

FOCUS



RESEARCH & INNOVATION

GETTING THE BEST FROM BOTH

Contributors discuss leadership in research organisations and the future directions and impact of CSIRO – along with key policy and social imperatives of the innovation debate

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**Organic, consensual,
collegial leadership for
universities**

By Alan Robson

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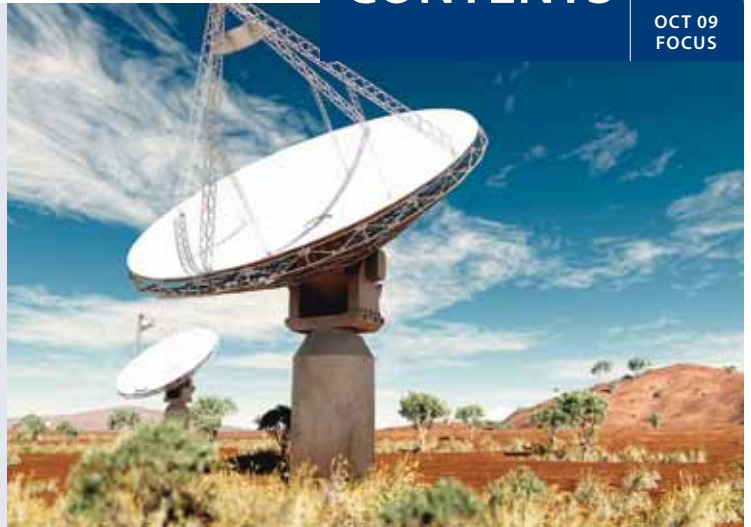
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Front cover: The Microelectronics Research Group at the University of Western Australia, led by Professor Lorenzo Faraone FAA FTSE (left) – inaugural winners of the Defence Science and Technology Organisation Eureka Prize.

Photo: UWA

FOCUS

ATSE *Focus* is produced to stimulate discussion and public policy initiatives on key topics of interest to the Academy and the nation. Many articles are contributed by ATSE Fellows with expertise in these areas. Opinion pieces on topics of national interest, particularly the Academy's key interest areas – climate change, water, energy and education – will be considered for publication. Items between 800 and 1500 words are preferred. Please address comments, suggested topics and article for publication to editor@atse.org.au.

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Our people are creative, innovative and intelligent and very focused on the centrality of their particular discipline. They value greatly their professional autonomy and academic freedom.



By Alan Robson

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Immediately after completing my PhD I spent two years in the Australian Army, including six months at Officer Training. What did I learn there? First, you must win the confidence, trust and support of the people you lead. Even in the army, where you can command the troops, the troops must want to do what needs to be done. Second, most of the time we work way within our capacity – you can still function after a six-day exercise in the cold and wet with little sleep. Third, leadership was defined in the army as the appropriate balance between achieving the task, maintaining the group and meeting individual needs.

Amanda Sinclair, in a very thought-provoking book called *Leadership for the Disillusioned*, makes a case for leadership as a way of being:

- that is reflective and thoughtful about self;
- that values relationships and the present;
- that is connected to others and embodied;
- that is not narrowly striving or ego-driven; and
- that is liberating in its effects.

Indeed in a recent study by Higgs (*Journal of Change Management* 9:2, 165-178) shows the domineering behaviour of narcissistic managers often damaged long-term performance in business. Research by Collins showed that companies that went from 'good' to 'great' were most often led by leaders appointed from within the organisation; most of these leaders had little profile outside the organisation.

Posner, in the book *The Leadership Challenge*, identified five fundamental leadership practices:

- challenging the process;
- inspiring a shared vision;
- enabling others to act;
- modelling the way; and
- encouraging the heart.

Challenging the process involves searching for opportunities and taking risks. A shared vision can only be inspired by envisioning the future and enlisting others.

Finally Lao Tzu the Chinese philosopher said: "To lead the people, walk behind them", and also, "As for the best

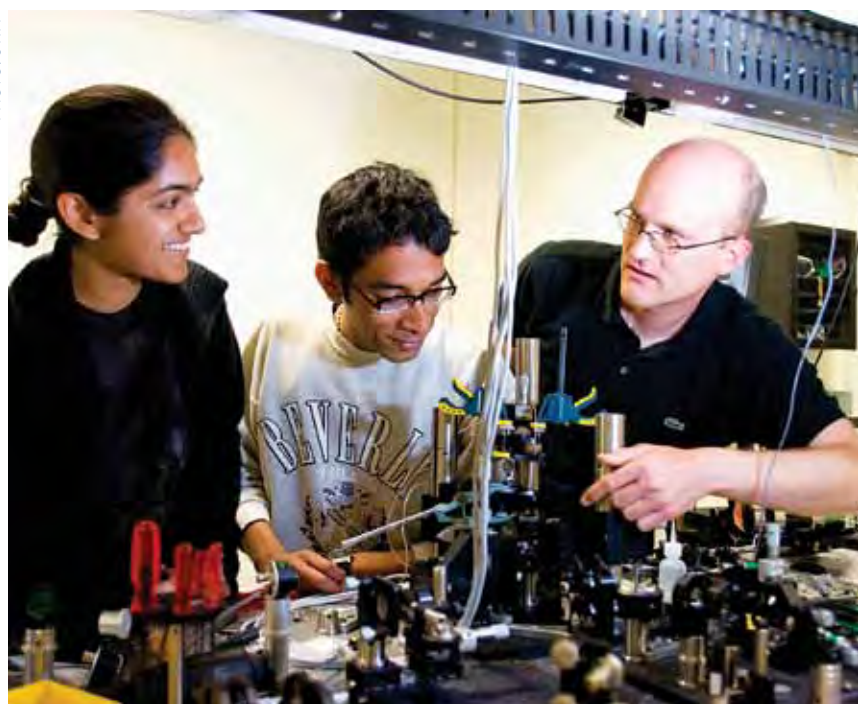
leaders, the people do not notice their existence. The next best leaders people honour and praise. The next the people fear and the next the people hate. When the best leader's work is done, the people say we did it ourselves."

I greatly benefited from an excellent course which provided me with both depth in science and breadth in agricultural ecosystems. The general education I received has enabled me to have a broader understanding of the many facets of agriculture. I am concerned that the narrowness of some degrees breeds specialists who find it difficult to relate to other disciplines. This is an age of integration, of synthesis skills, which are less well developed than the reductionist skills of analysis. We need to educate integrators who have the necessary numeracy skills. One difficulty in leadership of research teams is a shortage of individuals with the capacity to lead teams with a wide spread of disciplines.

– ALAN ROBSON

Hands-on work for UWA Engineering students.

PHOTO: UWA



From all of these writings you can see I do not subscribe to the idea of the leader as hero or the leader coming down from the mountain defining the direction and expecting everyone to follow. I believe in organic leadership, consensual leadership and in universities what is termed collegial leadership.

Leadership in universities and research organisations

The modern university is a complex organisation with core roles of teaching and research but also seeking to be a creative resource to the communities it serves.

Income is derived from many sources. At the University of Western Australia (UWA) only 30 per cent of the annual income of approximately \$700 million comes directly from the Federal and State governments.

Strong alliances with the public and private sectors are essential. Not counting the many professors in the Medical School supported by the health system, there are seven professors directly supported by the private sector, principally the resource industries.

There is not a single culture within universities – the culture of the Faculty of Arts is quite different from that of

the Business School or the Law School.

Our people are creative, innovative and intelligent and very focused on the centrality of their particular discipline. They value greatly their professional autonomy and academic freedom, a major factor in them choosing to work within a university rather than in more lucrative positions elsewhere. This culture, which is shared by many research organisations, has strong implications for leadership.

An effective leader within universities needs to listen, to persuade, to create an environment for effective decision-making, and must shape a university vision. Most of all a leader must build robust structures and strong teams. Isaac Newton said: “I can see further when I stand on the shoulders of giants”. I know of no sustainably successful universities where the leader is surrounded by ‘yes’ men or ‘yes’ women.

Shared vision

I see my major role as Vice-Chancellor in leading the development of a shared vision. At UWA this translates into being in the top 100 on the Shanghai Jiao Tong index by 2013 – 100 years after the first students enrolled. The second part of the vision is to be a top 50 university by 2050 on a range of indicators relating to teaching and learning,

FROM SEPARATING BLOOD TO SEPARATING COPPER

Using microscopic streams of liquid to separate valuable metals from dissolved rock could revolutionise mineral processing, according to researchers at the University of South Australia.

They have already shown the technique can be used to extract copper quickly and efficiently and believe the process can be scaled up to industrial levels and used for recovering many other minerals such as nickel, uranium, gold and platinum.

The technique, known as microfluidics, is already used commercially to separate and

purify biological samples of proteins, DNA and blood. Applying it to mineral processing is a classic case of Australian ingenuity, says Dr Craig Priest, a postdoctoral researcher in microfluidics.

“Microfluidics is the flow of liquids along microscopic channels – some finer than a human hair – to rapidly mix, react, analyse and separate material at high efficiencies and with excellent control,” he says.

“Converting rocks into metal requires many steps and precise control of physical and chemical conditions. Microfluidic streams give

us this control and allow multiple industrial steps to be carried out in a single, compact device.”

Dr Priest believes that in the next few decades, the impact of microfluidics on mineral processing plants could be similar to that of microelectronics on information processing. The technology could help mineral processing plants to become more compact, highly efficient, and consume less of resources such as water and power, he says.

This work is being carried out in collaboration with the University of Tokyo and is supported by the Australian Research Council (ARC) Special Research Centre Scheme, ARC Linkage and Linkage International Schemes, AMIRA International, and the governments of SA and Victoria.

Craig Priest was one of 15 early-career scientists who presented their research to the public for the first time this year at Fresh Science, in Melbourne, a national program sponsored by the Federal Government.

Craig Priest
with one of his
microfluidic
chips.



PHOTO: NALL BYRNE, FRESH SCIENCE

research and community service. The recent Quality Audit by the Australian Universities Quality Agency concluded that most staff support and endorse this vision.

The vision must be backed by detailed planning involving as many staff as possible. Most importantly, there must be evidence-based decision making and quantitative assessment of performance. There must also be consistency of direction – shifting the goal posts at regular intervals encourages individuals to pursue their own directions.

Once the culture is created the leader should get out of the way and rely on the professional behaviour of the staff. Importantly, however, the allocation of funding to departments or faculties must reward the same behaviours that are rewarded in promotion and tenure.

At UWA my remuneration is determined by the performance of the university in meeting key performance indicators relating to teaching and learning, to research, to equity of access and the financial management of the university. It is not related to what I do, it is related to how well the university is performing.

Within universities there is much discussion of the conflict between managerialism and collegiality. There are also some nostalgic references to a golden era of collegiality where universities were well managed by a community of scholars. It must have occurred before I started working in universities nearly 40 years ago.

