football field," Professor Webley says. "Zeolites have previously been considered to be molecular 'sieves' – separating gas molecules based on size. The trapdoor mechanism that allows the chabazite zeolite to trap CO<sub>2</sub> so efficiently is a new discovery."

The material can separate CO<sub>2</sub> from gas streams at a wide range of temperatures and pressures and has excellent potential for separating CO<sub>2</sub> from power station flue gases and natural gas production.

"The major costs of carbon capture and storage are on the capture side of the equation," Professor Webley says. "The high selectivity and lower energy requirement of the material mean that there is considerable potential to reduce the cost of gas separation, and therefore the overall cost of carbon capture and storage."

Research input came from CSIRO, the Department of Materials Engineering and Mechanical Engineering at Monash University and the Australian Synchrotron.



# Victorian chemical manufacturing centre

The Victorian Government has provided \$5.85 million to establish the Victorian Centre for Sustainable Chemical Manufacturing (VCSCM) at Monash University in a \$25 million collaboration between government, research and industry.

Led by Monash University together with CSIRO, the Plastics and Chemicals Industries Association and the Environment Protection Authority, VCSCM will undertake a range of activities enabling manufacturers to interact more closely and effectively with the research community to drive improved sustainable manufacturing outcomes.

The centre will increase awareness of the benefits of adopting sustainable manufacturing practices within the industry, demonstrating the unique research platforms of Monash and CSIRO.

Professor Milton Hearn FTSE, leader of VCSCM, said the centre's establishment would provide a key platform to support Victorian manufacturing to become more globally competitive.

Announcing the funding, the Victorian Minister for Manufacturing, Richard Dalla-Riva, said: "The VCSCM will provide dedicated resources around industrial research and manufacturing processes to Victorian manufacturers in the fine chemicals, pharmaceutical and food industries."

## GAS EXPORT BOOM HAS RISKS

The anticipated boom in east coast gas exports from Australia has some risks, according to a recent industry report prepared for the Australian Industry Group (Ai Group) and the Plastics and Chemicals Industries Association (PACIA) by the National Institute of Economic and Industry Research (NIEIR).

The report, *Large scale export of east coast Australia natural gas: unintended consequences*, identified the benefits and potential economic risks associated with gas exports. Among its findings:

- gas supply may be insufficient to avoid constraining domestic use;
- each petajoule of gas shifted from industrial use towards exports means giving up \$255 million in lost industrial output for a \$12 million gain in export output – that is, for every \$1 gained \$21 is lost;
- secure local gas supply is fundamentally important to a number of industries including non-ferrous metals and basic chemicals, plastics, pharmaceuticals and paints;
- gas exports are predicted to rise from two million tonnes in 2015 to up to 24 million tonnes in 2023;
- long-term gas supply contracts have evaporated for local industry as a consequence of export commitments;
- east coast gas prices will rise, potentially to as much as triple the current \$3 to \$4 per gigajoule – an increase several times larger than the costs related to carbon pricing; and
- current policy settings favour exports over domestic gas sales.

Ai Chief Executive Innes Willox says that Ai Group and PACIA members have been concerned for some time that potential unintended consequences of the gas boom were not widely appreciated. "While we are strong supporters of Australia's minerals and gas exports, there is a need for public recognition and discussion of the risks, and debate over what steps can be taken to best manage them."

PACIA Chief Executive Margaret Donnan says: "NIEIR's report raises doubts that the supply of natural gas will be sufficient in coming years

to meet both export commitments and domestic needs. Like the Prime Minister's Task Force on Manufacturing and the Queensland Government's recent Gas Market Review, the report highlights that major gas users currently face great difficulty in securing supply. NIEIR questions whether production and proven reserves will expand fast enough to provide confidence in secure long-term supply to all users."

## CSIRO LEADS TITANIUM MANUFACTURING

CSIRO has announced the opening of a new titanium additive manufacturing facility that will be used for developing advanced titanium parts for aerospace, medical, automotive and manufacturing applications.

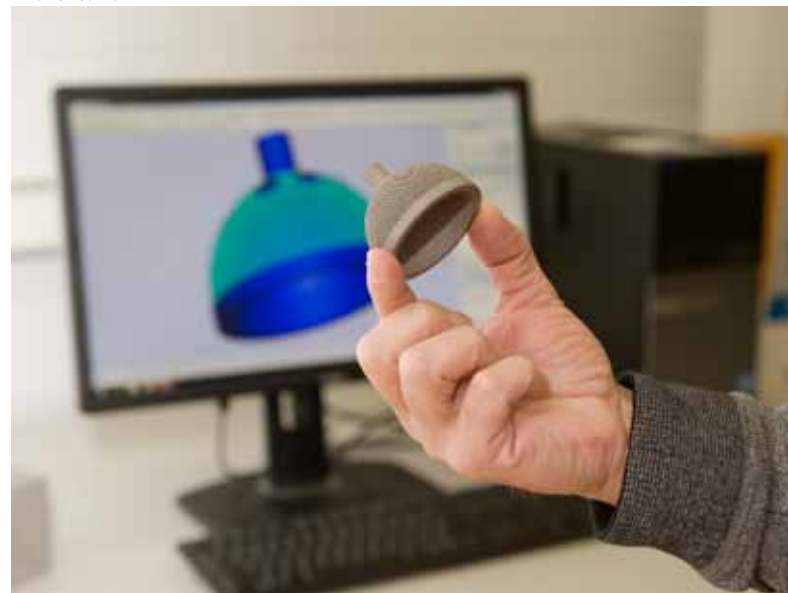
The facility, at CSIRO's Clayton site in Melbourne, houses the first Arcam additive manufacturing machine in the Southern Hemisphere. It uses electron beam melting to fuse metal powders into complex shapes layer by layer and creates three-dimensional parts from metals including titanium alloys, nickel and hard steel alloys.

CSIRO's expertise in titanium manufacturing includes electron beam melting, coldspray and thermally assisted machining. The new facility is part of CSIRO's Future Manufacturing Flagship.

CSIRO has identified additive manufacturing as a key opportunity for the manufacturing sector in Australia and has expertise in core supporting technologies, including materials science, polymer science and metal fabrication. Its industrial commercial additive manufacturing activities include the development of titanium pipe with Future Titanium Technologies and the production of aerospace hardware through the Joint Strike Fighter program with Ferra Engineering.

"Additive manufacturing is an emerging technology capable of changing the future of manufacturing in Australia and we are keen to facilitate the adoption of new technologies that will benefit Australian businesses," Director of CSIRO's Future Manufacturing Flagship Swee Mak says. "We have invested in a suite of technologies and research, which combined with our links with RMIT and Monash universities, provide industry with a unique opportunity to explore and engage in forward-thinking design and production techniques."

PHOTO: CSIRO



Part of a hip prosthesis made using the Arcam process, in front of a screen showing the computer-aided design for the implant.

# Risk management is at risk from 'social amplification'

One of the most perplexing problems in risk analysis is why some relatively minor risks or risk events (as assessed by technical experts) elicit strong public concerns and result in substantial impacts on society and the economy.

Such concerns and impacts are typically the result of 'social amplification' – changes in risk perception and response based on psychological, social, institutional and cultural processes.

Social amplification is most likely to flourish when the risks are serious and the situation is fraught with uncertainties.

These are key points made in an article by Professor Roger Kasperson, a research scientist at Clark University, Massachusetts, published (Vol 42, No 3) in *The Bridge*, the journal of the US National Academy of Engineering (NAE).

Professor Kasperson makes the point that risk perception and communication are important factors in decisions about managing risk events and their impacts and describes the social amplification of risk framework as a tool for understanding and accounting for public attitudes toward risk.

He says the framework links the technical assessment of risk with psychological, sociological, and cultural perspectives of risk

and risk-related behaviour and argues that hazards interact with these perspectives in ways that may amplify or attenuate public responses, and focuses on amplification.

"Risk amplification typically occurs at two stages in a risk scenario: in the transfer of information about risk and in social response mechanisms," he says.

"Signals about risk are both transmitted and processed by individuals and social entities, called amplification stations. The individual might be a scientist, for example, who communicates the risk assessment; a social entity might be the news media, a cultural group, or an interpersonal network. The perceived amplified risk leads to behavioural responses that result in secondary impacts or ripples."

Social amplification may qualitatively and quantitatively increase not only the perception of risk but also the risk itself and its consequences. For this reason, social amplification of risk must be included in analyses of public and regulatory reactions to risk events."

The key amplification stages are;

- filtering signals (only a fraction of all incoming information is actually processed);
- decoding and reframing signals

processing risk information (for example, drawing inferences);

- attaching social values to information as a basis for drawing implications for management and policy;
- interacting with cultural and peer groups to interpret and assess the validity of signals;
- formulating behavioural intentions about whether to tolerate a risk or take action against the risk or risk manager; and
- engaging in group or individual actions to accept, ignore, tolerate or change the risk.

Professor Kasperson says a particular policy strength of the social amplification of risk framework is its capacity to mesh emerging findings from different venues of risk and impact research, to bring various insights and analytic leverage into conjunction, and (particularly) to analyse connections and interactions in specific social and cultural contexts.

• The Bridge publishes opinion and analysis on engineering research, education and practice; science and technology policy; and the roles of engineering and technology in society. The intent is to stimulate debate and dialogue within the NAE membership and the broader community of policymakers, educators, business leaders and other interested citizens.

## LETTER

### THE CONSEQUENCES OF PREDICTING THE UNPREDICTABLE

On 22 October six Italian seismologists and one ex-government official were convicted of "multiple manslaughter for the downplaying the likelihood of a major earthquake six days before it took place". For this "crime" they were each sentenced to six years imprisonment. The earthquake which they have failed to predict occurred in the region of Abruzzo with the epicentre near L'Aquila on 6 April 2009 and was rated 5.8 on the Richter scale. Approximately 40,000 people were made homeless, 308 are known to have died and some 1500 injured.

It is, however, generally accepted by the scientific community that earthquakes are unpredictable, just as many other natural phenomena, particularly those whose effect has numerous causes. The law of causality, as it was formulated by the Nobel Laureate Henri Bergson (1859–1941), states: "This law means that every phenomenon is determined by its conditions, or, in other words, that the same causes produce the same effects."

It is my understanding that there is considerable uncertainty about the natural causes and effects influencing climate change.

There seems to be two common schools of thought about climate change: it is considered by some to be a natural phenomenon and by others to be merely a source of human activity. It is of course the consequence of both! Whereas the consequences of human influence on climate change can, arguably, be predicted with some degree of accuracy, the effects of the multiple natural causes of climate change, which in the past have caused glacial and interglacial periods, are extremely complex.

The Principle of Incompatibility, stated in 1972 by Lofty Zadeh, Professor at Berkley University, says: "As the complexity of the system increases, our ability to make precise and significant statements about its behaviour diminishes until the threshold is reached beyond which precision and significance (or relevance) become almost mutually exclusive characteristics."

A corollary principle may be stated succinctly as: "The closer one looks at a real-world problem, the fuzzier becomes its solution".

Also, considering the increase in carbon dioxide as the main cause of the potential increase in the average earth temperature, yet another major factor of the temperature increase – that of methane – is often neglected.

If, arguably, emissions of carbon dioxide can be effectively controlled and reduced, the same cannot be said about methane.

– Professor Alek Samarin FTSE



# Science experts blast Italian quake verdict

Six Italian scientists and a government official were recently found guilty of manslaughter for underestimating the risks of a major earthquake in the town of L'Aquila in 2009. All seven were members of the Major Risks Committee and were sentenced to six years in prison for failing to warn the population of the risks just days before L'Aquila and surrounding towns were hit by a quake that killed more than 300 people.