I believe a well-managed university must have a collegial culture. Collegiality is essential for creating a shared vision. Collegiality does not mean that every decision is made collectively. Collegiality demands genuine two-way communication. (There is always the ability to enhance communication at all levels of a university – not more communication but more effective, two-way communication. In particular, universities are much better at vertical communication than they are at horizontal communication.)

Transparency and openness

Collegiality also demands transparency and openness. Management by stealth because of greater knowledge is the enemy of collegiality. Finally, universities must be well managed in relation to staffing, buildings and other resources.

There is also considerable discussion within universities as to the appropriate balance between centralised activities and devolved activities. At UWA there is a performance-based budget allocation which devolves funding to faculties in a one-line budget. The faculties, where necessary, devolve funding in a one-line budget to schools. However,

there are many activities that need to be centrally coordinated. I think there is a need to be continually examining the balance between centralisation and devolution.

Finally, universities are not well structured to solve many of the problems or to meet the challenges of the modern world. Universities are organised along disciplinary lines but most challenges are multi-disciplinary. Universities are also very difficult for outsiders to navigate.

Many universities and research organisations have recognised these difficulties and have established mechanisms to counter them. The development of a matrix approach (for example the Flagship programs within CSIRO, or the Melbourne Institutes at the University of Melbourne).

At UWA we have established an Institute for Agriculture, an Oceans Institute and a Minerals and Energy Initiative. Each of these activities involves staff from several faculties and each is led by a director reporting to the Executive.

Further development of this matrix approach and the funding and management challenges of a matrix structure will be one of the major challenges within universities and research organisations.

An organisation must have clear goals and staff must have the independence to pursue these goals. Universities function best with distributed leadership but with clear objectives and high-level vision.

Above all, leaders must display integrity and trust. Trust is hard to earn and easily lost.

Leaders must also have generosity of spirit, celebrating but not claiming the successes. ◀

(An edited version of a recent address by Professor Alan Robson, titled 'Leadership in Universities and Research Organisations', to the Melbourne University School of Land and Environment.)

PROFESSOR ALAN ROBSON AO FTSE has been Vice-Chancellor of the University of Western Australia since 2004 and was previously Deputy Vice-Chancellor and Provost. He has also held the positions of Foundation Director of the Cooperative Research Centre for Legumes in Mediterranean Agriculture (CLIMA), Dean of the Faculty of Agriculture, Head of the School of Agriculture and Professor of Agriculture (Soil Science) at UWA. He is currently Chair of the Group of Eight universities and Deputy Chair of Universities Australia. Professor Robson was Deputy Chair of the Council of the National Library (1998–05), a member of the Western Australian Science Council (2003–09) and the CSIRO Board (2003–08).

Letters to the Editor

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– Andrew Barr MLA, Minister for Education and Training, ACT.

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Securing the future in a connected planet

Science must change if we are to help inform governments, communities and industry how choices in one area impact on another area.



By Megan Clark

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For the first time in our history, science is making predictions of how our actions will affect the world 50 and 100 years from now.

In this future we face the reality that we are all connected. Our choices in one area, such as water, impact on other areas, such as food security.

Martin Luther King warned us that we are all joined through an “inescapable network of mutuality”. We are now beginning to understand what he really meant. We all want a prosperous and healthy society, but we face significant challenges to securing our food, water and energy needs in a world of finite resources.

We have significant pressures on global systems – such as population growth, rapid urbanisation and climate change. These national and global challenges are connected. They cannot be dealt with in isolation.

Individuals, communities, industry and nations are seeking to understand this connectivity and the inevitable trade-offs necessary to achieve a sustainable society.

Science must change if we are to help inform governments, communities and industry how choices in one area impact on another area – particularly in a world where water, carbon and biodiversity will have prices and markets.

I am now nine months into my new role as Chief Executive of CSIRO and I would like to share my vision of what you can expect of your national science organisation.

Climate change

You have been saturated with the fact that over the past several decades our climate has been changing. You also know climate change is not new. So what is the essence of what is different this time? Simply the rate of change.

Atmospheric carbon dioxide concentrations are now well outside the range experienced during recent ice ages. They are now at values not experienced for millions of years. They are increasing at a rate we have not seen before.

One of the best indicators of this rate of change is sea level. We have been measuring sea level since 1870 and it

has been rising about 10 times faster than the average rate of rise over the previous 2000 years. Since 1993 the average rate of rise is almost double the 20th century average.

All nations are connected in this change. So are our latest measurements confirming this rate of change? Yes. Let me give you just two examples.

First, our observations of ocean temperature off eastern Tasmania over the past 60 years have revealed that winter water temperatures were 1.5°C above normal, due to strengthening of the southward-flowing East Australian Current. Sea urchins, normally found off eastern mainland Australia, are now happily colonising Tasmanian waters and millions of them are eating their way through extensive kelp forests and threatening the biodiversity and key abalone and rock lobster fisheries of the region.

The second example is rainfall. Our modelling is increasingly predicting reduced rainfall in south-eastern Australia, the main generating area for the River Murray. The predictions range from little change in the mean annual rainfall up to a decline of 15 per cent for each degree of global warming. Such a rainfall reduction could mean a more than 35 per cent reduction in run-off as the rain soaks into dry soils.

Run-off is what feeds our rivers. The Murray–Darling system has more than 50 per cent of all irrigated land in the country. It is linked to our food security.

All our communities need better predictions. We are making increasingly accurate and granular observations of what is happening.

We have 60 ocean probes, three ships taking continuous measurements, four seagliders, and satellites taking physical and biological measurements of our deep Southern Ocean. We have deployed a \$1 million measuring system south-west of Tasmania that will monitor the carbon cycle in the top 400 metres of the Southern Ocean.

With the Bureau of Meteorology, we track every single rain event over the Murray–Darling Basin and look at its intensity, how much water it has, how frequent these rain

events are and measure the run-off. We are working to understand where the water is coming from and how much will flow because this information is critical to future decisions.

We are also contributing on a global scale. More than 100 of the Nobel Prize-winning Intergovernmental Panel on Climate Change (IPCC) scientists are Australian, and more than 20 are from CSIRO. The work they and their international colleagues are doing measuring temperature, acidity and currents in places like the deep Southern Ocean is a vital part of the emerging global picture of climate change.

Food production

One area that we have to adapt to quickly is the production of food. In the next 50 years we will need to produce as much food as has been consumed over our entire human history.

Humans have met this challenge once before – from 1960 to 2000 world food production doubled through a combination of new technology and investment in agriculture. But this time two things are different.

First, we will need to achieve this where carbon and water have a price. We can no longer simply clear more forest and farm even more marginal land.

Second, this is happening at a time when we are seeing the greatest migration of our species to urban centres.

We will see profound shifts in the trade and transport of food. We are already seeing the impact on global, sea-borne trade of food. Cereal exports, the highest volume globally traded food commodity, have risen at a rate

double that of population growth. Trade volumes of milk, meat and beans have risen at even faster rates.

Australia has a strong interest in global food security. We produce 93 per cent of all food consumed in Australia, one per cent of all food consumed in the world and three per cent of the global sea-borne trade. So right now we feed 60 million people.

Increase in global sea-borne trade of food presents an opportunity for Australia but Australian agriculture is also highly exposed to climate change – we have significant constraints on irrigation water availability. Our agriculture is also 16 per cent of our national greenhouse gas.

Our science has potential for Australia to produce an even greater proportion of the sea-borne trade. We are making wonderful and exciting scientific developments in new drought-tolerant crop varieties, high-yielding wheat, greater nitrogen-use efficiency and improved grain nutritional benefits.

CSIRO's role

Living in a world where carbon has a value and irrigation water is restricted means new choices and trade-offs.

At the start of the 21st century, it was clear that the Murray–Darling was in trouble. A whole-of-basin water assessment was required. CSIRO was given the challenge in November 2006 to lead the world's first rigorous assessment of the potential impacts of climate change on surface and groundwater availability across a major river basin.

BUSINESS SPENDING ON R&D REACHES \$14 BILLION

Business expenditure on R&D (BERD) in Australia topped \$14 billion for the first time in 2007-08, according to ABS statistics.

BERD increased to \$14.379 billion from \$12.548 billion in 2006-07 – an increase of 15 per cent in current price terms. Over the five years to 2007-08, BERD increased an average of 17 per cent in current price terms.

As a share of GDP, BERD increased to 1.27 per cent, up from 1.2 per cent in the previous year. This is the highest it has ever been – BERD did not exceed one per cent of GDP until 2005-06.

This places Australia 14th in the OECD rankings of BERD. Australia ranks in the top 10 for gross expenditure (GERD) due to relatively high government and higher education expenditure on R&D.

The BERD average across the OECD is

1.59 per cent, although the figure is distorted up by the weight of Japanese and US expenditures. The leading nation is Japan at 2.68 per cent, followed by Sweden (2.66 per cent), Korea (2.65 per cent), Finland (2.51 per cent) and the US (1.93 per cent). Australia leads the UK (1.15 per cent) and Canada (1.05 per cent).

The ABS statistics show that 69.8 per cent of R&D is carried out by large firms employing more than 200 people (and that share is trending up). Interestingly, most government programs supporting/funding BERD target SMEs.

Experimental development (62.4 per cent) and applied (32.1 per cent) account for a significant majority of BERD by type of activity.

Manufacturing accounted for 29.9 per cent (trending down) with mining (22.8 per cent), professional, scientific and technical

services (15.5 per cent) and financial services (9.9 per cent) comprising the four largest industry sectors.

More than 55 per cent (\$7.9 billion) of BERD was in engineering with information and computing sciences (\$3.67 billion/25.6 per cent), medical and health sciences (\$897 million/6.2 per cent), technology (\$661 million/4.6 per cent) and agriculture and veterinary sciences (\$321 million/2.2 per cent) comprising the top five fields of research.

Other STEM fields of research were chemical sciences and earth sciences (both \$227 million/1.65 per cent), environmental sciences (\$123 million/0.9 per cent), biological sciences (\$99 million/0.7 per cent), physical sciences (\$29 million/0.2 per cent) and mathematical sciences (\$19 million/0.15 per cent).

It was the most comprehensive and technically challenging water-modelling project ever undertaken in Australia, and possibly the world. It provides governments, industry and communities with an unprecedented level of water information to guide their future planning and investment.

We are working with our research partners to extend this work to the river basins of northern Australia, south-west Western Australia and Tasmania. This means Australia will lead the world in building a national model of its water.

This is exactly what a national research organisation should do – bring together all the smartest research and researchers across the nation to catalyse a national response to some of the biggest challenges we face.