The implication for those who serve on assessment committees is daunting. Comments from Australian and overseas experts reflect the risks involved in prediction:

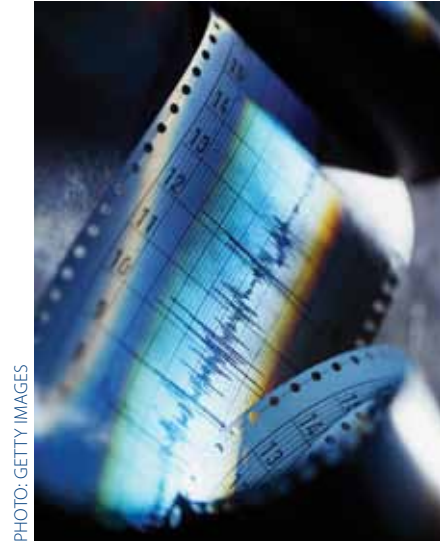


PHOTO: GETTY IMAGES

- “This is an extremely alarming verdict. If this sets a precedent then national governments will find it impossible to persuade any scientist to sit on a natural hazard risk evaluation panel. In the longer term, then, this decision will cost lives not save them. We don’t have the ability to predict earthquakes, but what national governments need to do is spend time and money ensuring that the buildings in areas of potential earthquake risk are able to withstand expected earthquakes.”  
– Professor Bill McGuire, Professor of Geophysical and Climate Hazards, University College London
- “Ironically, the conviction of the scientists is likely to imperil the very need that this incident has highlighted: for open and clear communication between the scientists and the public. In a further irony, only now has the first action been taken against the engineers who designed modern buildings that collapsed and caused fatalities and no action has yet been taken against the government officials who were responsible for enforcing building code compliance. It has occurred to some observers that the local government officials may be scapegoating the scientists to avoid prosecution themselves.”  
– Professor Paul Somerville, Deputy Director of Risk Frontiers Natural Hazards Research Centre, Macquarie University
- “This bizarre verdict will chill anyone who gives scientific advice, and I hope they are freed on appeal. The lesson for me is that scientific advisors must try and retain control over how their work is communicated, and are properly trained to engage with the public.”  
– Professor David Spiegelhalter, University of Cambridge
- “If it stands, this verdict will have a chilling effect on earthquake science in Italy and throughout Europe. For instance, who would now be willing to serve on an earthquake hazard evaluation panel when getting it wrong could mean a conviction for manslaughter? And what will be the effect on the ‘impact’ agenda? Here in the UK scientists are being challenged to ensure that their research has influence outside academia; this case suggests that such engagement can be very dangerous.”  
– Professor Sandy Steacy, University of Ulster
- “This potentially sets back scientists’ desire and ability to engage openly with the public and authorities on the risks faced by society from natural hazards, particularly those involving seismic activity.”  
– Dr John Elliott, Department of Earth Sciences, Oxford University
- “This is very unusual path for the criminal law to tread, and ... the outcome is, quite frankly, bizarre. The public policy repercussions are significant too. From now on, one might safely predict that one of two things will happen: either Italian seismologists (or epidemiologists, or climatologists or any scientists for that matter) will remain quiet about their predictions unless they are absolutely certain (which will never be the case) or they will predict a worst case scenario, which will inevitably lead to resources being spent (and largely wasted) on anticipating things that will rarely, if ever, happen.”  
– Professor Rick Sarre, School of Law, University of South Australia
- “Communication of earthquake hazard probabilities to the wider public is a complex issue. Following this verdict, seismologists and other natural hazards experts are will find it even more difficult to achieve a balance between communicating what the most likely outcomes are, whilst acknowledging the chance of low probability, extreme outcomes. To err in one direction leaves them open to being charged with being “too reassuring” but to err in the other leaves them open to being accused of being alarmist – either way minor nuances in the language used can be interpreted differently by different audiences leaving the experts in a no-win situation.”  
– Wayne Peck, senior seismologist in the Seismology Research Centre, Environmental Systems & Services
- “If the scientific community is to be penalised for making predictions that turn out to be incorrect, or for not accurately predicting an event that subsequently occurs, then scientific endeavour will be restricted to certainties only and the benefits that are associated with findings from medicine to physics will be stalled.”  
– Professor Malcolm Sperrin, Director of Medical Physics, Royal Berkshire Hospital

## Ageing means “unprecedented change”

Professor Greg Tegart AM FTSE, Chair of ATSE's Health and Technology Forum, told a recent workshop in Melbourne that Australia was facing unprecedented change as population ageing was accelerating worldwide.

He was addressing the opening session of the Future Directions in Assisted Living and Healthcare Workshop, convened by ISCRR (the Institute for Safety, Compensation and Recovery Research) and Monash University.

The aim of the two-day workshop was to identify the needs of people with disabilities and the aged, and to explore the potential for technology to assist people to live independently and remain in their own homes. It brought together international and national industry experts, architects, designers, IT specialists and disability and carer professionals and advocacy groups.



Greg Tegart

Professor Tegart said home healthcare technology was an attractive option as it empowered patients to self-manage and shifted costs from high-cost institutions to individual people's homes. Despite this, he said, the uptake of technology remained limited.

Professor Tegart detailed the following ways to improve uptake:

- keep technology simple for both patients and healthcare professionals;
  - tailor the technology to the needs of users;
  - focus on high-volume and low-cost solutions;
  - embed an IT infrastructure to act as basis for integrated systems;
  - enhance human contact by better connection of patient to family and care staff; and
  - build relationships to get all sectors of healthcare working together.
- He also outlined potential for uptake in aged care as:
- security and safety – elderly-friendly housing, falls prevention, communication and social interaction;
  - diagnosis and treatment – telehealth, coping with degenerative diseases, nanomedicine; and
  - assistive technologies – biorobotics, brain/machine interaction, mobility systems.

Professor Tegart emphasised the critical role of a multidisciplinary, cross-sector network, which he saw as a key opportunity for the participants at the workshop.

## ANSTO TO FILL NUCLEAR MEDICINE SHORTAGE

The Australian Nuclear Science and Technology Organisation will be key to Australian plans to combat a looming nuclear medicine supply crisis.

Global supply of nuclear medicine is under threat, with reactors responsible for 70 per cent of the world's Molybdenum-99 (Mo-99) production due to be decommissioned in the next few years. Mo-99 is the base material used in scans that diagnose heart disease and a variety of cancers. Applications include bone oncology, neurology and kidney and gastrointestinal tract disorders.

ANSTO CEO Dr Adi Paterson FTSE updated the Australian Parliament on plans to put Australia at the heart of the fight against a looming international nuclear medicine supply crisis. He told a Budget Estimates Hearing that Australia would go from producing 550,000 doses of nuclear medicine at the Lucas Heights reactor to making enough medicine to

help 20 million people a year around the world.

Earlier this year ANSTO and the Australian Government announced the \$168 million plan to significantly increase ANSTO's nuclear medicine production capacity.

Speaking after the hearing, Dr Paterson said: “One in two Australians will receive a nuclear medicine procedure in their lifetime, and around 80 per cent of those will need Mo-99. Mo-99 is a key tool in the fight against cancer and heart disease. It's absolutely essential for an effective diagnosis.

“In the face of increasing demand and diminishing supply, Australia is taking a global leadership role in meeting healthcare needs.”

## ARE FABA BEANS THE CANCER ANSWER?

Anti-cancer properties have been found in extracts from Australian-grown faba beans, along with effects that may have implications for treating hypertension and maintaining healthy weight.

As part of a study into the health benefits of faba beans, Charles Sturt University (CSU) PhD student Siem Siah applied phenolic compounds from faba beans to five different cancer cell lines in laboratory experiments at Wagga Wagga. In all cases the rate of cancer cell death was accelerated.

The findings have been published in the peer-reviewed *British Journal of Nutrition*. The Grains Research and Development Corporation funded the research; NSW DPI chemist Dr Jennifer Wood co-supervised Ms Siah's PhD with Dr Chris Blanchard from CSU; and Dr Izabela Konczak from CSIRO Food and Sciences oversaw the experiments.

“We know that antioxidant properties are potentially linked to anti-cancer properties, so we were trying to look for the connections,” Ms Siah says. She grew cultures of four cancer cell lines – bladder, stomach, liver and colon cancers – in flasks, then applied the phenolic compounds to them directly and waited 24 hours to measure the proliferation of cells. The rate of cancer cell multiplication was greatly reduced once the faba bean extracts were applied. For a fifth type of cancer cell, acute promyelocytic leukemia, Ms Siah applied a method called flow cytometry.

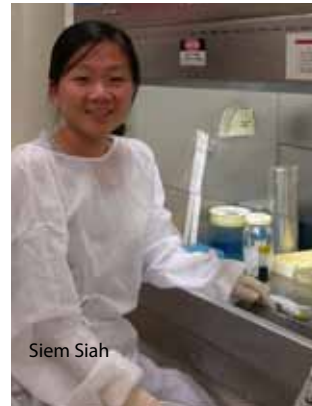
Dr Wood says the experiment yielded an insight into the mechanism that inhibited the cancer cell multiplication.

“Normal healthy cells are programmed to multiply, grow and die (cell death is called apoptosis),” Dr Wood says. “Cancer cells evade the process of apoptosis, continue to proliferate and become tumours. This work showed faba bean phenolics induced normal cell death in the cancer cells. Conversely, the extracts had no effect on the proliferation of normal human colon cells tested – a very favourable outcome.”

Additional experiments on the interaction with important human enzymes showed that phenolic extracts from faba beans inhibited angiotensin converting enzyme (ACE), a common target of pharmaceutical medication for hypertension.

The compounds also inhibited the action of the digestive enzymes alpha-glucosidase and lipase, which could mean slower digestion (and therefore a longer feeling of satiety), and lower sugar and fat absorption by the digestive system.

PHOTO: KARUNRAT SAKULNAMRAT



Siem Siah



# Merck backs UQ Nanopatch

A University of Queensland invention that will deliver vaccines without the need for needles has struck a significant partnership with US-based pharmaceutical giant Merck.

The Nanopatch technology, which aims to replace the traditional needle and syringe with a patch smaller than a postage stamp to deliver vaccines painlessly and more efficiently, will be licenced to Merck to begin commercial production on a vaccine.

UQ Vice-Chancellor Professor Peter Høj FTSE said the partnership accelerated the process of delivering the revolutionary health technology to people throughout the world.

"A major vaccine maker has looked at technologies around the world and chosen the UQ-invented Nanopatch," Professor Høj said. "That is a tremendous credit to the team of researchers who developed the technology, led by Professor Mark Kendall. It also reflects the excellence of UQ's research commercialisation, which ensures that practical, life-enhancing discoveries are made accessible to the people who need them."

"This link-up with Merck is especially inspiring because it may lead to the relief of serious health problems, particularly in remote and developing regions. In the immediate term, it will employ more people in Brisbane's innovation economy and boost the global reputation of Queensland and Australian R&D."

The Nanopatch technology, now being developed by privately held biotechnology company Vaxxas, originated from Vaxxas Chief Technology

Officer Professor Mark Kendall's research group at UQ's Australian Institute for Bioengineering and Nanotechnology.

Through the Merck partnership, Vaxxas will be eligible to receive payments for up to two additional vaccines developed by Merck using the Nanopatch platform,

as well as milestone payments on Merck vaccine development and regulatory approvals, and royalties on sales of any Merck vaccines that ultimately use the Nanopatch platform.

The Nanopatch works through thousands of small projections designed to deliver a vaccine to abundant immune cells in the skin; needles deliver a vaccine to muscle, where there are few immune cells. Nanopatch delivery can improve the efficiency of vaccines with only a hundredth of the dose used with a needle.