I believe we need to similarly take on the challenge of building a national picture of our carbon footprint and assessment of future energy options. The approach will require not only the best multi-disciplinary teams of scientists from CSIRO and our universities, but also our best economists from places like Treasury and the Australian Bureau of Agricultural and Resource Economics (ABARE), Federal and State policy makers, the community and industry.

This platform will be vital in supporting Australia's need for new national infrastructure suited to a new low-carbon economy.

The role of CSIRO is to provide the science and help catalyse the development of the 'integrated assessment' platform that will be needed for good decision-making. Such a comprehensive picture will allow us to achieve maximal emissions reduction while maintaining economic growth and prosperity.

As we adjust to a world where carbon has a value, adopting a low-carbon pathway will require Australia to look at its land and water resources in a fundamentally different way. We stand ready as an organisation to help Australia tackle these very difficult assessments.

We cannot secure Australia's future unless our science works on challenges that face all nations.

CSIRO aims to be one of the most respected R&D organisations in the world. Our strategy remains to focus on these major challenges that face humankind and our nation. We will do this through our 10 National Research Flagships.

We will continue to step up to the plate to work with universities and other research agencies and organisations like the Bureau of Meteorology to integrate our knowledge into comprehensive pictures of our national water resources, carbon footprint and our biodiversity.

We aim to make an impact in three areas: a sustainable environment (which I've discussed), the community and industry.

Our communities need help facing the challenges of the future. We will continue to develop foods that can

improve health, provide nutrition advice to children and adults, and help make sense of how to make a difference in a carbon world.

Three targets

We will continue to bring a cross-disciplinary approach to tackle three of the largest health issues that face our nation – obesity, Alzheimer's disease and colorectal cancer.

Australians trust CSIRO to bring excellent science to help them with the challenges of today and tomorrow. But these challenges are not just of interest to governments and communities. We are seeing increased investment from our industry partners as well.

We will help Australian businesses access the breadth and depth of our organisation and our networks to be more competitive. We are helping CSL develop safe vaccines, BHP Billiton to better understand the performance of products in downstream processing, Telstra enable the house of the future and AGL build the power industry of the future.

To build whole new industries we will continue to build platform and breakthrough technologies such as wireless LAN, which is now in more than a billion wireless devices; next-generation space technology; polymers to build printable electronics and solar cells; and gene technology for new drugs, proteins and plants.

As an organisation with goals and values that go beyond our science, we know we will be successful when our people always go home safely at night and share a sense of discovery; our collaborators and partners realise lasting value from our science and describe working with us as a pleasure; and we remain a trusted adviser to the people of Australia.

We remain committed to the integrity of our science, which has been a foundation for CSIRO since our beginnings more than 80 years ago.

We live in a connected world. Science needs to work on challenges that face all nations to secure a future for humankind. Only then can we secure a future for Australia. ◀

(An edited version of a recent address to the National Press Club.)

DR MEGAN CLARK FTSE, Chief Executive, CSIRO, is a member of the St Vincent's Hospital Foundation Board, the Prime Minister's Science, Engineering and Innovation Council, and the Automotive Industry Innovation Council. She began her career as a mine geologist and subsequently worked in mineral exploration, mine geology, research and development management, venture capital and technical strategy areas with Western Mining Corporation for 15 years. More recently she was Vice-President Technology and Vice-President, Health, Safety, Environment, Community and Sustainability with BHP Billiton. Dr Clark served on the Expert Panel for the Review of the National Innovation System.

The unfinished business of innovation: keeping the dialogue alive and urgent

It is clear that innovation and technological change got us into many of the messes we are in today, but only innovation and technological breakthroughs will get us out of trouble.



By Terry Cutler

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My career represents a somewhat schizophrenic split between technology strategy and policy, and varied involvements in the humanities and arts. This schizophrenia, however, has reinforced my enduring interest in cross-disciplinary and trans-disciplinary practice, especially in mission-directed industrial research.

In my service on the boards of both research and cultural agencies, I confront the recurring irony that it is the industrial research agencies such as CSIRO that more actively seek to develop cross-disciplinary capability-building than my colleagues in the humanities or social sciences.

One area of unfinished business in innovation policy and practice is how to secure the greater engagement of the humanities and social sciences around the innovation table. Crudely put, their contribution remains marginal and uninfluential (except, of course, for the negative influence of the neoclassical economists, who simply don't believe in innovation policy and public investment in it).

Another of my hobby horses is how we promote a greater leadership role from the (learned) academies in setting national priorities, and how the several academies might better coordinate and leverage their potential contributions to public policy.

At one level there has been no shortage of attention to innovation over the past few years.

First we had a Green Paper from an expert panel commissioned by the Government. *Venturous Australia* was released in September 2008. The Government's White Paper, *Powering Ideas: An Innovation Agenda for the 21st Century*, was issued almost nine months later, in conjunction with the Federal Budget. Although there has been considerable attention to the actual measures announced in the Budget, the White Paper itself has largely gone unnoticed. Many people with an interest in innovation still don't know it exists.

This is a pity, because the innovation agenda must be kept alive. This is all the more important because of the

need to draw lessons about innovation in times of recession, and in facing up to global challenges like global warming where the responses need to be more than the sum of national strategies and positions. Many of the challenges we now face call for transnational thinking and approaches.

Looking back over our work in the past few years I now wonder whether the canvases we have been working on were too small, and whether we have sufficiently stepped back to look at a bigger picture of the paradigm shifts and challenges we face in the 21st century.

The White Paper

In assessing *Powering Ideas* it is important to note that it is more than a response to *Venturous Australia*, which has become just one report among many on which the White Paper builds. The Government statement claims to also address the 2007 pre-election statement, New Directions for Innovation, Competitiveness and Productivity, the CRC Review, the textile, automotive and pharmaceutical reviews, the review of higher education, the House of Representatives inquiry into research training, and the outcomes of the 2020 Summit.

No wonder then that, apart from the immediate Budget commitments, the White Paper is very general and open to many interpretations. The statement aims to articulate a 10-year strategy for Australia and it does this through setting very broad directions rather than describing pathways to a future.

In considering *Powering Ideas* I am highly mindful that, with hindsight, there were several blindspots in *Venturous Australia* and particular areas that I personally would have liked to emphasise more strongly, and I am sure other members of the Review Panel will have similar checklists. This is consistent with the point I made last year in transmitting the Report to Government – that we had not done justice to the depth of issues raised in consultations and that, with a subject like innovation, there is never a 'final position'.

Innovation, like understanding, is a journey, a process of change, and not a destination. There needs to be a continuing discussion as circumstances change, as our understanding of the innovation challenge deepens, or as new opportunities emerge. The same point needs to be made strongly in considering *Powering Ideas* – it cannot stand as the last word.

Powering Ideas was released in conjunction with the announcement of Budget measures. There were laudable and very significant innovation measures announced in the Budget, especially given the economic circumstances. These measures are an important first tranche against a longer-term statement of commitment.

However, the word innovation occurs merely five times in the Treasurer's 2009 Budget speech and strangely it is not part of an overall narrative about the position Australia is in. Indeed, my one criticism of the Budget speech, as a literary work, is that it does not provide a narrative, a storyline. It talks about recession and the "momentous challenges" of the economic downturn, but does not pause to reflect and elaborate on the actual nature of these challenges so that we could frame our understanding of the appropriateness and scope of the necessary responses.

My biggest disappointment is that there is no echo, in the Budget speech or the accompanying commentary, of the point made strongly two years ago in pre-election statements that innovation is, and must be, a central plank of economic policy.

Innovation was rightly seen then as the glue linking competitiveness, productivity and national economic diversification beyond undue reliance on volatile resources booms.

The Prime Minister rightly highlights the importance and impact of the economic reforms of the Hawke-Keating Government in the 1980s in making industry competitiveness and productivity central issues for this nation. Almost overnight a protectionist, domestically oriented economy was exposed to global forces where, as someone put it during the 2008 innovation review, we lost the alibi that success could be "the survival of the least uncompetitive".

However, there are several important points about our subsequent national experience over the past two decades that we have not stressed enough or explained sufficiently but

which bear on how we think about the business of innovation into the future.

Core R&D and innovation destruction

One unintended, or certainly little discussed, consequence of micro-economic reform in the late 1980s and early 1990s was the destruction of core R&D and innovation capability in basic infrastructure areas of the economy such as telecommunications, water, transport and energy – all now vital in the context of climate change and globalisation.

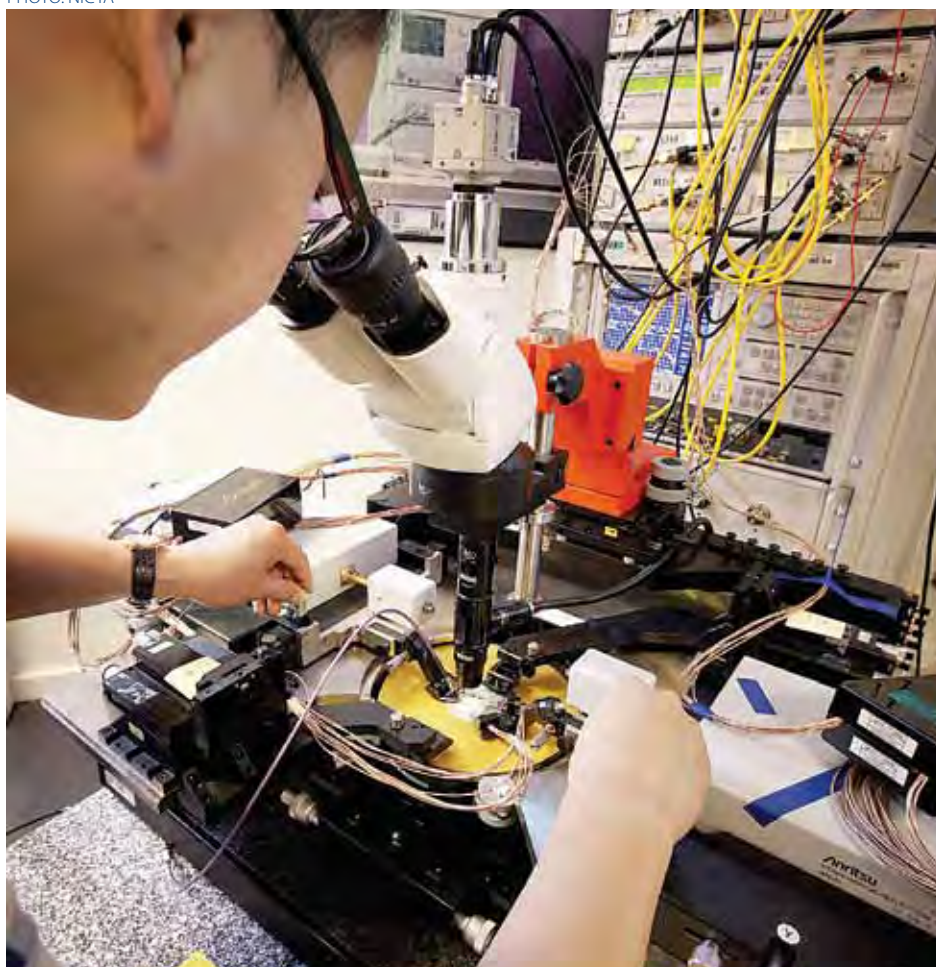
There were at least three influences at work here.