The Nanopatch has the potential to improve patient convenience, reduce needle-stick injuries and overcome cross contamination. It is designed for thermostability and may not need refrigeration, potentially making transport cheaper and easier, particularly to developing nations.

Professor Kendall co-founded Vaxxas in 2011 with a \$15 million investment from Australian and US investors to advance the Nanopatch towards clinical testing and product development. UQ's main commercialisation company, UniQuest, led the initial commercialisation of the Nanopatch technology prior to the creation of Vaxxas.

Professor Kendall was the 2011 winner of *The Australian Innovation challenge* for the nanopatch technology.

## VACCINES NEED TO BE QUICKLY PRODUCED

Immunising people with vaccines that are quick and inexpensive to produce is the key to preventing large-scale spread of infectious disease, says Professor Anton Middelberg FTSE from the Australian Institute for Bioengineering and Nanotechnology at The University of Queensland.

Using modern molecular and bioprocessing tools, Professor Middelberg and his team are developing vaccines that can be changed and manufactured for the entire Australian population within days of a new virus appearing.

"The new vaccines we are developing are also much cheaper to mass-produce than traditional technologies, so are relevant where cost is an issue – for example, in the developing world," Professor Middelberg says.

"We use biotechnology to create the safe parts of a virus, and then we use nanotechnology to assemble these building blocks into a virus-like particle (VLP) in a reactor.

"VLPs resemble viruses but, as they only use the safe part of the virus, they are not infectious. However, being a safe mimic of the dangerous virus, they raise an excellent immune response.

"Biotechnology allows us to make VLPs rapidly using bacteria and the VLPs can be manipulated within reactors (not cells) to change composition and target the new disease-causing agent. This enables an incredibly fast response to new threats."



Anton Middelberg

## NEW, EASY TEST FOR SIGHT KILLER

Scientists from Australia's Vision Centre have demonstrated a quick, accurate test for one of the world's leading causes of blindness.

A new study shows that age-related macular degeneration (AMD) can be more rapidly and inexpensively diagnosed effectively under bright lights, instead of requiring patients to sit for 20 minutes in a darkened room.

"AMD accounts for half of the legal blindness cases in Australia," says Professor Ted Maddess from The Vision Centre and The Australian National University. "It affects one in seven people over the age of 50, costing the nation \$2.6 billion a year. Globally, it affects 25 to 30 million people, with an annual cost of \$343 billion.

"Scientists have proposed that it might be better if the patient has their vision adapted to the dark prior to the test," he says. "This is because they had found that rod receptors – vision cells that we use to see in black and white and in low light – die earlier in AMD than the cone receptors we use to see in colour during the day. So it had been suggested that AMD tests would be more accurate if they were based on the health of a person's rods."

However, recent research has shown that the eye's cones, while dying later than rods, start to deteriorate at the same time as the 'night' vision cells.

"We found little to no difference in the results. This means that the cones of an AMD patient are about as damaged as the rods, so tests that are based on a person's cone vision are just as accurate."

"Our research indicates that it's not necessary for people to be dark-adapted, which eliminates any long waiting periods and the need for dark rooms. So it is an easier test than was previously thought."



Mark Kendall



An impression of the seven mirror array at the heart of the GMT.

## Mirror milestone for giant telescope

Construction of what will be the world's largest, most-advanced optical telescope – the Giant Magellan Telescope (GMT) – has reached a major milestone, with fabrication completed in Arizona of the first of seven enormous and technically challenging mirrors that will enable unprecedented advances in understanding the universe.

The mirror is 8.4 metres in diameter and was cast at the University of Arizona from 20 tonnes of glass, melted then shaped and polished to precise optical standards. The mirrors are to be made of low-expansion glass moulded into a light-weight honeycomb structure. The most challenging aspect of making the GMT's mirror segments arises from the asymmetric shape of the six outer segments.

One of the mirror segments will be mounted at the centre axis of the telescope, with the other six mounted surrounding it, with each mirror segment mounted into its own 'cell', a complex active support system that will keep the mirror in the proper position relative to the other segments.

The telescope will be located at Las Campanas, an observatory in the Chilean Andes operated by the Carnegie Institution for Science, and is scheduled to commence operations toward the end of the decade.

The Australian National University is leading Australia's participation in the GMT international consortium. Other GMT partner institutions include Astronomy Australia Ltd, the Carnegie Institution for Science, Harvard University, the Korea Astronomy and Space Science Institute, The Smithsonian Institution, Texas A&M University, the University of Chicago, the University of Arizona and the University of Texas at Austin.

The project is supported by funding from the Australian Government's Education Investment Fund as part of the Super Science Initiative, securing access for Australian researchers to the telescope and building Australia's capacity to participate in its design and component manufacture.

Professor Harvey Butcher, Director of the ANU Research School of Astronomy and Physics and a member of the GMT Board, says: "Never before has a large telescope mirror been made on this scale and with this level of technical precision."

Professor Matthew Colless, Director of the Australian Astronomical

Observatory and Vice Chair of the GMT Board, says: "The Giant Magellan Telescope has the potential to transform how we see the cosmos and our place in it."

## ANSTO TO MANAGE SYNCHROTRON

The Australian Synchrotron in Melbourne will now be managed by the Australian Nuclear Science and Technology Organisation (ANSTO), following the announcement in March that the Australian and Victorian governments had secured the future of the Synchrotron through a \$100 million, four-year funding arrangement.

The Minister for Science and Research, Senator Chris Evans, said the agreement would enhance the capacity of the Synchrotron and ANSTO to deliver important scientific outcomes for Australia.

Neutron scattering science at ANSTO and accelerator science at the Australian Synchrotron have told researchers different stories about how things work at the molecular level. "When combined, these two complementary science disciplines give a more comprehensive view that will enable new Australian discoveries, from better ways to fight disease to how industrial processes operate," Minister Evans said.

The Synchrotron accelerates electrons to create light beams a million times brighter than the sun. These intense beams allow hundreds of scientists every year to examine sub-microscopic structures, improving research outcomes in medicine, agriculture, bioscience, engineering, forensics and environmental science.

ANSTO's CEO Dr Adi Paterson FTSE said the new operating arrangements were another step in an extraordinary growth period for science in Australia.

"ANSTO is the long-time custodian of some of Australia's most significant science infrastructure. We manage one of the world's best multi-purpose research reactors, OPAL, which produces nuclear medicines and neutrons used for scientific research at our adjoining Bragg Institute.

"We also operate two particle accelerators and are in the building phase of the Federal Government's new Centre for Accelerator Science, which will attract local and international scientists."

## BIRDS LIKE NATIVE STREET TREES

A world-first study in Canberra has shown that birds favour native trees in our cities and the number of native trees on suburban streets has a big effect on the numbers and types of birds in the area.

"We found that suburbs with more than 30 per cent native street trees have 11 per cent more bird species of all types than those with exotic street trees," say Dr Karen Ikin and Professor David Lindenmayer from the ARC Centre of Excellence for Environmental Decisions and ANU.

The researchers surveyed 66 bird species at 40 locations across Canberra and grouped native birds by their tolerance of urbanisation.

"With the exception of native birds that avoid urban areas, a significantly higher number of bird species – both feral and native – were found in suburbs with more than 30 per cent of *Eucalyptus* trees," Dr Ikin says.

"Exotic trees like oaks, elms and plums are the most popular choices in current street tree plans. While these trees have their benefits, such as providing more sun in the winter or bushfire protection, our study reveals that they may have a negative impact on native birdlife."

Eucalypts, on the other hand, have a crucial role in maintaining biodiversity. "They provide food, nest sites and shelter for birds via foliage, flowers, bark, canopy air spaces and leaf litter," Dr Ikin says.



# Clinton launches UWA's USAisa Centre

US Secretary of State Hillary Rodham Clinton took the opportunity during her visit to Perth in November to launch the Perth USAisa Centre at The University of Western Australia.

The Centre aims to be a leading policy think tank on the Australia-Asia-US strategic and economic relationship, a teaching and research centre, and a conduit for a deeper Australian understanding of US business, culture, history, politics and foreign policy. It will work in close partnership with the United States Studies Centre at the University of Sydney and add new dimensions, drawing on the distinctive attributes of WA and its existing relationship to Asia.

Professor Paul Johnson, UWA Vice-Chancellor, said the Perth USAisa Centre would rapidly become a globally significant institution, drawing strength from proximity to Asia and the expertise and existing links in WA.

"The Perth USAisa Centre will be in a unique position, both geographically and in a policy sense, to analyse and understand the US and Asia," Professor Johnson said.

Perth USAisa Centre is a \$10 million initiative between the US Studies Centre, the American Australian Association and UWA, with major funding from the Australian and WA governments and US corporations.

The Perth USAisa Centre will initially specialise in three policy areas:

- the Australia-Asia-US strategic and economic triangle – evolving political-military relations in the Indo-Pacific, including American military presence in north-west Australia and Australia's defence procurement plans, including next-generation submarines; WA's

key role in China-US economic relations as a location of American investment and a supplier of the Chinese and broader Asian market, with a focus on iron ore, liquefied natural gas and food production;

- the business of energy and sustainability – maximising the long-term benefits of the resources boom; alternative energy including wind, solar and geothermal; and food, soil and water sustainability;
- WA and the American west – leveraging the close historical, cultural, climatic and environmental parallels between these two regions.

It will also provide undergraduate and postgraduate teaching and opportunities for Australian students to study in the US to gain an international perspective and critical understanding of American politics, foreign policy, business, law, media, culture and society.

## CSIRO JOINS CHANGE RESEARCH COMMUNITY

Australia has joined the International Institute for Applied Systems Analysis (IIASA), which specialises in the application of advanced systems analysis to examine the complex systems that are at the heart of today's global challenges, specifically energy, water, food, climate change and population growth.

Membership of IIASA, which is based in Europe, offers Australian research agencies coordinated access to networks of national science academies, research organisations and networks and also supports the efforts of many Australian research organisations, including CSIRO, to grow international partnerships and collaborations.

CSIRO will be the National Member Organisation that represents Australia on the governing council.

IIASA is an international scientific institute that conducts research into the critical issues of global environmental, economic, technological and social change. It is independent and funded by scientific institutions in Africa, the Americas, Asia and Europe. IIASA's 20 national members include Austria, Australia, Brazil, China, Egypt, Finland, Germany, India, Indonesia, Japan, Republic of Korea, Malaysia, Netherlands, Norway, Pakistan, Russian Federation, South Africa, Sweden, Ukraine, and the US.

## RMIT GETS \$80M DESIGN HUB

An \$80 million centre for design research and teaching at RMIT will help increase cross-disciplinary collaboration with industry in Australia and on the international stage.

Opening the Design Hub at RMIT, the Federal Minister for Tertiary Education, Senator Chris Evans, said the massive 10-storey, 13,000M<sup>2</sup> centre was built with \$28.6 million from the Australian Government through the Education Investment Fund.

"Design is a building block for innovation, it contributes to local industries and increases economic productivity," Senator Evans said. "The Design Hub provides the research space needed – at a scale never previously available at RMIT or elsewhere in Australia – to increase research and postgraduate teaching in design.

"The new Hub brings together Australian design researchers, leading international researchers and industry practitioners to work on joint projects, from architecture to interior design.

"The Hub gives Australian students and researchers the space they need for the sort of cross-disciplinary research that will make Australia truly innovative in this field and be more competitive in the global economy."



Hillary Rodham Clinton at UWA.

# Online media coaching resource for scientists

The misrepresentation of science and a need for more science heroes in the media are the driving forces behind a new online tool for scientists.

Developed by the Australian Science Media Centre with support from CSIRO, Science Media Savvy is a pioneering online tool to help scientists work with the media and better inform public debate on major issues.