- 1 The newly deregulated and privatised entities ceased to be demanding customers with scale.
- 2 Changes to procurement practices driven by the market and policy reforms saw the wind-back of corporate R&D in Australia, accelerating a more global trend in that direction.
- 3 The newly privatised utilities came under increasing equity financing and stock market pressures, affecting their capacity for indigenous R&D and reinvestment in infrastructure.

The basic stocks of research and innovation capability had been developed within a public-sector environment, but these stocks did not transfer naturally or directly into

Accelerating
technological
change has
altered the
way we live.

PHOTO: NICTA



the successor entities. At the time there was no compensatory public-sector investment or policy focus to preserve capability. Now we are scrambling to rebuild capability in just these areas.

Innovation capability takes a long time to translate into socioeconomic benefit, so that the impact of capability destroyed or undercapitalised can have long-run consequences for competitiveness and our national ability to respond to important national challenges. There are important lessons for us here about always looking out for unintended consequences.

The productivity boom

There are also important lessons to be drawn from a better understanding of the productivity boom in the 1990s. Over the period from 1992 to 2004 the sources of productivity were highly concentrated in agriculture and just three service industries – wholesale trade, communications and finance.

The review panel noted that sustained productivity gains in agriculture were driven off a highly developed sectoral innovation system based on statutory producer levies, matched by the Commonwealth, and well-developed field extension services for technology diffusion.

It also noted two important insights about the forces at play in service markets.

First, Australia was enjoying the fruits of its first 'education revolution' of the 1970s – the entry into the workforce of a new cohort of 'bright young things', including an influx of women graduates into the workforce, increasingly IT literate and technology savvy. There is a salutary reminder here that there is a generational lag for benefits to accrue from an education revolution and that changing skills and attitudes within the workforce make a difference.

Second, most of the productivity growth in services was enabled by the deployment of ICT platforms, which supported innovative changes to business models and business processes. This highlights the crucial importance of enabling the adoption and adaptation of technology platforms in a small-country economy, where 98 per cent of the world's innovation and technology is not invented here. It also reminds us that innovation, like knowledge, is cumulative – innovation builds on innovation.

The important follow-on question, of course, is why we have not seen comparable productivity gains in so many other sectors of the economy, especially the service industries like health, education and community services largely controlled by government. Not enough critical at-

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CONTENT MATTERS

tention has been applied to this question.

The global recession has been a wake-up call. In our enthusiasm we tend to forget that innovation is not morally neutral – it can lead to bad outcomes as well as good. It was dazzlingly innovative financial instruments that eventually undermined the global financial system. This breakdown is now threatening to hollow out the crucial innovation pipeline of technology start-ups, as these start-ups find it increasingly difficult to find equity capital for growth or survival.

Also, we would not be debating emission trading schemes and global warming if it were not for 200 years of breakneck technological change and innovation. Accelerating technological change has changed the way we live and dramatically lengthened our life spans. But on the other side of the ledger has been the collateral damage to our planet and the prospects for sustainability and resilience.

We need to step back and look at a bigger picture. Research and science – broadly defined (in its original sense) as the domain of knowledge – is arguably going through its greatest transformation in 200 years.

Two centuries ago we saw the beginnings of the teaching and research knowledge paradigm we know today. Today a number of factors challenge old paradigms and create pressures for finding new ways of doing things, which include:

- the growing focus on life sciences and the built and natural environments as policy and research domains affecting society fundamentally (in place of the prior emphasis on natural and material sciences, and manufacturing industries;
- the emergence of a digital, networked information and communications infrastructure, which changes the dynamics of market capitalism and introduces new dimensions into the business of ‘doing’ science and research;
- the emergence of ‘open source’ and open innovation models of collaboration and collective action;
- the seemingly exponential growth of knowledge, and its underlying information and data pools, which calls for new approaches to information management; and
- the growing prominence and criticality of complex, wicked problems that are not amenable to traditional and linear problem-solving approaches.

New levels of effort

There is an increasing recognition that responding to complex societal problems such as climate change, population health, future energy resources and global food security

requires new levels of trans-disciplinary, trans-sectoral and trans-national effort.

I am not sure that either the green or white papers on innovation adequately addressed these global trends or examined whether our current innovation programs and funding models might actually act as barriers to addressing them.

Thus the big piece of unfinished business – or rather business we have scarcely started – is how we act as global innovators to address the large-scale innovation needed to tackle trans-national and societal challenges beyond the reach or remit of stand-alone national innovation strategies or the ‘micro-innovation’ at a firm or industry level.

In early June 2009 I joined a group of innovation advocates from 11 countries, which met to canvas the formation of an i20 Group – an innovation 20 to mirror the G20 Group – to address the failure of current institutional frameworks to adequately address the custody and the mobilisation of large-scale, collective efforts around ‘innovation for society’.

This group has committed to work together to promote and advocate a global agenda. One extreme example of a transnational, large-scale challenge that has no natural owner or custodian is geo-engineering as a fallback, desperate response to global warming.

It is clear that innovation and technological change got us into many of the messes we are in today, but only innovation and technological breakthroughs will get us out of trouble.

As Hillary Clinton keeps remarking, let us not waste a good crisis. With unfinished business, and now pressing new business, we must keep the dialogue on innovation alive and urgent. ◀

(An edited version of a recent address to the Victorian Division of ATSE.)

DR TERRY CUTLER FTSE is an industry consultant and strategy adviser in the information and communication technology sector, and the principal of Cutler & Company. He is also the Deputy Chairman of CSIRO. Dr Cutler has held numerous important advisory and decision-making positions with Australian government agencies, including roles as Chair of the Review of the National Innovation System, the Information Policy Advisory Council, the Industry Research and Development Board, the Australia Council and the Australasian Cooperative Research Centre for Interaction Design.

Contributions are welcome

Opinion pieces on topics of national interest will be considered for publication in *ATSE Focus*. Items between 800 and 1500 words are preferred. They must list full name, title/role, organisation (if relevant), city of residence and email address for publication. Please address to editor@atse.org.au

Innovation and social democracy underpin successful societies

Innovation is not an abstraction. Nor is it an end itself. It is how we make a better Australia, and contribute to making a better world.

By Senator Kim Carr

Edited from a recent speech to the John Curtin Institute of Public Policy in Perth, by Senator Kim Carr, Minister for Innovation, Industry, Science and Research.

Senator Kim Carr launches ATSE's *Energy and Nanotechnology Report*.

Labor nailed its colours to the mast on innovation in *Powering Ideas: An Innovation Agenda for the 21st Century*: "Innovation is not an abstraction. Nor is it an end itself. It is how we make a better Australia, and contribute to making a better world – a prosperous, fair and decent world in which everyone has the chance of a fulfilling life."

Innovation and social democracy are both predicated on a belief in progress – not just in the world of things, but also in the social world. It is this belief – and the collective willingness to act on it – that distinguishes successful societies from societies that fail.

When we talk about progress we are really talking about the pursuit of excellence. This is something every one of us has an interest in – every worker, every consumer, every citizen, every entrepreneur, every researcher. None of us can afford to settle for business as usual. We should always be raising the bar – both for ourselves and for the nation.

Values may endure – whether they be a commitment to fairness and equality, or simple pride in the work we do. But everything else is subject to constant change and, if we get it right, continuous improvement.

Because social democrats understand that people have lives outside the marketplace, we also understand that no reform program – no innovation agenda – can be complete if it serves only economic objectives. Our kind of innovation must always have a social, cultural and political dimension as well.

If we wanted to sum up what a social democratic innovation agenda might look like, we could do worse than revive the Dutch Labour Party's old commitment to the "spreading of income, knowledge and power".

Spreading income

We could also do worse than look at what Labor has done in innovation, industry, science and research over the past 21 months, although I would be the first to acknowledge that we still have a long way to go.

The most useful thing we can do to achieve an equitable distribution of incomes is ensure that everyone has a high-wage, high-skill job: high-wage, because that's the only way we can maintain our standard of living; high-skill, because that's the only way we can immunise ourselves against competition from low-end producers (the kind of competition that drives wages and living standards down).

Our success in creating jobs like these will depend very much on willingness to face some harsh realities. One of those realities is climate change. Another is globalisation.

Climate change is a serious threat, but it is also an opportunity. Labor has been quick to introduce programs that will drive the development of greenhouse-friendly technologies – technologies we can both use at home to reduce the impact of global warming and export worldwide to generate wealth and jobs for Australia.

Climate Ready, the Green Building Fund and the Green Car Innovation Fund are just three examples. The Carbon Pollution Reduction Scheme will create incentives for innovation across the economy. The Clean Energy Initiative will support the development of clean coal and renewable energy technologies, with a particular focus on solar. It is no accident that it includes \$400 million for research infrastructure.

It is no accident that we have launched a Climate Adaptation Flagship within CSIRO or a Clean Energy Innovation Centre within Enterprise Connect. It is no accident

that we included \$387 million for the closely related fields of marine and climate science in the Super Science Initiative.

We are supporting both the development and application of technologies that are ready to leave the drawing board right now, and the research – often basic, blue-sky research – that will fuel the development of new technologies for years to come. It is all about using our brains to move up the value chain.

This is the answer to the challenge of globalisation. We can never win the race to the bottom, so we need to get serious about winning the race to the top. We will never be the world's cheapest producer – even if we wanted to be – so we must aim at being the smartest.

If you are wondering why we increased support for research and innovation by \$3.1 billion in the last Budget, this is the answer. If you are wondering why we have redesigned support for the automotive and textiles, clothing and footwear industries to reward innovation, this is the answer. If you are wondering why the Super Science Initiative includes \$504 million specifically for research that will drive the development of future industries, this is the answer.

If you are wondering why we have established Enterprise Connect, or our system of industry innovation councils, wonder no more. If you are wondering why we are creating a new Commonwealth Commercialisation Institute, or why we are introducing more generous incentives for business R&D, I'm sure you've figured it out by now.

We have to make Australian industry more creative and more productive. We are pretty good at invention and discovery, but we have to get a whole lot better – remembering that the rest of the world is not standing still. We must be able to come up with products and services so good and so original that no one else can match them – not just once in a blue moon, but all the time.

This is the only way we can secure those high-skill, high-wage jobs. This is the only way we can go on growing the economic pie so that everyone gets a decent slice.

Spreading knowledge

The second part of the Dutch trinity is achieving a more equitable distribution of knowledge.

Given the size of our population, we can't let talent go to waste. That means we need to give everyone the chance to develop their skills as far as they want and as far as they can. This isn't just about making effective use of human capital. It is also about social justice.

One study suggests that three-quarters of the global increase in inequality since the 1980s has been caused by technological progress. This is because advances in technology increase the premium on skills, favour those who already have educational advantages and reduce demand

for low-skilled inputs.

We cannot sit back and watch Australia break into two nations: one with the capacity to master the latest techniques and technologies, and one without. That's why we have established the Productivity Places Program to get more people into vocational training and apprenticeships. That's why we have set targets that will see more kids finishing high school and doing bachelor degrees – including more kids from disadvantaged backgrounds. And that's why we have increased support to allow more people to do research degrees and go on to research careers.

This is all about giving individuals better access to the skills and knowledge they need to participate fully in the innovation culture we are creating.

At the same time, we're also giving industry better access to the knowledge it needs to become more innovative and more productive. That's where our new investments in research infrastructure come in. That's where our dramatically increased funding for university research comes in. That's where new initiatives like the Joint Research Engagement Scheme, the Researchers in Business Program, and the mission-based funding compacts for universities come in. All are designed to strengthen the links between public-sector researchers and private industry.

Australia's resources are finite, and we have to use them as effectively as we possibly can. One way to do that is by increasing collaboration – within industry, within the research sector and between the two – both within Australia and internationally.

Australia's new \$43 billion National Broadband Network will make collaboration much easier – not just by accelerating communications, but by inspiring entirely new services and applications.

Spreading power

The third and final item on the social democratic innovation agenda is achieving a more equitable distribution of power.

Both the left and the right are prone to focus exclusively on market power – the power that comes from controlling great wealth, or the means of production, or both. We too easily forget that civil society and our democratic institutions have always functioned as countervailing centres of power – even during interludes of extreme capitalism.

We still have a constitution under which schoolteachers can become Cabinet ministers, and we should value that.

The entrenched belief that you can't make a difference through the political process is highly convenient to those who hold market power, because it discourages people from raising their voices.

In my own portfolio, I have broadened representation by inviting unionists to sit on industry innovation coun-

cils, Enterprise Connect advisory boards and other consultative bodies. I have appointed a representative committee to provide independent advice to the Australian Research Council, and consulted exhaustively before introducing new policies and programs. Is this enough? Of course not, but I think this is where we should be heading.

In my undergraduate days, Professor Carole Pateman advocated participatory democracy, arguing that encouraging community and workplace democracy would build decision-making skills, lift general political competence, and make groups more inclusive, cohesive and egalitarian.

Maybe it is time we started thinking this way again – especially given the evidence that workplace democracy increases productivity and cuts downtime by involving workers directly in the innovation process, reducing supervisory overheads, empowering workers “to employ the knowledge that only they have”, and creating decentralised lines of communication that make it easier to fix problems as soon as they arise.

The cause of continuous improvement is best served by cooperation rather than confrontation, and it is most likely to succeed when it involves the whole enterprise, from the boardroom to the factory floor.

No one pretends creating a good country in which

people can lead decent lives is easy – and it is not the business of social democrats to downplay the challenges. We must always set our sights on achieving the maximum conditions for fairness and fulfillment, not the minimum.

We know that social inclusion and equal opportunity is important. That’s why Labor has created a portfolio dedicated to ensuring that all Australians feel valued and have the opportunity to participate fully in community life. Yet we also know that further steps are required to ensure that the society we are including people in is just. It is these steps we must focus on.

Managing social risks is important, but it is no substitute for redistributive measures that increase people’s capacity to take charge of their own lives. It is these measures we must focus on.

These are challenges Labor accepts and that we are responding to – confident in the belief that, by working together, we can make the world a better place.

Collective action is not the problem, it is the solution. Social democrats have faith in the intellectual and imaginative powers of their fellow human beings. They have faith in our combined capacity to shape the future.

That, more than anything else, is what links the culture of social democracy to the culture of innovation. ◀

SCIENCE CAN INVIGORATE THE SERVICES SECTOR

Science plays a huge, but unrecognised, role in the service sector, and has the potential to greatly expand its influence and the benefits it can bring, according to a report published by the Royal Society.

The report, *Hidden wealth: the contribution of science to service sector innovation*, analyses the impact of science on the service sector, which currently employs more than 80 per cent of the UK working population.

The report reveals that STEM (science, technology, engineering and maths) is omnipresent in the service sector but rarely recognised. In particular, STEM is often embedded in the form of human capital, infrastructure (for example, computing and IT) and the STEM capabilities of external consultancies.

Professor David Rhind, who chaired the Royal Society report’s working group, said the service sector generated between half and three-quarters of the world’s wealth and accounted for more than 80 per cent of employment in the UK.

“Despite this, little research has been

done into how innovation, which drives the expansion of the service sector, develops,” he said. “The report identifies science and related subjects as startlingly significant in this development, which is intrinsically linked to the growth of the UK economy in the future and our emergence from recession.”

It details a raft of measures that would improve and assist the development of the UK service sector and innovation, considering in particular the public and banking sectors.

Some key recommendations included:

- research communities and agendas for the service sector should be built and supported;
- multi-disciplinary training should be developed in higher education institutions alongside more service sector placements to ensure relevant multi-disciplinary capabilities are acquired by STEM-trained personnel;
- the scale of knowledge exchange between service organisations and public science base should be greatly increased; and
- understanding of innovation in the service

sector and the role of STEM should be improved.

Organisation-specific recommendations included:

- Research Councils, the Bank of England and the Financial Services Authority (FSA) should ensure that the research base contributes to more effective modelling of systemic risk in financial services; and
- the Department of Business, Innovation and Skills, together with the Technology Strategy Board and Research Councils, should develop one or more world-class, independent centres of modelling and risk assessment relevant to financial services.

“It is of great concern that services, innovation and the role of STEM are so poorly understood, leading to the lack of a coherent policy for service innovation,” Professor Rhind said. “This deficiency makes the recommendations of the report all the more significant, as they provide a template for future policy, one which the UK urgently needs.”

Tropical potential: a tale of two inequities*

Many of the world's population, mainly those living in the tropics, lack the most basic of essential goods and services – food, medicine and housing.

By Peter Andrews

chief.scientist@qld.gov.au

* apologies to Charles Dickens

I want to tell you about two inequities – one Australian, one global – and how the two might be linked to deliver a win-win outcome. The first inequity was pointed out a generation ago by then Federal Minister for Science, Barry Jones (a Fellow of all four Australian learned academies), who noted that although Australia's research effort was comparable, on a per capita basis, to other advanced nations, our subsequent development and commercialisation outcomes were only one-third and one-tenth of those of our competitors, respectively.

Twenty-five years later the figures are not much different. We do 50 per cent more published research, per capita, than the OECD average, but patent 50 per cent less, and lag even further behind when it comes to commercial returns.

These figures are not surprising. They simply reflect the nature of our investments. Our non-business investment in R&D, comprising primarily research conducted by government and higher education, is as good or better than that elsewhere in the OECD, but our business expenditure on R&D (BERD) is half or even one-third of that in leading OECD nations.

The result of this imbalance, from the point of view of an investor in knowledge-intensive industries, is a surfeit of low-hanging fruit – about twice as much high-quality undeveloped research per capita as in the US.

Let me give you two brief examples:

- the anti-influenza drug Relenza, although not as well known as its sister drug Tamiflu, was the very first marketed drug to be designed to fit a target site – in this case the protein neuraminidase on the surface of the flu virus – using computer modelling; and
- similarly, the cervical cancer vaccine Gardasil – also designed from first principles – was the world's very first anticancer vaccine.

Both were created in Australia, but both were licensed and developed overseas. So that's the first inequity: great research, weak development.

The second inequity is the fact that many of the world's people, mainly those living in the tropics, lack the most basic of essential goods and services – food, medicine and housing.

For example, the vast majority of the world's health budget is spent on the small proportion of citizens dwelling in the developed world, despite the fact that standard health indicators such as infant mortality are more than 20 times worse in some tropical countries than they are in Australia.

Environmentally, tropical populations fare no better. Over 700 million people in the tropical world rely on forests or savannah for food, fuel and income, and 250 million more depend on coral reefs. Yet tropical forests continue to be cleared at unsustainable rates and the productivity of the world's coral reefs will decrease by 70 to 80 per cent by 2050.

PHOTO: BRAD COLLIS



A Cambodian research extension officer tending vegetable trials that were part of an AusAID project. Such Australian investment in strengthening agricultural economies in the region could be a 'win-win' for poverty alleviation and future commercial ties.

And finally, food. As you and I sit down to our lunch every day, 15 per cent of the population of Oceania go to bed hungry. In sub-Saharan Africa 30 per cent more are waking up the same way.

Why is this so? All of these problems are amenable to research in tropical agriculture, health and ecosystems – areas where Australia has outstanding research capabilities. Why isn't our surfeit of research being applied to these tropical problems?

Recently, a group of 40 scientists, educators, industrialists and government officials from the developed and developing worlds met in Cairns to consider this question at the 'Life in the Torrid Zone' symposium.

They concluded that there was a real opportunity to use Australia's expertise in tropical agriculture, health and

environmental sciences to not only build new Australian industries, but also to deliver enhanced social, economic and environmental benefits throughout the tropics. In particular, they noted that the sum of the planet's tropical economies, the global tropical product, is projected to reach US\$40 trillion, 20 times Australia's projected GDP, by 2025. Of that US\$40 trillion, between 25 and 30 per cent will be spent on importing goods and services, and more again will be spent on developing new industries in the tropical world.

So, there's the win-win. By building knowledge-intensive industries producing tropical goods and services, Australian investors can access the fastest-growing and least-contested markets in the world, and the tropical world can gain access to the fruits of Australia's research.

The key to achieving this will lie in our ability to create networks in education, research, business and government with tropical countries in our region, notably in South-East Asia and the Pacific, and to build stronger linkages between researchers and businesses, between entrepreneurs and investors, and between Australian companies and their future tropical markets.

Working with James Cook University, government research organisations and the business community in northern Queensland, the Queensland Government has recently sponsored the formation of a new not-for-profit association, TropLinks Inc, to build these linkages.

TropLinks Inc aims to catalyse the growth of industries based on Australia's tropical expertise by actively identifying funding pools and attracting investment for projects and industry development and bringing members together to create a united, internationally recognised presence.

Its ultimate goal is to double the growth rate of northern Australia's tropical economy. We look forward to working with you to make it happen. ◀

This article was first published in R&D Review. Further information on TropLinks Inc can be found at www.troplinks.com, or by contacting CEO Graham Poon at info@troplinks.com.