Featuring interviews with news journalists and editors, advice from researchers experienced in media, and videos highlighting how to improve print and broadcast interview experiences, this free resource provides tips and advice for understanding and dealing with the news media.

"We have to engage with the media because there's so much misunderstanding and misrepresentation of science," says Nobel Laureate and Science Media Savvy contributor Professor Peter Doherty AC.

"Science needs its own heroes who are willing to step forward and go into bat for science," says editor-in-chief of news.com.au and Science Media Savvy contributor David Penberthy. "It's important too to recognise that the general public is more sophisticated than they are often given credit for."

The instant online availability of Science Media Savvy.org will help fill a gap in terms of what is currently available to scientists, giving them advice on dealing with the media as they need it, from any internet-enabled computer, mobile phone or tablet.

**More information:** [ScienceMediaSavvy.org](http://ScienceMediaSavvy.org)

## BUILDING THERMOMETER ACCURACY

Australian physicists are on a quest to build the world's most accurate thermometer. A \$150,000 Precision Measurement Grant from the US National Institute of Standards and Technology will fund theoretical research at the University of Queensland and optical experiments based at the University of Adelaide with support from the University of Western Australia.

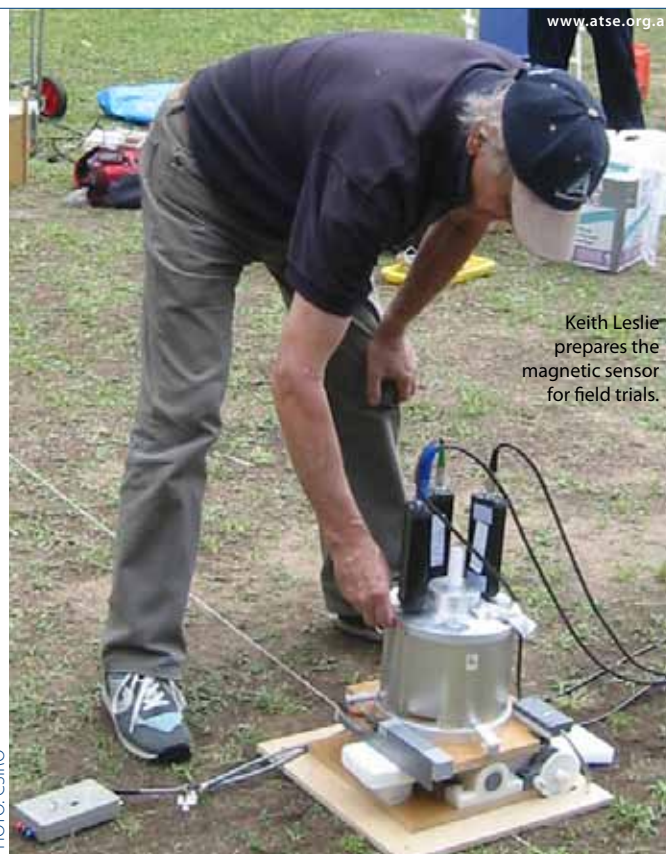
Lead researcher, UQ's Dr Tom Stace, says the grant will support the research team in using quantum mechanics to create a thermometer capable of measuring temperature to an accuracy of better than one part in a million. The team also involved Professor Andre Luiten of the University of Adelaide and UWA's Professor Eric May.

Dr Stace says the grant paves the way for an exciting project that is critical in a century-long international physics effort to base measurement units, such as the metre and the Kelvin, on fundamental physical constants, rather than specific physical, reference objects. As part of this effort, the physics community wants to define fundamental constants as exact quantities.

The Precision Measurement Grants, which started in 1972, have never before been awarded outside North America. Of 25 proposals submitted this year, only two were successful.

The US National Institute of Standards and Technology, a branch of the US Federal Government Department of Commerce, is one of America's oldest physical science laboratories, established to enable US industrial competitiveness at the turn of last century.

The Institute's measurements support the smallest of technologies – nanoscale devices so tiny that tens of thousands can fit on the end of a single human hair – to the largest and most complex of human-made creations, from earthquake-resistant skyscrapers to wide-body jetliners to global communication networks.



Keith Leslie prepares the magnetic sensor for field trials.

PHOTO: CSIRO

## CSIRO WORKING TO FIND SEA FLOOR EXPLOSIVES

Using technology developed to find mineral deposits underground, CSIRO has developed a sensor to detect undetonated explosives on the sea floor.

More than 10 million acres of the world's coastal waters are contaminated by undetonated explosives, according to the US Government agency the Strategic Environmental Research and Development Program (SERDP). Typically, these small explosives rust and corrode at sea, making them even more dangerous.

The sensor was developed as part of a project with SERDP and US-based research organisation Sky Research. It has been proved in a stationary laboratory environment. Trials have been conducted to prove it in motion, in preparation for anticipated underwater trials.

Its technique is very similar to that used to detect underground mineral deposits, says CSIRO electrical engineer Dr Keith Leslie.

"Our highly sensitive sensor – the high temperature superconducting tensor gradiometer – delivers significantly more information about the target's magnetic field than conventional sensors used for this type of detection," Dr Leslie says. "It provides data on the location, characterisation and magnetic qualities of a target, whether it is a gold deposit or an explosive."

"The marine environment is difficult to sample due to electrical currents produced by waves, which affect underwater magnetic fields. In mineral exploration, near-surface deposits are being exhausted, leading our search for minerals deeper underground, where targets are more difficult to detect with traditional surface and airborne measurements."

The CSIRO sensor can provide valuable geological information that discriminates between prospective and non-prospective areas or targets. It avoids unnecessary drilling and minimises the risk of overlooking valuable mineral deposits.

Eventually the technology may renew exploration efforts at abandoned sites where drilling programs were based on insufficient or inaccurate information. It also has the potential to help clear landmines.



# Now hear this! The Cochlear story



By Ian Rae  
iandrae@bigpond.com

Following her Doctor of Business Administration thesis on small firms in the Australian biotechnology industry, Veronica Bondarew set out to write the Cochlear story. The book was at an advanced stage when she had to abandon it, but it was 'brought back to life' by Peter Seligman, himself an important player in the Cochlear story.

Why, you might ask, do we need another book on Cochlear, one of Australia's best-known innovation stories, when authors can list several others in their bibliography.

Part of the answer is that none of the existing literature takes the story beyond 2000 when Professor Graeme Clark AC FRS FAA FTSE published his *Sounds from Silence*. Interesting things have happened since then, especially in the past eight years since Dr Chris Roberts FTSE took over as CEO and President. A more cogent answer is that this book is organised on quite different lines, with chapters devoted to the contributions of different categories of people – entrepreneur, scientist, politician and public servant, engineer, surgeon, marketer – and to the impacts on recipients.

A number of the featured people are fellows of the Academy of Technological Sciences and Engineering – Clark himself, of course, Catherine Livingstone and Chris Roberts. As well as detailing the personal contributions, Bondarew and Seligman tell us a lot about the business strategies and the company's up and downs.

There is good coverage of the period when the project was owned by Pacific Dunlop and the reasons it was cut free; the success of Catherine Livingstone AO FTSE – a 'saving grace' – in getting things back on track; and strong leadership at Board level by David Pennington. There are interesting stories, too, of struggles to meet regulatory requirements and to overcome

resistance by deaf people (and their communication therapists) who did not want their silences disturbed by technology.

While this treatment is effective in meeting its objective of personalising much of the story, it does blur the timeline and also presents the technology as something of a Glass Bead Game, the details of which the reader can struggle to put together into a coherent package. For the big picture, I found it helpful to read Clark's 2000 book, after which I was able to go back to the details.

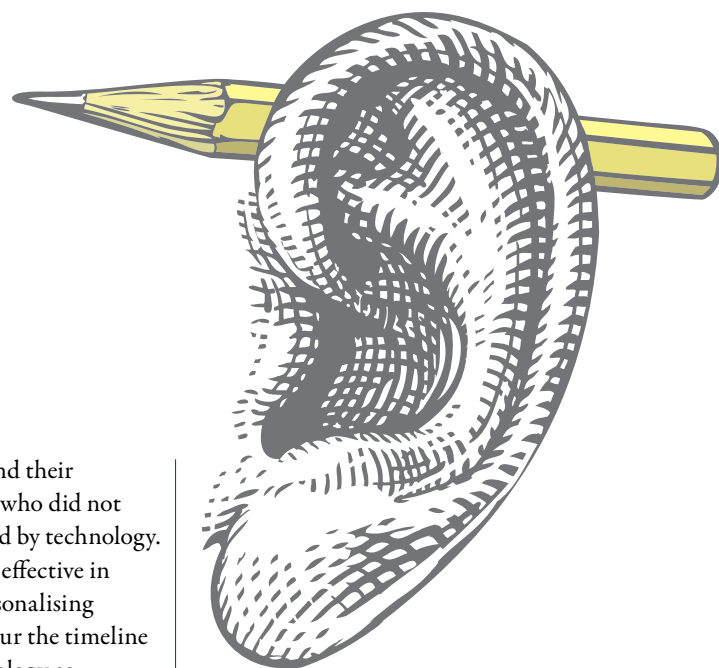
Bondarew and Seligman include a technology-dense chapter entitled 'Software and Hardware' in which they relate the continual development of the device, including the company's practice of updating earlier recipients as new models were developed, thus operationalising the company motto 'Hear now. And always'.

The bionic ear consists of an implant with electrical connections to key nerves and a battery-powered external module to detect and process sounds before delivering them across the skin to the implanted device. Initially this speech processor was large and the task of miniaturising it so that it could be carried in a pocket or eventually worn on the head is one of the fascinating story lines. Part of it, to give just a simple example, is the inclusion of magnets inside and outside the skin, to ensure maximum efficiency by aligning the processor with the implant.

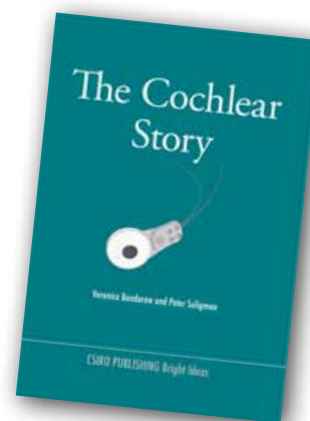
In the last few pages, there is a good index, a short bibliography and some pertinent photographs.

This is the first book in CSIRO's Bright Ideas series in which "each book will provide a fascinating and accessible story on a single invention that has changed our everyday lives".

Incredible though it is, Cochlear is only one such implantable device for overcoming deafness, albeit a major one



This is the first book in CSIRO's Bright Ideas series in which "each book will provide a fascinating and accessible story on a single invention that has changed our everyday lives".



*The Cochlear Story* by Veronica Bondarew and Peter Seligman (CSIRO Publishing – Bright Ideas 2012, paperback, 248pp; \$49.95)

with 70 per cent of the global market (and 160,000 satisfied customers). While the lives of recipients and those around them are profoundly affected, this is a small number on the global scale.

It will be interesting to see what is judged in subsequent CSIRO volumes as affecting 'our lives'.

PROFESSOR IAN RAE FTSE, an Honorary Professorial Fellow at the University of Melbourne, is a former Technical Director of ATSE. He was President of the Royal Australian Chemical Institute (2006–08) and has served for more than a decade as a technical adviser to the United Nations Environment Program.

# ATSE INFOCUS

NUMBER 175  
DECEMBER 2012



Stephen Hopper and Lyn Beazley at the dinner.

## Fellows in WA Science Awards limelight

Internationally acclaimed plant conservation biologist Professor Stephen Hopper AC FTSE, who recently stepped down as director of London's World Heritage-listed Royal Botanic

Gardens in Kew to take up a new Chair in Biodiversity at UWA, was inducted into the WA Science Hall of Fame at the Western Australian Science Awards 2012 in Perth in October.