PROFESSOR PETER ANDREWS AO FTSE was appointed

Queensland Chief Scientist in 2003. He is an eminent scientist and bio-entrepreneur with long standing interests in policy and economic development issues associated with science, research and innovation. He has led teams working in drug design and development in Victoria and Queensland, is the author of more than 100 publications and inventor of two patents. Professor Andrews has been at the forefront of initiatives to develop the Australian biotechnology industry and is a strong advocate of the development and commercialisation of Australian research. Since 1985, he has founded or co-founded six scientific companies.

ATSE BACKS THE AUSTRALIAN SCIENCE MEDIA CENTRE

The Academy has become a Gold Sponsor of the Australian Science Media Centre (AusSMC), based in Adelaide, which supports scientists to take more initiative and play a leading role in informing public debate through the news media.

Established in 2005, AusSMC has won a deserved reputation for helping leaders in the science and technology communities engage with journalists to promote media interest in what is generally known as 'science' journalism.

Climate change, energy and water scarcity are just a few of the big issues that need bold solutions from a public empowered by knowledge and AusSMC works on a number of fronts to help scientists make a big impact on the way issues are covered in the media.

AusSMC is a non-profit organisation that represents no particular faction in science. Its agenda is simply to utilise evidence-based science to shed light on issues and present a broad spectrum of scientific opinion.

AusSMC staff use a growing database of media-friendly experts who are ready to comment on issues as they emerge and have the capacity to engage with journalists. AusSMC's promise to media is "we won't blind you with science".

The AusSMC operates from Adelaide with four full-time and two casual staff and is headed by CEO Dr Susannah Elliott. Although most

enquiries are received during office hours, the national centre is on call 24 hours a day for significant breaking stories and emergencies.

When science and technology topics (from genetics to geosequestration) are leading the news bulletins, the AusSMC staff round up comments from the list of experts for rapid distribution to media outlets across the nation. These quotes are used either directly by journalists in their stories, for follow-up interviews or as a barometer of where individual scientists stand on an issue.

AusSMC runs national briefings for journalists in cities around Australia. Experts are targeted to give short presentations and answer media questions with time set aside for one-on-one interviews. All briefings are streamed live over the internet, making them easily accessible to journalists throughout the country.

Assisting journalists in finding a suitable expert for their story is all part of a normal day for the AusSMC. The centre maintains a growing network of contacts that helps locate the right expert quickly.

The AusSMC website (www.aussmc.org) is updated constantly and has proven to be a valuable resource for journalists and scientists. It includes an archive of information and quotes on recent hot topics and briefings, 'nutshells', science blogs and more.

ATSE has used the services of AusSMC previously and is a contributor to its work. It expects to develop closer relations with AusSMC as a result of its sponsorship.

The centre is based on the UK's acclaimed Science Media Centre (SMC), an initiative of Baroness Professor Susan Greenfield, the well-known British neuroscientist and Director of the Royal Institution of Great Britain. AusSMC was inspired by the Baroness during her period as an Adelaide Thinker in Residence in 2004-05 and she is now its patron.

AusSMC is governed by a Board of Management and advised by a panel of eminent scientists. The AusSMC Board includes Dr Graham Mitchell AO FAA FTSE, Chief Scientist of Victoria, and Mr Graeme Liebelt FTSE, MD and CEO of Orica Ltd.

The Science Advisory Panel includes: Professor Peter Andrews AO FTSE, Queensland Chief Scientist; Professor Snow Barlow FTSE, University of Melbourne; Professor Robin Batterham AO FREng FAA FTSE, ATSE President; Laureate Professor Adrienne Clarke ACFAA FTSE, University of Melbourne; Emeritus Professor Ian Lowe AO FTSE, President, Australian Conservation Foundation; Emeritus Professor Nancy Millis AC MBE FAA FTSE, University of Melbourne; and Emeritus Professor Sir Gustav Nossal AC CBE FRS FAA FTSE, University of Melbourne.



**AusSMC in action –
briefing journalists.**

Geoengineering could be “our only hope”

The future of the Earth could rest on potentially dangerous and unproven geoengineering technologies unless emissions of carbon dioxide can be greatly reduced, the latest Royal Society report has found.

Geoengineering the climate: science, governance and uncertainty found that unless future efforts to reduce greenhouse gas emissions are much more successful than they have been so far, additional action in the form of geoengineering will be necessary if we are to cool the planet.

Geoengineering technologies were found to be very likely to be technically possible and some were considered to be potentially useful to augment the continuing efforts to mitigate climate change by reducing emissions. However, the report identified major uncertainties regarding their effectiveness, costs and environmental impacts.

“It is an unpalatable truth that unless we can succeed in greatly reducing CO₂ emissions we are headed for a very uncomfortable and challenging climate future, and geoengineering will be the only option left to limit further temperature increases,” said Professor John Shepherd, who chaired the Royal Society’s geoengineering study.

“Our research found that some geoengineering techniques could have serious, unintended and detrimental effects on many people and ecosystems – yet we are still failing to take the only action that will prevent us from having to rely on them. Geoengineering and its consequences are the price we may have to pay for failure to act on climate change.”

The report assesses the two main kinds of geoengineering techniques: carbon dioxide removal (CDR) and solar radiation management (SRM). It says CDR techniques address the root of the problem of rising CO₂ and so have fewer uncertainties and risks, as they work to return the Earth to a more normal state. They are therefore considered preferable to SRM techniques, but none has yet been demonstrated to be effective at an affordable cost, with acceptable environmental impacts, and they only work to reduce temperatures over very long timescales.

SRM techniques focus on reflecting the sun’s energy away from the Earth, meaning they lower temperatures rapidly, but do not affect CO₂ levels. They therefore fail to address the wider effects of rising CO₂, such as ocean acidification, and would need to be deployed for a very long time. Although relatively cheap to deploy, there are considerable uncertainties about their regional consequences, and they only reduce some of the effects of climate change, while possibly creating other problems.

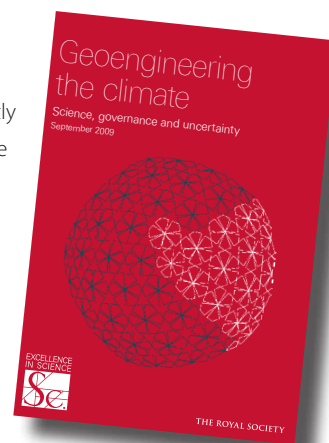
The report concludes that SRM techniques could be useful if a threshold is reached where action to reduce temperatures must be taken rapidly, but that they are not an alternative to emissions reductions or CDR techniques.

“None of the geoengineering technologies so far suggested is a magic bullet, and all have risks and uncertainties associated with them,”

Professor Shepherd said. “It is essential that we strive to cut emissions now, but we must also face the very real possibility that we will fail. If ‘plan B’ is to be an option in the future, considerable research and development of the different methods, their environmental impacts and governance issues must be undertaken now. Used irresponsibly or without regard for possible side-effects, geoengineering could have catastrophic consequences similar to those of climate change itself. We must ensure that a governance framework is in place to prevent this.”

Australian commentators responded as follows.

- Professor of Natural Resources Engineering at RMIT University John Buckeridge said we needed to focus on reducing the rampant consumption of natural resources rather than geoengineering.
- “Geoengineering responses are like the old lady who swallowed a spider to catch the fly, creating a whole set of new problems,” said Professor Ian Lowe FTSE, President of the Australian Conservation Foundation.
- Kevin Walsh, Associate Professor of Meteorology at the University of Melbourne, said: “The report correctly concludes that there is no substitute for a concerted campaign to reduce greenhouse gas emissions, while acknowledging that some geoengineering options may be helpful in the future.”



Geoengineering the climate

is available at

<http://royalsociety.org/displaypagedoc.asp?id=35110>

CO2CRC FUNDED FOR FURTHER FIVE YEARS

The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), one of the world’s leading carbon capture and storage (CCS) research collaborations, is one of 10 successful CRCs funded in the 11th selection round of the CRC Program, with funding to 2015

“We are very pleased that the Australian Government has decided to fund CO2CRC for a further five years,” said Chief Executive Dr Peter Cook CBE FTSE. “The decision allows us to maintain the highly successful multi-disciplinary research teams we have assembled to accelerate deployment of CCS technology and further strengthen our international CCS connections.

“Extending CO2CRC until 2015 will allow us to further capitalise on the three demonstration projects we now have in operation – the CO2CRC Otway Project, the HRL/CO2CRC Mulgrave Capture Project and the CO2CRC H3 Capture Project.

“These demonstration projects are already producing important outcomes in storage and capture research, including showing that storage of CO₂ can be safe and effective and that capture costs can be reduced.”

World Climate Conference seeks global consensus



By John Zillman

j.zillman@bom.gov.au

The Third World Climate Conference (WCC-3) in Geneva was focused on climate prediction and information for decision-making and was aimed at fostering international consensus on a global framework for climate services that would link science-based climate prediction and information with the management of climate-related risks and opportunities in support of adaptation to climate variability and change.

In effect, it sought to build on the established globally coordinated systems for climate observations and research to provide a world climate services system to complement and support the work of the IPCC and the UNFCCC in assisting countries and sectors to better manage the impacts of climate variability and change.

WCC-3 commenced with an Expert Segment during which experts in the various aspects of climate science and service provision, from all the main climate-sensitive sectors of society, took stock of the needs and capabilities for service provision in the various sectors and agreed on a coordinated set of conclusions and recommendations, which were drawn together in a 35-page Conference Statement.

They called, in particular, for major strengthening of:

- climate observing systems;
- climate research;
- climate services information systems;
- climate user-interface mechanisms; and
- capacity building for climate services in developing countries.

The Expert Segment was followed by a High-level Segment, which was co-chaired by the former President of Switzerland and the President of Mozambique and includ-

The third World Climate Conference (WCC-3) took place in Geneva from 31 August to 4 September 2009. It was opened by the President of Switzerland and addressed by the present (Ban Ki-moon) and former (Kofi Annan) Secretaries-General of the United Nations and many other dignitaries including nine heads of state and government and the Chair of the former World Commission on Environment and Development (now the Brundtland Commission), Dr Gro Harlem Brundtland. It initiated action for the establishment of a new Global Framework for Climate Services, with support from more than 160 countries and 50 international organisations, including the International Council of Academies of Engineering and Technological Sciences (CAETS).

The first (1979) and second (1990) World Climate Conferences, convened by the World Meteorological Organization (WMO) and its international climate partner organisations, led to the establishment of the World Climate Program (including the World Climate Research Program (WCRP)), the Intergovernmental Panel on Climate Change (IPCC), the Global Climate Observing System (GCOS) and the Climate Agenda, and provided the scientific underpinning for the negotiation of the UN Framework Convention on Climate Change (UNFCCC), which was signed at the 1992 Rio Earth Summit (see references page 24). They have largely shaped the international response to the climate change issue over the past 30 years.

ed some 2500 national and agency delegates and other participants. Following receipt of a report on the outcome of the Expert Segment, WCC-3 adopted a High-level Declaration setting in train the action for detailed design and implementation of the proposed Framework (Figure 1) over the next 16 months.

Professor René Dandliker delivering the CAETS statement in support of the Global Framework for Climate Services.

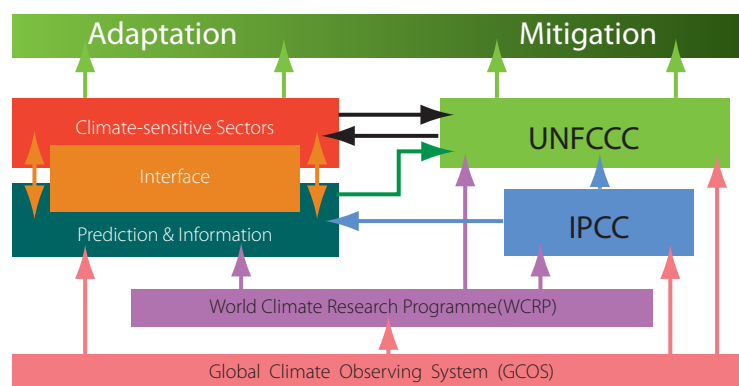
The text of the High-level Declaration had been negotiated among governments over the previous six months and was finalised for adoption by acclamation at the conclusion of the opening ceremony for the High-level Segment.

Following the adoption of the Declaration, the Conference heard almost two days of ministerial (and other national) and agency statements of support for, and plans for contribution to, the Framework.

The Australian delegation to WCC-3 was led by Mr Howard Bamsey of the Department of Climate Change and the Australian Statement in the High-level Segment was delivered by Dr Mike Coughlan of the Bureau of Meteorology.

The CAETS Statement was delivered by Professor René Dandliker, President of the Swiss Academy of Engineering Sciences. It stressed the role of the CAETS academies in providing scientific and engineering advice and support for national strategies for climate change mitigation and adaptation within their countries. It included reference to recommendations on climate and ocean observations and services from the Sixteenth Convocation of CAETS, which was hosted by ATSE in Cairns in July 2005.

WCC-3 established a follow-up mechanism to take on board the outcome of both the Expert and High-level Segments in the detailed design and implementation of the new Global Framework for Climate Services over the next couple of years. ◀



A schematic representation of the proposed Global Framework for Climate Services built on the Global Climate Observing System (GCOS) and the World Climate Research Programme (WCRP) to support and complement the role of the Intergovernmental Panel on Climate Change (IPCC) and the UN Framework Convention on Climate Change (UNFCCC) in providing the climate information and prediction services to enable climate-sensitive sectors and countries to better manage both their adaptation and mitigation responses to climate variability and change.

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PROFESSOR JOHN ZILLMAN AO FAA FTSE was Chair of the International Organising Committee for WCC-3. He is a professorial fellow at the University of Melbourne, Chair of the Steering Committee of the Global Climate Observing System, former President of the World Meteorological Organization and Commonwealth Director of Meteorology. He has served ATSE in many roles, including President, 2003–06.

LETTER

IS FASHION MORE IMPORTANT THAN SAVING LIVES?

My congratulations to Professor Malcolm Chaikin AO OBE FTSE on being honoured with the Award of Hon DSc from the University of Leeds, and to Dr Keeva Vozoff FTSE on being honoured with the Reginald Fessen Award by the Society of Exploration Geologists in the US.

Regrettably, many of the outstanding scientists in Australia are not receiving the recognition that they unquestionably deserve.

I was Chairman of the Prizes and Awards Committee of the ATSE from 1992 till 1994 inclusive. In this role I nominated several eminent Australian scientists for the Award of the Order of Australia. This Order is administered by the Honours Secretariat at the

Government House in Canberra. None of my nominations were approved by the Honours Secretariat, in spite of the fact that some were supported by the President of ATSE.

I found this most surprising, as the criteria for election to the Fellowship of the ATSE, in my opinion, should entitle a Fellow of this Academy to at least an Award of a Member in the Order of Australia, and possibly even an Officer in the Order.

Thus, I was not particularly surprised when in the latest Queen's Birthday Honours one of the most eminent and illustrious medical doctors, the late Professor Chris O'Brien, who dedicated nearly all of his life fighting the most terrible diseases, was posthumously made an

Officer of the Order of Australia whereas, in the same list, Ms Carla Zampatti was appointed a Companion of the Order of Australia, the highest award which is considered by some to be equivalent to Knighthood.

I have no doubt whatsoever that Ms Zampatti deserves this honour for her outstanding contribution to the Australian commerce. What I find most disturbing, however, is that Professor O'Brien was denied a similar award by the Honours Secretariat, the members of which apparently consider that providing Australians with fashionable dress is more important than saving their lives.

– Professor Aleksander Samarin FTSE

The world loses its leading hunger fighter

Nobel Peace Laureate and renowned wheat scientist, Dr Norman E. Borlaug, died in September, aged 95, after an exemplary life dedicated to fighting hunger in developing countries.

The International Maize and Wheat Improvement Center (CIMMYT, by its Spanish name) joins with members of the international

development community to mourn his passing.

High-yielding wheat varieties and improved farming practices, first developed by Dr Borlaug and his team in Mexico during the 1950s, were introduced into South Asia in the 1960s and may well be responsible for saving hundreds of millions of people from starvation.

Known as the 'Green Revolution', his work gave rise to science-based agriculture in developing countries. Today,

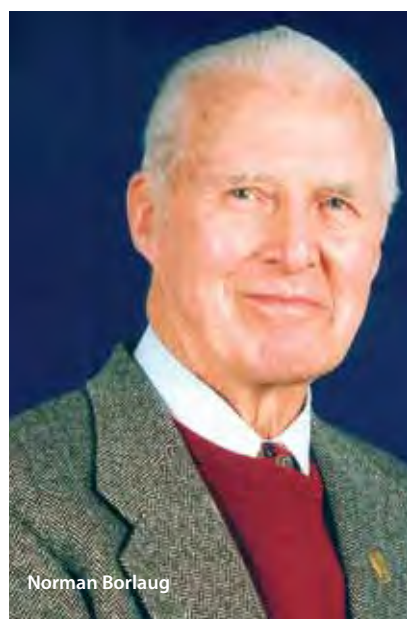


PHOTO: CIMMYT

high-yielding, disease-resistant wheat varieties based on Dr Borlaug's pioneering work are grown on 80 million hectares throughout the world.

He received the 1970 Nobel Peace Prize for those achievements, and his success led to the establishment of a network of 15 international agricultural research centres, including CIMMYT. Dr Borlaug worked as a CIMMYT wheat breeder and research director for nearly four decades and was a CIMMYT scientist at the time he received the Nobel Peace Prize.

In 1986 he joined forces with former US President Jimmy Carter and the Nippon Foundation of Japan, under the chairmanship of Ryoichi Sasakawa, to develop an African agricultural initiative. Over a 20-year period, the Sasakawa-Global 2000 agricultural program, as it is known, has been working in 15 African countries to transfer improved agricultural technology to several million small-scale farmers.

Norm Borlaug was especially proud of his role in establishing the World Food Prize in 1986. This prize has grown in stature and is now considered the 'Nobel Prize for food and agriculture'. Some 25 men and women have been recognised for their outstanding contributions to increasing the quantity, quality and availability of world food supplies.

He used his fame and influence to champion the cause of smallholder agricultural development around the globe. Over a 63-year

career, he travelled tirelessly to more than 100 nations, visiting farmers and agricultural scientists in their fields. It is estimated that over his lifetime he personally spoke to more than 500,000 students and ordinary citizens, explaining the challenges and complexities of world food production.

Dr Borlaug was voted a member of the academies of agricultural science of 11 nations, received 60 honorary doctorate degrees from those countries, and was honoured by farmer and civic associations in 28 countries.

His work was recognised in the US, where he received the Presidential Medal of Freedom, the National Medal of Science and the Congressional Gold Medal, the nation's highest civilian award.

Tim Reeves FTSE, a Former Director-General of CIMMYT, spoke at a condolence meeting organised by the Indian Council of Agricultural Research.

"It was very moving to hear Indian colleagues' remembrances of Dr Borlaug," Mr Reeves said. "One colleague, who was a young wheat scientist at the time of Norm's 'Green Revolution' work, told me: 'You just don't realise how much effort Dr Borlaug put in to make things happen. He worked ceaselessly in the fields with farmers, and often had to sleep at night on benches at railway stations, whilst living on poor quality food and water. For us he was like Krishna on Earth'.

"To me Norm was an inspiration during the seven years I was in Mexico. He had an unquenchable fervour for helping the resource-poor of the world through enhanced food security and livelihoods, and his enthusiasm rubbed off on everyone he met.

"He was a truly great man and as we all attempt, in some small way, to carry on his legacy, it must be to re-energise our calls for increased investment in the research and development necessary to ensure that the world's farmers have the tools and knowledge to ensure future food security.

"Norm would have expected nothing less."

\$7 BILLION "CAN PREVENT" 25 MILLION MORE MALNOURISHED CHILDREN

Twenty-five million more children will be malnourished in 2050 due to the effects of climate change, according to a report by the International Food Policy Research Institute (IFPRI), *Climate Change, Agriculture, and Food Security: Impacts and Costs of Adaptation to 2050*.

This study, the most comprehensive assessment of the impact of climate change on agriculture to date, compares the number of malnourished children in 2050 with and without climate change.

"This outcome could be averted with US\$7 billion per year of additional investments in agricultural productivity to help farmers to adapt to the effects of climate change," said Gerald Nelson, IFPRI senior research fellow and the report's lead author.

"Investments are needed in agricultural research, improved irrigation and rural roads to increase market access for poor farmers. Access to safe drinking water and education for girls is also essential."

The report says that without new technology and adjustments by farmers, climate change will reduce irrigated wheat yields in 2050 by about 30 per cent in developing countries compared to a no-climate-change scenario, it said. Irrigated rice yields will fall by 15 per cent.

Biofuel and crop research boost

The High Resolution Plant Phenomics Centre, Black Mountain, Canberra.

CSIRO and US Department of Agriculture (USDA) researchers have been awarded a A\$1.6 million grant to increase the understanding of genes responsible for growth and yield in grasses for use as bio-energy and food crops.

The research team will identify the genes associated with key plant properties responsible for growth, flowering and grain-filling in grasses, using the advanced robotic and imaging plant research tools of the Australian Plant Phenomics Facility (APPF).