The WA Science Hall of Fame recognises meritorious contribution to the science community over an extended period of time.

Winthrop Professor Stephen Powles FAA FTSE, an international expert on herbicide resistance in crops and weeds who has made significant contributions to Australian agriculture, was a Scientist of the Year Finalist.

Dr Bernard Bowen AM FTSE accepted the award for Scientist of the Year on behalf of Professor Peter Quinn, whose efforts to develop WA's radio astronomy capabilities played a central role in the success of the Australian Square Kilometre array campaign.

WA's Chief Scientist, and member of the ATSE WA Committee, Professor Lyn Beazley AO FTSE, and WA Science and Innovation Minister John Day attended the presentation dinner.

## RICHARD LARKINS TO CHAIR SYNCHROTRON

Emeritus Professor Richard Larkins AO FTSE has been appointed Chair of the Australian Synchrotron Company Ltd and the Australian

Synchrotron Holding Company Pty Ltd.

The Australian Nuclear Science and Technology Organisation (ANSTO), which will manage the Synchrotron, has welcomed the appointment.

"Professor Larkins has extensive experience in scientific research, health and academic management," said ANSTO CEO Dr Adi Paterson FTSE. "As a former Vice-Chancellor and President of Monash University, Professor Larkins is a long-term partner of the Australian Synchrotron and understands the needs of this landmark Australian science infrastructure.

"We are absolutely delighted that someone of Professor Larkins' calibre will be bringing his invaluable experience to the Synchrotron at this important time in its history. ANSTO is very much looking forward to working with Professor Larkins to deliver the Australian Synchrotron as a truly national science facility," Dr Paterson said.

Professor Larkins succeeds Mrs Catherine Walter AM after her five years as Chair.

Richard Larkins



Stephen Powles (right) receives his certificate from Minister John Day.



## SA FAREWELLS PETER HØJ

The University of South Australia farewelled Vice Chancellor Professor Peter Høj FTSE (right) before he left to take up the VC role at The University of Queensland. Farewelling him are (from left) ATSE Director Emeritus Professor Mike Miller AO FTSE, UniSA Director of Services Ms Carol Sutherland, and SA Division Chair and UniSA Chancellor Mr David Klingberg AO FTSE.





Tony McMichael

## ANU farewells Tony McMichael

The Australian National University recently held a two-day conference covering issues from climate change to lead poisoning to commemorate the 40-year career of Professor Tony McMichael AO FTSE.

To mark the world-renowned researcher's retirement from the National Centre for Epidemiology and Population Health, ANU hosted a festschrift – a formal celebration of his career.

Experts from around the world gathered to present talks on the wide range of subjects Professor McMichael has looked at over the past four decades, foremost of which are the health consequences of climate change.

"The effects of climate changes in the past are really just a small taste of what we could expect to happen in the coming century," Professor McMichael said.

"For example, with warming, mosquito-borne Japanese encephalitis could spread to Australia via Cape York."

One area that Professor McMichael is passionate about is creating strategies to deal with the effects of climate change, such as the rising number of deaths during severe heat-waves.

"We've built our cities in ways that often maximise them as heat traps," he said. "During a heat-wave, not only do residents get exposed to the extremes during the day, but temperatures don't go down at night. We need more green space, more ventilation, and better insulation of private houses and public buildings."

### KEYNOTE SPEAKERS AT THE CONFERENCE WERE:

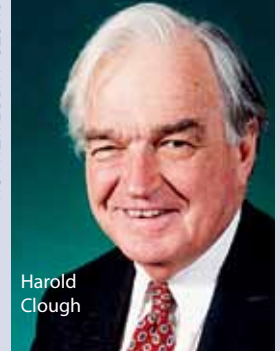
- Professor Alistair Woodward, University of Auckland;
- Dr Sari Kovats, London School of Hygiene and Tropical Medicine; and
- Professor Kirk Smith, University of California Berkeley.

A book of invited essays based on the festschrift will be published next year.

Graham Schaffer addresses the launch breakfast.



PHOTO: ANDREW TALLON



Harold Clough

## SMART ENGINEERING REPORT LAUNCHED

The Academy was a key partner in the launch event in Brisbane in November of the report *Engineering Queensland – The Smart Engineering State*, prepared by Professor Graham Schaffer FTSE in collaboration with the Office of the Queensland Chief Scientist, Dr Geoff Garrett AO FTSE (see *Focus* 174).

The breakfast launch, at Brisbane's Customs House, posed the questions: 'Can Queensland – as a cluster of firms, universities and research organisations – provide global scale and specialised engineering services to compete internationally? Can Brisbane be a true world engineering city, along the lines of Houston, USA? Is this desired? Is it even possible? And what do we need to do to get there?'

The launch of the Report – a proposal for building Queensland as a global centre of engineering excellence – allowed attendees to engage with an expert panel on the topics. It was a partnership between the Queensland Government, UQ, Engineers Australia and ATSE.

The Customs House Long Room event drew people from industry, government and academe, including new Fellows, Mr Andy Greig FTSE – who told the audience he would be supporting ATSE's education endeavours – and Mr Charlie Sartain FTSE.

## UWA CLOUGH SCHOLARS PROGRAM RELAUNCHED

Top engineering students at The University of Western Australia will again have the opportunity to apply for scholarships through the Clough Scholars program, which has been revived.

The program was established in 1969 and was the brainchild of former Clough chairman and managing director Dr Harold Clough AO OBE FTSE. It has awarded more than 200 scholarships to WA's brightest engineering students. Past recipients include government, business and resource industry leaders.

Clough will award four scholarships each year to top students in the first and final year

of their Masters of Professional Engineering degree.

UWA Acting Vice-Chancellor Professor Bill Loudon said the program had contributed significantly to the university's success.

"Dr Clough was instrumental in creating one of the first successful university-industry partnerships and this laid the foundations for many other successful ongoing UWA-industry partnerships," Professor Loudon said.

## STELR AT TEACHERS' CONFERENCE

Rod Dunstan, STELR Education Officer, recently attended the National Conference for Environmental and Sustainability Educators in Melbourne.

Thea Nicholls is at Melbourne's Brentwood College, one the STELR schools involved in the STELR/API Solar Car Program.

Thea said that the STELR program was a hit with teachers and students and the solar cars got some of her least motivated students really involved. "They came in at lunchtimes to work on their cars, which is a first for them and something I certainly was surprised by," Thea said.



Rod Dunstan and Thea Nicholls.

# Top business leaders join ATSE

Leading business figures are prominent among the new Fellows elected to the Academy.

They include Mr Michael Chaney AO FTSE, Sir Rod Eddington AO FTSE, Mr Alan Joyce FTSE, Dr Marius Kloppers FTSE and Mr Sam Walsh AO FTSE.

They are among 37 Australian researchers, technological scientists, engineering, innovation and business leaders in water, energy, resources and medical technologies elected as Fellows of the Academy.

The new Fellows include some of the most prominent women in Australia's technology industries, including Professor Rose Amal FTSE, Dr Bronwyn Evans FTSE, Dr Katrina Fairley-Grenot FTSE, Ms Karlene Maywald FTSE, Ms Chloe Munro FTSE and Professor Robyn Owens FTSE.

The Vice President of the Chinese Academy of Sciences, Professor Jinghai Li FTSE, was recognised a new Foreign Fellow in the Academy's annual election process.

Other prominent figures elected include: Professor Don Bursill AM FTSE, SA Chief Scientist; Professor Ed Byrne AO FTSE, Monash University Vice Chancellor; Mr Andy Greig FTSE, MD, Bechtel Australia; Mr Jim Hallion FTSE, Head, Department of Premier and Cabinet, SA; Mr David Knox FTSE, CEO, Santos; Mr Charlie Sartain FTSE, CEO, Xstrata; and Mr Hamish Tyrwhitt FTSE, CEO, Leighton Holdings.

Health technology figures elected include Professor Branko Celler FTSE, Dr Andrew Cuthbertson FTSE and Professor Klaus Schindhelm FTSE.

Prominent ICT names include Dr John O'Sullivan FTSE, Dr Terence Percival FTSE, Professor Stan Skafidas FTSE and Mr Glenn Wightwick FTSE.

## THE FULL LIST FOLLOWS

## 2012 FELLOWS

### Professor Rose Amal FTSE

Scientia Professor, The University of New South Wales

Professor Amal is an internationally recognised chemical engineering researcher. Her work on particle and catalyst technologies has resulted in safer and cleaner water supplies and has fuelled dramatic improvements in waste management through innovative approaches to recycling and clean energy. Her achievements have been recognised by her appointment as a Director of an ARC Centre of Excellence and ARC Professorial Fellow and as a UNSW Scientia Professor while still at a relatively early stage of her career.

### Dr Ian Brown FTSE

CEO and Managing Director, Clover Corporation Ltd

Dr Brown has successfully led industrial programs to develop technologically advanced innovative products that meet commercial customer and consumer needs. He has applied existing science and fostered research collaborations to substantiate the health value of food ingredients he has developed. Himaize™, the world's first commercial resistant-starch ingredient, developed under his leadership, is used in bakery and other consumer products worldwide to enhance bowel health.

### Professor Don Bursill AM FTSE

Chief Scientist, South Australia

Professor Bursill has made an outstanding contribution to the water industry and government. He has spent 39 years in the water industry, with his principal interests being in water quality policy and management, treatment technologies, water resources planning and management and analytical techniques. He is nationally and internationally recognised for his expertise and leadership and has headed a number of international collaborative programs.

### Professor Edward Byrne AO FTSE

Vice-Chancellor and President, Monash University

Professor Byrne has made important contributions to clinical neurology and neurological research, most notably elucidating the role of mitochondrial failure in common disorders and human ageing. He has had a long engagement with industry through leadership of major academic industry collaborations, development of Neurosciences Victoria and Neurosciences Australia, and Board membership of substantial companies such as Cochlear and Bupa. He is Deputy Chair of the Group of Eight universities.

### Dr Peter Carberry FTSE

Deputy Director, CSIRO Sustainable Agriculture Flagship

Dr Carberry is internationally recognised in the science and application of systems research and modelling in agriculture. He is a key developer of the APSIM (Agricultural Production Systems sIMulator) model and its



Rose Amal



Don Bursill



Ed Byrne

commercial delivery. He has been instrumental in increasing the participation of Australian farmers and agribusiness in delivering outcomes from research investments. He has led soil fertility development projects in south Asia and Africa.

#### **Professor Branko Celler FTSE**

**Chief Scientist, CSIRO ICT Centre**

Professor Celler is an internationally regarded leader in the field of Telehealth and was among the first to recognise the importance of community-based management of chronic disease in ageing populations – now an issue of huge social and financial importance to healthcare services globally. Through successful commercialisation via Telemedcare Pty Ltd, Professor Celler has made an enduring impact upon the development and realisation of telehealth products and services.

#### **Mr Michael Chaney AO FTSE**

**Chairman, Woodside Petroleum Ltd and National Australia Bank, and Chancellor, The University of Western Australia**

Mr Chaney has had an outstanding impact on Australia's minerals resource industry. From eight early years as a petroleum geologist, he moved to the Australian Industry Development Corporation where he was involved in financing for the North-West Shelf development. He then joined Wesfarmers where, as Managing Director, he diversified the company across a range of activities including coal mining, gas processing and distribution, chemicals and fertiliser manufacture and rail transport.

#### **Ms Janis Cocking FTSE**

**Chief, Maritime Platforms Division, Defence Science & Technology Organisation**

Ms Cocking led the scientific and technological support program for the Collins class submarines, solving many problems that beset the early submarines of the class. She has also demonstrated how unmanned underwater systems can complement manned submarines in delivering enhanced defence capability. She now serves with distinction as Chief of DSTO's Maritime Platforms Division, where she oversees the S&T support program for the Royal Australian Navy's fleet.

#### **Dr Andrew Cuthbertson FTSE**

**R&D Director and Chief Scientific Officer, CSL Ltd**

Dr Andrew Cuthbertson has a distinguished record of research – at the University of Melbourne, Walter and Eliza Hall Institute, Howard Florey Institute and the US National Eye Institute – into the molecular development biology of the eye and eye diseases. Dr Cuthbertson has a keen interest in biotechnology drug development, particularly in the emerging field of immunotherapy. He played a lead role in the commercialisation of the Gardasil recombinant vaccine against the human papilloma virus.

#### **Sir Rod Eddington AO FTSE**

**Chairman, Infrastructure Australia**

Sir Rod has built on an outstanding education in engineering and a Rhodes Scholarship to become one of Australia's most accomplished and influential industry and business leaders. He is the inaugural chair of Infrastructure

Australia and was commissioned by the British Government to study and report on links between transport and the economy. He was CEO of British Airways and Cathay Pacific Airways, and board roles have included Qantas, Ansett, Rio Tinto, JP Morgan and News Corporation.

#### **Dr Bronwyn Evans FTSE**

**Senior Vice President Quality, Clinical & Regulatory, Cochlear Ltd**

Dr Evans is an outstanding Australian engineering leader who has effectively promoted engineering as a rewarding career for women. She is Chair of Engineers Australia's National Board of the Centre for Engineering Leadership and Management (CELM) and Chair of the Advisory Board of ROBOGALS. She is a director of both The John Holland Group and The Warren Centre for Advanced Engineering and was named by EA in 2007 among Australia's Top 25 Most Influential Female Engineers.

#### **Dr Katrina Fairley-Grenot FTSE**

**Advisor, Science and Technology Policy Fellow, Australian Institute of Company Directors**

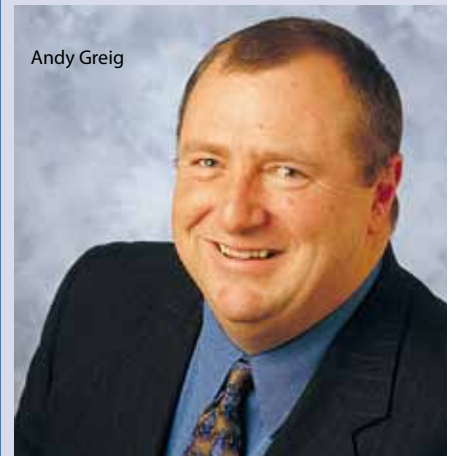
Dr Grenot has demonstrated the talent and experience to integrate visible and invisible trends into well-designed plans to address complex challenges such as strengthening Australia's innovation system. Her roles include Chair of the Rural Research and Development Council, Member of the Prime Minister's Science Engineering and Innovation Council and Carbon-Energy-Water Intersection Expert Working Group and Australian Research Committee Expert Advisory Group.



Michael Chaney



Sir Rod Eddington



Andy Greig



**Professor Kevin Galvin FTSE**

Director, Centre for Advanced Particle Processing and Transport, University of Newcastle

Professor Galvin is the inventor of the Reflux Classifier, a radical separation technology used in mineral processing. Each unit can recover \$100 million worth of coal a year and sales and orders of the units are near 60. Impact of his work has been recognised by the 2012 Ian Wark Medal, the IChemE Innovation Award in 2010 and the B-HERT award in 2005. Recent industry take-up of Professor Galvin's invention has been rapid, with exports to eight countries.

**Mr Andy Greig FTSE**

Managing Director, Bechtel Australia and President, Bechtel Corporation, Mining and Metals Global Business Unit

Mr Greig has grown Bechtel Australia to staff numbers of about 3500, servicing major infrastructure projects across Australia. These include most of the nation's major liquefied natural gas facilities, the largest coal services facility in the world and Rio Tinto's Yarwan 2 alumina refinery. In 2002, Mr Greig convinced Bechtel management that Brisbane rather than Denver was the logical home for the Mining and Metals Unit – one of five business lines that make up the Bechtel international empire.

**Dr Bruce Godfrey FTSE**

Principal and Director, Wyld Group

Dr Godfrey has had sustained and outstanding impact in the leadership, nurturing and commercialisation of energy research and development and innovation in Australia and internationally. His focus has been on the SME (small and medium business) sector where he has

led the development of R&D through to commercialisation and to international markets through various CEO roles. Dr Godfrey has also played an important part in the development and implementation of energy R&D strategy for Australian governments.

**Mr Jim Hallion FTSE**

Chief Executive, Department of Premier and Cabinet, South Australia

Mr Hallion is an engineer and Chief Executive, Department of Premier and Cabinet in South Australia. He has been Chief Executive of the Departments of Industry and Trade, Primary Industries and Resources, and Transport, Energy and Infrastructure. He has been involved in many major infrastructure projects and has revitalised SA's resources industry and its gas and electricity markets. Mr Hallion has also been active in water reform and is a Member of Infrastructure Australia.

**Dr Paul Heithersay PSM FTSE**

Executive Director, Department for Manufacturing, Innovation, Trade, Resources and Energy, SA

Dr Heithersay has arguably been the most influential government scientist/executive in the global minerals sector over the past decade. The initiatives implemented to encourage mineral exploration and development in South Australia have been copied by government agencies worldwide. SA has gone from a mineral exploration and development backwater to being consistently ranked among the world's best places for the minerals industry to do business.

**Professor Martyn Jeggo FTSE**

Director, Australian Animal Health Laboratory, CSIRO

Professor Jeggo is recognised nationally and internationally for veterinary laboratory

diagnosis and research. He developed an international system for veterinary laboratory accreditation and developed and managed laboratory networks, supporting the global eradication of rinderpest and other livestock disease control programs, delivering significant economic benefits. Since 2002, he has managed the redevelopment of the Australian Animal Health Laboratory (AAHL), now a leading global research institute.

**Mr Peter Johnson FTSE**

Principal, Arup Group

Mr Peter Johnson is an Australian consulting engineer specialising in fire safety engineering design. He has led the Arup Group's Division with more than 200 engineers in 23 offices around the world from an Australian base. The projects are important – Heathrow Airport T5 Terminal, Beijing Olympic Aquatic Centre (Water Cube), Sydney Opera House upgrade and Denmark's Fehmarnbelt Tunnel. Earlier he was involved in the program that reformed the building regulations, with seminal influence on fire safety.

**Mr Alan Joyce FTSE**

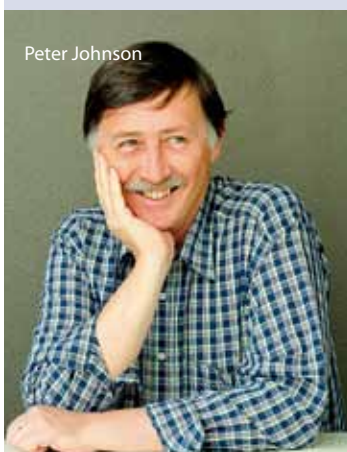
Managing Director and Chief Executive Officer, Qantas Airways Ltd

Mr Joyce has a record of achievement in the airline industry. He obtained a Bachelor of Science in Applied Science (Physics and Mathematics) with Honours and a Master of Science in Management Science, both from Trinity College, Dublin. His airline work included information technology, network planning, schedules planning, operations research and network strategy. Mr Joyce is recognised for his leadership in Australia's airline industry at Ansett, Jetstar and Qantas. He is a Fellow of the Royal Aeronautical Society.

**Dr Marius Kloppers FTSE**

Chief Executive Officer, BHP Billiton

Dr Kloppers has built on an education in chemical engineering and materials, with a PhD from MIT, to become a leading world figure in the minerals industry. He began his career in South Africa and, after receiving his MBA, worked as a management consultant with McKinsey & Co in the Netherlands. He joined the Billiton Group in 1993, where he was a core member of the team that created the group's aluminium business. Mr Kloppers played a central role in the merger of BHP and Billiton and is chairman of the International Council on Mining and Metals.



Peter Johnson



Marius Kloppers

**Mr David Knox FTSE****Chief Executive Officer and Managing Director, Santos Ltd**

Mr Knox is an influential industry leader in South Australia and the nation. A mechanical engineer, he has 30 years' experience in the global oil and gas industry, including Managing Director of BP Developments in Australasia and positions with BP, ARCO and Shell in Australia, the UK, US, the Netherlands, Norway and Pakistan. He is Chairman of APPEA, a Council Member of Business Council Australia and the Royal Institute of Australia, and a Fellow of the Institution of Engineers, Australia.

**The Hon Karlene Maywald FTSE****Chair and Commissioner, National Water Commission, and Consultant, Maywald Consultants Pty Ltd**

Ms Maywald has had a lifetime involvement with the River Murray, particularly in the South Australian Riverland, and a thorough understanding of Australian water resource management. She understands the specific science of River Murray operations, their impact on communities, and the need for those communities to understand and respect the need for a sustainable river flow in the river. As a SA Government Minister she marketed the need for change to landholders and public servants.

**Professor Cynthia Mitchell FTSE****Professor, Institute for Sustainable Futures, University of Technology, Sydney**

Professor Mitchell is making outstanding contributions in water cycle management in industrial and urban settings. Her work for change is highly valued by industry and community groups, striking the balance between relevance and rigour and making

a practicable difference in embedding sustainability practices. She has made an exceptional contribution, both to the development of researchers and the continuing professional development of industry and community groups.

**Ms Chloe Munro FTSE****Chair and Chief Executive Officer, Clean Energy Regulator**

Ms Munro has pursued a career at the interface of science and technology, public policy, service delivery and corporate finance. Following New Zealand appointments leading to the creation of Crown Research Institutes, she held appointments in the Victorian Treasury; as Secretary of two Victorian Government departments; senior positions in Telstra; and Commissioner and Chairman of the National Water Commission. She holds a number of significant Board appointments.

**Dr John O'Sullivan FTSE****Honorary Fellow, CSIRO**

Dr O'Sullivan's innovation, research and leadership in wireless technologies and networking has impacted on the global use of computers, the internet and how we work through a patented invention that has now been incorporated in more than a billion devices produced world-wide. The financial impact of this invention has been significant for Australia. He has also made significant contributions to radio astronomy instrumentation that have impacted on the operation of radio telescopes as well as new telescope development.

**Professor Robyn Owens FTSE****Deputy Vice-Chancellor – Research, The University of Western Australia**

Professor Owens' fundamental research in computer science and her collaborative

application of this research to innovations have led to major improvements in human health and wellbeing, nationally and internationally. She is recognised widely for her scholarship, her productive collaboration with researchers and practitioners from other disciplines, her contribution to system-wide excellence in research and research policy and her contributions to professional and community bodies.

**Dr Terence Percival FTSE****Director, Broadband and Digital Economy Business Team, NICTA**

Dr Percival has made major contributions in telecommunications and wireless internet, transforming successful research to industry and achieving global impact. These are exemplified by development of a new standard for international satellite communications, a key role in the development and patenting of Wi-Fi, resulting in more than \$750 million benefit to Australia, and pioneering the application of broadband in telehealth and film post-production.

**Mr Charlie Sartain FTSE****Chief Executive Officer, Xstrata Copper**

Mr Sartain is a highly respected industry leader and mining engineer. With MIM Holdings he rose to Executive Manager, Latin America and General Manager of Minera Alumbra, Argentina. Since Xstrata's 2003 takeover of MIM and his global appointment as Chief Executive Officer of Xstrata Copper, he has grown the company from ninth to fourth largest copper miner in the world, with a network of global mines all run from Brisbane. Mr Sartain is responsible for mines in Peru, Argentina, The Philippines and PNG.



Karlene Maywald



Chloe Munro



Robyn Owens

**Professor Klaus Schindhelm FTSE**

**Senior Vice President – Global Applied Research, ResMed Ltd**  
Professor Schindhelm has significantly enhanced Australia's international leadership in the area of medical devices/materials as a result of his successful research, development and translation into commercial reality. His research at the University of New South Wales was instrumental in development of artificial organ systems and biomaterials for contact lens applications. Research led by Professor Schindhelm at ResMed resulted in computerised methods to detect/treat abnormal breathing in sleep, thus securing the international market for this Australian company.

**Professor Stan Skafidas FTSE**

**Director, Centre for Neural Engineering, University of Melbourne**

Professor Skafidas is recognised for his vision, leadership and major technical accomplishments in industry, research institutions, academia and international standardisation committees. Adaptive frequency-hopping technology that he developed now forms a critical part of the Bluetooth standard and has been incorporated in several billion devices. His research in nano-electronics has advanced the disciplines of wireless communications, single chip radars and medical diagnostic systems.

**Dr Erica Smyth FTSE**

**Chair, Toro Energy Ltd**

Dr Smyth is exceptional for her leadership of technology-based enterprises, particularly through policy and technical improvement/innovation. She is Chair of Toro Energy (uranium), Scitech, the Diabetes Research Foundation (WA) and ScreenWest, and Director of ANSTO, EMECO Holdings Ltd (heavy earth moving equipment) and the Royal Flying Doctor Service (Western Australia). She is an influential and inspirational advocate of the minerals and energy industries.

**Professor Doreen Thomas FTSE**

**Associate Dean (Research & Research Training) and Head of Mechanical Engineering, University of Melbourne**

Professor Thomas has an outstanding international reputation for fundamental mathematical research in network optimisation. The software encapsulating her work is now used by the largest mining

companies in the world to reduce underground mine development and haulage costs. Professor Thomas has won a national teaching award for her contribution to engineering education and mentorship and is a passionate ambassador for women in science and engineering.

**Mr Hamish Tyrwhitt FTSE**

**Chief Executive Officer and Managing Director, Leighton Holdings**

Mr Tyrwhitt is an accomplished civil engineer with 27 years' experience in the construction industry. He is Chief Executive Officer and Managing Director of Leighton Holdings, an international contractor operating in more than 20 countries, and the world's largest contract miner. The Leighton Group employs more than 50,000 people. Hamish Tyrwhitt previously led Leighton Asia Ltd, which covered operations in Mongolia, The Philippines, Hong Kong, Malaysia and India.

**Ms Leonie Walsh FTSE**

**Director, Productive Management Solutions Pty Ltd**

Ms Walsh's career has demonstrated an exceptional combination of technical excellence, leadership and strategic vision in the area of technological innovation and commercialisation. Starting from her successes in polymer chemistry at Dow, she has advanced to globally significant successes in technology commercialisation and strategic leadership in industrial innovation. She is President of the Australasian Industrial Research Group.



Glen Wightwick

**Mr Sam Walsh AO FTSE**

**Chief Executive, Iron Ore Group, Rio Tinto Ltd**

Following a distinguished career in the automotive industry with General Motors and Nissan Australia, Mr Walsh joined Rio Tinto where he became Chief Executive of the Aluminium Group. He is now Chief Executive of Rio Tinto's global Iron Ore Group and has overseen its rapid expansion, with more than US\$7 billion spent on mine expansions and major infrastructure developments since 2004. He has led a technological initiative for automation in the mining industry, culminating in the centre in Perth for remote operation of much of the Pilbara fixed plant, mobile and rail equipment.

**Mr Glenn Wightwick FTSE**

**Director R&D & CTO, IBM Australia**

Mr Wightwick has made a major contribution to developing Australia's ICT industrial R&D base, driving the establishment and growth of IBM's Australian Technology Development Laboratory to become one of the largest in Australia, with more than 650 staff, and then driving the establishment of IBM's Australian Research Laboratory. He is a significant contributor to Australia's innovation system, with key Government and university roles, and is one of the best known and respected ICT industry R&D leaders in Australia.

**2012 FOREIGN FELLOW****Professor Jinghai Li FTSE**

**Vice President, Chinese Academy of Sciences**

Professor Li has pioneered the comprehensive Energy-Minimisation Multi-Scale (EMMS) theory for gas-solid systems. The theory has been applied to many different complex systems, and generalised into the EMMS paradigm of computation featuring the structural similarity ranging from multiphase flow fundamentals to software and hardware application, leading to the construction of supercomputers. His research outcomes have been widely used in the chemical and energy industries. He plays an important role in formulating policies for science and engineering in China, and fostering close research collaborations between Australia and China.





Paul Fraser

## Paul Fraser a CSIRO Fellow

Dr Paul Fraser FTSE, a Fellow since 2005, has been inducted as a CSIRO Fellow in recognition of his world-leading research relating to the major greenhouse gases (GHG) that drive climate change, as well as the conception and development of the Cape Grim Air Archive in Tasmania.

Dr Fraser has published more than 200 research papers and reviews, including 10 in *Nature* and *Science*. His research provides a scientific basis for efforts by Australian industry and government to reduce GHG emissions.

"The work by people like Dr Paul Fraser, who is a world leader in climate and atmospheric research, is not only vital for understanding and adapting to a changing climate, but is adding to the knowledge and expertise of a whole generation of scientists around the world in a range of other areas," said CSIRO Chief Executive Dr Megan Clark FTSE.

Dr Clark also announced that a team of that set a new world record of 10 gigabits per second for wireless data transmission had been awarded the 2012 CSIRO Chairman's Medal. The Ngara Backhaul Project Team was presented with the medal at the annual CSIRO Awards in Canberra in October.

Gigabit wireless networks can be used to complement high-speed fibre connections, in infrastructure for mobile communications, and for ad hoc communications services. This technology is at least 100 times faster than current Wireless Local Area Networks.

## EDWIN VAN LEEUWEN GOES TO MOSCOW

Dr Edwin van Leeuwen FTSE has moved to Moscow to take up the position of Director of Business Development with Norilsk Nickel



Edwin van Leeuwen

International after being Managing Director of Norilsk Nickel Australia since July 2010.

He still has links to Australia through the development of Norilsk's Honeymoon Well nickel deposit in Western Australia. The Norilsk Nickel Group is the world's largest nickel and palladium producer and one of the largest producers of platinum and copper.

As Director of Business Development he will focus on commodities opportunities in Africa, Australia, South America and Asia, which will diversify the Norilsk Nickel mineral portfolio.

Dr van Leeuwen was global research and technology manager with BHP Billiton for 24 years, leading a number of national and international research and technology groups to develop innovative technologies for the mining and petroleum industries.

From 1985–96 he worked in various roles at BHP as Manager Technology, Business Development and Minerals Development. From 1996–01 he worked in BHP Minerals.

From 2002–07 he worked as Global Manager at BHP Billiton in Exploration, Mining and Resource Optimisation.

From 2007–09 he worked as Global Manager Strategic Countries and External Relations (including Russia, China and India), BHP Billiton.

In 2009 was appointed Director of Geothermal Energy at the University of Melbourne and was awarded a VESKI Innovation Fellowship in April 2010.

In 2002 he won an ATSE Clunies Ross award for his contributions to exploration geophysics.

## MILTON HEARN WINS LEIGHTON MEDAL

Professor Milton Hearn FTSE, a Fellow since 1990, has been awarded the Royal Australian Chemical Institute's highest honour, the Leighton Memorial Medal, in recognition of his outstanding contributions to the field of chemistry in the areas of research, innovation, industry assistance and community

involvement.

Professor Hearn is the Director of the Centre for Green Chemistry at Monash University. Under his leadership, the centre has recently received Commonwealth and Victorian government and industry support in investments of more than \$100 million towards the creation of the Green Chemical Futures Centre and its imbedded industry-facing Victorian Centre for Sustainable Chemical Manufacturing.

The aim of the centre is to stimulate interactions with Australian industry and to provide major activities for the education of the general public through programs involving primary and secondary schools and public outreach groups.

Professor Hearn has mentored a large number of successful PhD and MSc candidates, many of whom have gone on to make a major contribution to academia, industry and government in Australia and abroad.

He has been involved with Australian and international companies in numerous R&D projects and the transfer of chemical technologies, and continues to be a scientific adviser to a number of companies prominent in the chemical, pharmaceutical and biotechnological sectors.

Professor Hearn is senior author of more than 550 scientific publications and several books and is the inventor/co-inventor of 32 patents/patent applications.



Milton Hearn

## Nancy Millis – extraordinary involvement and influence

*This is an edited version of a tribute to Emeritus Professor Nancy Millis AC OBE FAA FTSE delivered at a memorial function in her honour at University House, University of Melbourne, by Emeritus Professor Adrienne Clarke AC FAA FTSE, Chancellor of La Trobe University.*

It has been said that Australia is run by about 100 people. If that is so, Nancy was at least 10 of these.

Her involvement and influence was extraordinary. To each role she brought her sense of fun, her no-nonsense, practical approach and her prodigious knowledge.

She was our walking Wikipedia. She knew microbiology, molecular genetics, water ecology – both freshwater and marine – entomology, ichthyology, botany, horticulture, soil science, conservation ... and the list goes on. She was the sort of person you wanted to be with.

She was vitally interested in all the people in the organisations of which she had been part. The number of these was immense. There were literally hundreds – appointment committees, review committees, promotion committees and so on – from which her influence was felt far and wide.

She was Chancellor of La Trobe University from 1992 to 2006. During these 14 years she presented degrees to about 30,000 graduates and oversaw a great expansion of the university. She is very fondly remembered for all the qualities we know so well. Her name is immortalised at the university, in many ways: the Nancy Millis Room for entertaining guests, the Nancy Millis lecture series and a research building at the Albury-Wodonga campus. She was particularly proud of the achievements of the Biochemistry School and of the beautiful grounds and gardens at the Bundoora campus.

Five days before her death, she asked me about La Trobe, how it was travelling under the new leadership and what was in flower in the gardens. La Trobe was in her thoughts. La Trobe is very proud to have had her as a critical part of their history and is planning their own special memorial event in her honour.

She was Council member and Fellow of ATSE. She was a very practical scientist. She solved problems that were important for Australia, in sewage, water management,

conservation, agriculture and so on. ATSE was the Academy that embraced these very practical directions.

She was a key part of the establishment of the Crawford Fund to support Agriculture in developing countries. She steered the Academy's



Nancy Millis celebrating her 90th birthday.

*"As a friend of Nancy Millis's of 55 years standing, it is an honour to pay tribute to her memory. Of all the great things she did, the one of most outstanding help to me was her work in the regulation of research in genetic engineering. No Director of the Walter and Eliza Hall Institute could have had a steadier, more forceful and sensible hand on this very sensitive tiller. She captained the ship for a very long time and set the pattern for the future."*

– Professor Gus Nossal AC CBE FRS FAA FTSE, The University of Melbourne.

*"Nancy has been one of the great characters and great stalwarts of the Academy for the past 35 years. She remained her same down-to-earth, no-nonsense self until the end."*

– Professor John Zillman AO FAA FTSE, former President of the Academy

work to produce data and reports that could inform Governments and decision makers and really make a difference. She attended most of the Academy lectures and functions right up until the time of her accident.

I would often drive her home after these events and she would always deliver a critical appraisal of the lecture and often of the lecturer too! It was always

## Ana Deletic wins Victoria Prize

Professor Ana Deletic FTSE, who joined the Academy in 2011, has won the \$50,000 Physical Sciences Prize in the 2012 Victoria Prize for Science and Innovation.

Professor Deletic, Professor of Civil Engineering and Director, Centre for Water Sensitive Cities, Monash University, has established herself as a world leader in stormwater management, pioneering Biofiltration techniques, which enable the removal of critical pollutants from captured urban runoff.

Her innovative engineering solutions, developed in a context of outstanding interdisciplinary collaboration, make it possible to harness the potential of stormwater to overcome water shortages, reduce urban temperatures, improve waterway health and aesthetically enhance urban environments in order to create more liveable Australian cities for future generations.

Professor Deletic's innovation is already changing the face of urban stormwater management. Her ground-breaking technology is operational at thousands of sites in Australia and is being rolled out in Singapore and Israel, providing a rare example of Australian technological innovation being adopted by nations that are themselves at the forefront of research and development in urban water sustainability.

an entertaining drive home.

Then there was her role in a small start-up AgBio company, Hexima Ltd, of which Professor Marilyn Anderson FTSE and I were founding scientists. A critical time in the company history was when it was ready to embark on field trials of the transgenic cotton it had developed. To enable this, the company needed to establish its own Institutional Biosafety Committee (IBC). This was a prerequisite for undertaking field trials.

Hexima was a small company with limited resources and we wondered how we could do it. After debating the problem, we came to the position that if Nancy would serve, we would be in a good position to fulfil the other requirements. So I was delegated to make the request.

Nancy understood the seriousness of the task. And here, as part of this story is another facet of Nancy's life that has not been mentioned, but one that I really loved – she loved poetry.

She and I established many years ago that we had both been raised in times in which we were expected to commit tracts of poetry to memory. We both knew many of the same poets – some of her favourites were Lewis Carroll, AA Milne and, in this case, Lord Macaulay.

When I asked her to serve on the IBC for us, she thought for a while and then said: "Yes I will stand on thy right hand and hold the

bridge with thee" – and I was able to respond by saying: "And up spake brave Herminius, of Titian blood was he, I will abide on thy left side and hold the bridge with thee".

We laughed and she agreed. The decision had far-reaching implications. Not only were our own field trials successful, but the expertise in conducting field trials became another business for the company. An application for a field trial for a multinational was brought to the Hexima IBC only last year.

Marilyn described to me how Nancy, at 89 years of age, went through the application line by line and struck terror into the heart of the consultant for the major company. He emerged sweating after his ordeal. Nancy was sharp and diligent to the end.

She did not tolerate fools, cant or pomposity and her response to these could be quite wicked. Sometimes she dealt them directly, as in "Bullshit!" – which I have heard ring out more than once or twice in meetings. In other situations, it was more subtle.

I also recall one particularly difficult meeting we were both at. It was clear that the chairman was biased and as a preliminary to dealing with the situation, Nancy turned to me and said, not too sotto voce: "The slithy tove" to which I could reply, also not too quietly: "Yes, gyring and gimbaling as fast as he can".

Lewis Carroll's 'Jabberwocky' was one of her favorites and she would often greet me with:

"Oh Frabjous day, Callooh Callay."

We loved her joy of living and we "chortle in our joy". We did have such fun! She is sadly missed.

*"Nancy's achievements in the field of biotechnology were significant, but just as significant was the trail she blazed and the barriers she broke down for women in science."*

– Dr Megan Clark FTSE, CEO of CSIRO.

*"Nancy has been a shining light to scientists, including but not only women scientists, for so many decades. Her passing will be deeply felt by all of us. Nancy leaves behind such a magnificent record of achievements, including her time on the Council of the Australian Institute of Marine Science in the late 1980s/early 1990s when I had the great pleasure of knowing her best. Her contributions to biotechnology, marine and aquatic science were extraordinary. And, above all, those who worked with her experienced her extraordinary and keen intelligence, no matter the topic, her deep knowledge and her drive to help make the world a better and more well-founded place."*

– Dr Meryl Williams FTSE, Chair of ACIAR and former head of AIMS

## PEER AWARD FOR PAIN PROFESSOR

Professor Maree Smith FTSE, the Queensland pain research innovator, has been awarded a 2012 Life Sciences Queensland (LSQ) Industry Award for Excellence.

The Award, selected by peer vote, is presented to individuals who have made "significant contributions to the performance and success of the Queensland life sciences industry" and "demonstrated a breadth of impact across the sector in Queensland".

Professor Smith has pursued life sciences translational research at The University of Queensland for more than 20 years. Two key discoveries led to the formation of UniQuest start-up companies QRx Pharma Ltd and Spinifex Pharmaceuticals.

QRxPharma was floated in 2007, listing on the Australian Securities Exchange with 25 million shares. It raised \$50 million, with an initial market capitalisation

of \$150 million, setting an Australian record as the largest biotech IPO to date, and also the largest biotech capital raising at an IPO. Its lead product, MoxDuo, is awaiting FDA approval.

In 2003, Professor Smith won a UniQuest Trailblazer for her idea for a novel analgesic, which has been developed by Spinifex Pharmaceuticals and shown to be effective in a recently completed phase 2a clinical trial.

Professor Smith shared the LSQ Industry Excellence Award with Dr Jim Aylward, who patented Australia's first FDA-approved cancer chemotherapeutic drug. She is the co-founder

and Executive Director of the UQ Centre for Integrated Preclinical Drug Development/TetraQ and a Professor of Pharmacy at UQ.

In 2008, she received the Women in Technology Biotech Outstanding Achievement Award and in 2009 she was awarded

Honorary Fellowship of the Faculty of Pain Medicine (ANZCA). She joined the Academy in 2011.

Professor Smith is Head of the Pain Research Group in UQ's School of Pharmacy and directs its preclinical pharmacology research program, which focuses on improving understanding of the mechanistic basis of a range of pain states and their pharmacological management, with a view to alleviating chronic pain in patients.

Congratulating Professor Smith on this latest honour, UniQuest Managing Director David Henderson acknowledged the profound impact her ground-breaking research will have on pain therapies in the future.

"New drugs based on Professor Smith's discoveries are close to market-ready, and that's not only because of the quality and volume of her scientific endeavour; it's also because she has played an active and integral role in the global biotech industry to accelerate access to a whole new approach to pain management," Mr Henderson said.



Maree Smith



## Richard Horsley: leader in engineering and sport

Emeritus Professor Richard Horsley FTSE, from the Faculty of Science and Engineering at Curtin University, died in Perth on 29 September, aged 71. He had been a Fellow since 1997.

Before becoming an Emeritus Professor in 2001, Professor Horsley served as the Executive Dean of the Division of Science and Engineering for nearly 10 years.

Professor Horsley's death was a big setback to the engineering and academic communities in Western Australia. He will be remembered as an engineer, an academic

leader, a sporting champion, but above all as a great human being.

He had more than 30 years' experience in mineral processing, non-



Richard Horsley

Newtonian flows and slurry system design, both in academe and in industry. He had an international reputation in the field of non-Newtonian fluid dynamics and mineral processing. His work on a viscometer, which allowed the accurate determination of the rheological properties of settling slurries, permitted the accurate determination of the effects of various additives on a laboratory scale. This enabled him to pioneer the control of slurry properties for the mining industry, so as to optimise the design of pipelines for carrying settling slurries as well as the performance of hydrocyclones.

Professor Horsley continued to be active in research despite his retirement. He had published more than 100 papers. He also had an active consultancy practice in the fields of slurry system design and as an expert in industrial and motor vehicle accidents.

He obtained his Master of Engineering degree from Bristol University in 1970, and a PhD from the University of the Witwatersrand in 1974. He had a distinguished career with various organisations before joining RMIT as a Course Director from 1978–84. He joined WAIT in late 1984 as the Head of

School of Process Engineering. He became a Professor when WAIT became Curtin University of Technology in 1987 and later served as the Deputy Vice-Chancellor (1991–98) and Executive Dean (1998–03).

During this period he was responsible for all academic and administrative matters for the Division of Engineering and Science at Curtin. On retirement in 2003 he was appointed an Emeritus Professor.

He was was an excellent sportsman with a high level of skills and achievements. He played first grade rugby union with Eastwood District Rugby Union Club in Sydney in the early 1960s, as a hooker. He also played tennis at Wimbledon, qualifying for the first round in men's doubles in the Championships, although not progressing further. He also represented English universities in tennis and was awarded full colours for tennis while a graduate student at Bristol University. He continued to play tennis at a high club level until he required knee surgery. In his latter years he became an enthusiastic and competitive lawn bowler.

Professor Horsley is survived by his wife Jenny, two sons and three grandchildren.

• With thanks to Professor Moses Tade, Dean of Engineering, Curtin University.

## MARTIN COLE PUBLISHES SECOND BOOK

Dr Martin Cole FTSE, who has been a Fellow for 20 years, has recently published his second novel – *The Code of the Apocalypse* – a sequel to his first, *The Code of the Pharaoh*.

In *The Code of the Pharaoh*, archaeologists stumble upon an Egyptian hieroglyphic code that leads them around the world in a race to decipher many more intriguing clues on their quest to find the lost secret of an ancient machine that could grant immortality.

*The Code of the Apocalypse* is an epic adventure to exotic places to learn the secret of an ancient prophecy hidden within Mayan hieroglyphic inscriptions, which powerful human and alien forces plan to exploit during a foretold worldwide catastrophe – the Apocalypse.

An electronics engineer, Dr Cole has drawn upon a wide range of skills and interests, which include graphic art, scientific research, engineering design, manufacturing, international marketing, astronomy, history, languages and a passion for reading.

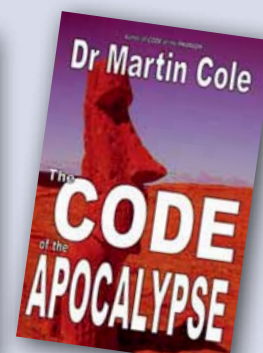
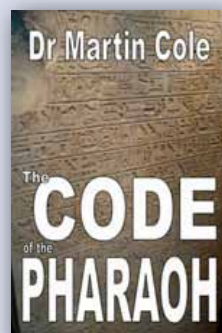
He served eight years on the Prime Minister's Science, Engineering and Innovation Council and is a former National President (2000–01) of Engineers Australia. He was founding Chair of Astronomy Australia Ltd.

He holds dozens of patents and has received numerous awards for leadership in design and export of Australian products. His career has centred on the design of electronic products, systems and software for security and fire prevention, and he is best known for pioneering the aspirated smoke detection industry worldwide.

*The Code of the Pharaoh* is a mystery adventure novel inspired by scientific and historical facts that is set in the present day with flashbacks to ancient times. Also engaging as a travelogue, there is a sub-theme of deception and a romantic twist. The work contains nearly 50 different illustrations including hieroglyphs, maps and plans.

The sequel, *The Code of the Apocalypse*, is a mystery adventure inspired by scientific and historical facts set in 2012. The work contains more than 80 different illustrations and provides map references to the numerous locations visited so the action can be followed through satellite images on Google Earth.

Further details are available at [www.imrac-books.com](http://www.imrac-books.com) and the books are available (RRP \$24.95 printed and \$9.95 e-book) from [www.dymocks.com.au](http://www.dymocks.com.au), [www.eabooks.com.au](http://www.eabooks.com.au) or [martincol@bigpond.com](mailto:martincol@bigpond.com).



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Scientists at The University of Queensland are addressing this issue before it's too late. Professor Robert Henry and his team have discovered wild rice plants that have a natural resistance to the pests attacking crops under stress.

Their studies have shown wild plants are far more resilient in hotter, drier conditions. The result of this will be useful in selecting crop varieties able to cope with the changing environment and could potentially bring many crops back from the brink of destruction.

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