The US Department of Energy (DOE) has recognised the unique, world-class capability of the APPF by providing the funds through its Plant Feedstock Genomics program. The DOE will apply the results to biofuel grasses development and CSIRO will increase the productivity of cereal food crops such as wheat.

The Scientific Director of the APPF's High Resolution Plant Phenomics Centre in Canberra, CSIRO's Dr Bob Furbank, said the combined technology of CSIRO, the Phenomics Centre and USDA would advance the development of biofuels and higher-yielding cereal crops.

"Using world-leading technologies developed at the Phenomics Centre, genes which enable biofuel crops to grow in marginal agricultural land will be identified," he said. "This knowledge will also rapidly advance yield and stress-tolerance research in crops such as wheat."

Biofuel crops must have traits for efficient and environmentally sustainable crop production and a chemical composition appropriate for conversion to liquid fuels. They must also be bred to require fewer inputs, for example pesticide and herbicide applications, fertiliser, water, and the use of energy-consuming farm equipment.

LIVING WITH GM CROPS

International experts will converge on Melbourne in November to discuss coexistence between GM and non-GM crops.

Professor German Spangenberg FTSE, Conference Chair, says the GMCC-09 conference will highlight best-practice examples from around the world.

"GMCC-09 will have a strong focus on challenges for industry. We're excited to announce a workshop on logistical approaches for cost-effective GM analysis

hosted by Guy Van den Eede from the Institute for Health and Consumer Protection in Italy," Professor Spangenberg said.

"Bernhard Koch will also be leading a session on legal frameworks for coexistence. Dr Koch will discuss the efforts in developing worldwide coexistence legal strategies."

Issues and overlap on technical, economic and regulatory issues involved in coexistence will also be discussed.

"The conference will host speakers from 21 countries worldwide. This is an excellent



Earth scientists at centre of global food crime fight

Australian earth scientists have joined forces with food scientists and chemists in an international effort to fight global food crime using new tamper-proof technology that pinpoints exactly where in the world particular foods have been produced – and they are calling on the Australian Government to implement the technology.

The globalisation of world markets has increasingly led to fraudulent behaviour in the global food trade – including organised food crime – as some traders attempt to boost their profits by deliberately mislabelling substandard produce so it appears to have come from countries where foods are considered to be superior and free of contaminants, such as Australia and New Zealand.

But the new tamper-proof technology – which uses isotopic and trace-element signatures unique to foods from individual regions across the world – can now provide a forensic fingerprint showing exactly where the food was produced, right down to a district level.

Once introduced, this technology will enable Australian and New Zealand producers to maintain their high-quality market niche, while also protecting domestic consumers from sub-standard imports, according to Dr Anita Andrew, a member of the Geological Society of Australia (GSA) and an earth scientist involved in the development of the technology.



Dr Anita Andrew

“The security of the food supply chain has become a huge issue,” said Dr Andrew, a Director of Sydney-based company Environmental Isotopes. “Consumers want to know where their food is coming from and that it is safe from pesticides and other contaminants. They are prepared to pay a premium for food whose origins are known and can be assured.

“Although there are paper-based systems designed to combat food fraud, such as country-of-origin labelling, this can easily be subjected to tampering – there are numerous examples of food products that have been produced in Asia but are labelled as products of Australia and New Zealand and then exported to Europe.

“The beauty of this new technology is that it identifies the origins of foodstuffs by the unique isotopic and trace-element signatures that all foods have. These signatures are an inherent part of the foodstuff, specific to the particular regions in which they were grown, and tamper-proof.”

Dr Andrew said recent research in Australia demonstrated that this technology was so sensitive it could pinpoint milk from different districts across the country because the isotopic signature the milk carried was based on the geology underlying the pasture that the cow grazed.

“We believe a great first step would be the development of an Australian and New Zealand database of isotopic signatures to facilitate the accurate origin assignment of dairy products produced within Australasia.

“Our strong message to the Australian Government is that this technology should now be introduced: it will bring huge benefits to food exporters as well as consumers.”

The Geological Society of Australia is seeking to promote earth science and careers in earth science through its Earth Science Showcase. Subscribe at mediasubscribe@gsa.org.au



German Spangenberg

opportunity for Australian researchers and industry to learn from international experience,” Professor Spangenberg said.

“There has been significant growth in the introduction of GM crops in global agriculture. The conference will provide a strong knowledge base that can be used to develop feasible coexistence strategies between GM and non-GM crops.”

Key issues will include strategies for coexistence and organisational measures

across the supply chain, socioeconomics of coexistence and many others, as well as highlighting the progress of the Australian approach in the coexistence of GM canola.

“We also want to address the planning for coexistence measures in advance of other GM crop introductions such as wheat, rice, fruit crops and pastures,” said Professor Spangenberg.

More information can be found at www.gmcc-09.com

This house uses hardly any gas or electricity for heating and cooling due to its construction materials, orientation, size and placement of windows and eaves made of foliage.

Households can reduce carbon emissions

PHOTO: CSIRO/CHRIS TAYLOR

CSIRO scientists say householders can reduce their home and car energy use by as much as 50 per cent by making changes to daily activities.

The new book, *The CSIRO Home Energy Saving Handbook – How to Save Energy, Save Money and Reduce Your Carbon Footprint*, is a practical guide to saving energy and reducing greenhouse gas emissions around the home. It was written by the CSIRO Energy Transformed Flagship's Dr John Wright FTSE, Dr Peter Osman and Peta Ashworth.

"As the book explains, there are lots of things that we, as individuals, can do to reduce energy use and greenhouse gas emissions at home," Dr Wright said. "Even better, the book shows people how it's possible to cut their energy use without too much impact on their lifestyles."

The handbook offers information on how to measure and reduce an individual's carbon footprint in all aspects of modern living, including:

- simple energy-saving tricks around the house;
- maximising a home's potential for easy heating and cooling;
- ways to save on shopping and transport;
- making the most of gardens; and
- tips for building and renovating homes.

The CSIRO Home Energy Saving Handbook is available for \$29.99.

NEW WAY TO SWEETEN NATURAL GAS – AND TO BOOST ABNORMALITY DETECTION

Curtin University of Technology's Professor Robert Amin and Associate Professor Ahmed Barifcani have developed a more efficient and cost-effective way of removing contaminants from natural gas streams – and their innovation has won the 2009 Curtin Commercial Innovation Award for the best commercially oriented innovation arising from research by Curtin staff and students.

Rohan McDougall, Curtin's Office of IP Commercialisation Director,

said their innovation could significantly benefit the gas processing industry and help in the ever-increasing global demand for energy.

"Professor Amin and Professor Barifcani's new process has the advantages of being energy efficient and requires lower infrastructure costs than alternative methods. It also results in minimal loss of hydrocarbons in the separation process and is versatile enough to adapt to a wide range of gas compositions. In addition, both hydrogen sulfide and carbon dioxide can be captured individually with 99 per cent purity and can be used in other processes or sequestered."

Professor Amin is the Director of the Woodside Hydrocarbon Research Centre in Curtin's School of Chemical and Petroleum Engineering and an international leader in the field of gas processing technology.

ATSE Fellow **Professor Svetha Venkatesh**, John Curtin Distinguished Professor in the Curtin Department of Computing, was runner-up in the award.

She was acknowledged for her statistically based abnormality detection system that provides detection of abnormal events such as loitering and potentially dangerous behaviour in real time even in the presence of large numbers of people behaving normally. The development of this technology will lead to improved security responses to events of interest in areas where public safety is of major concern.

Professor Jeanette Hackett, Curtin Vice-Chancellor, with Professor Amin and Associate Professor Barifcani.





Burj Dubai tower.

Towering challenge wins concrete recognition

The Concrete Institute of Australia (CIA) has presented GHD with an Award for Excellence for its groundbreaking work in pumping concrete to a height of 601 metres during construction of the world's tallest building, the more than 160-storey tower, the Burj Dubai.

The Burj Dubai currently stands more than 800m high. Its final height will not be revealed until construction is complete.

The GHD team, led by concrete specialist Dr James Aldred, was involved in concrete mix development as well as quality control and assurance on materials used throughout the project.

One of the major challenges posed by the project was the soaring temperatures experienced in the Middle East, where it can be 50°C in the shade. A decision was taken to do all concreting for the vertical elements of the tower at night, and the concrete's water content was made up almost entirely of flake ice during the summer months. Getting the concrete mixture right was also crucial, with five different mixtures tested during trials.

RESEARCH COLLABORATION FOR ENERGY-EFFICIENT ALUMINIUM SMELTING

Scientists from CSIRO and five universities will research sustainable energy-efficient technologies for the Australasian aluminium industry through a collaboration launched in September.

Primary production of aluminium is highly energy intensive, and reducing the amount of energy used will assist the industry in maintaining competitiveness.

The 'breakthrough technologies for primary aluminium' research cluster brings together researchers from Swinburne University of Technology, the University of Auckland, the University of New South Wales, the University of Queensland, and the University of Wollongong, in collaboration with CSIRO scientists.

Cluster researchers will investigate design improvements for high-temperature aluminium reduction cells, such as new materials for sidewalls and cathodes, improvements to process control and regulation, and breakthrough technologies for novel electrolytes, non-consumable anodes and multi-stage high-temperature production.

\$100 MILLION SMART GRID, SMART CITY PLAN LAUNCHED

The Australian Government has announced the next step in transforming Australia's energy grid, which it says has the potential to reduce home energy bills, reduce carbon pollution and help tackle climate change.

The \$100 million Smart Grid, Smart City initiative will see Government and energy and communications sectors working in partnership to roll out Australia's first commercial-scale smart grid.

Releasing the report *Smart Grid, Smart City: A new direction for a new energy era*, Environment Minister Peter Garrett said it provided valuable insights into how smart grids could work in Australia.

"From the power plant to the power point, smart grids enable a two-way flow of information between energy suppliers and consumers. Linking all these energy data points creates a web of information, so that energy can be delivered where and when it is required; the potential economic benefits of creating an internet for the energy industry are staggering."

Minister for Broadband, Communications and the Digital Economy, Senator Stephen Conroy, said: "Connected digital technologies like smart grids will underpin our future carbon-constrained economy and this collaborative initiative is a great opportunity for Australia to become a leader in this field. The National Broadband Network will enable a whole range of applications to help Australia create a smarter and more efficient energy network."

The Minister for Resources and Energy, Martin Ferguson, said the roll out would complement the work already undertaken on smart meter deployment in Australia through the Ministerial Council on Energy. "This program represents an important opportunity to deploy smart grid technology at a scale to test the benefits to the grid and consumers."

Smart Grid, Smart City: A new direction for a new energy era, the draft grant guidelines and details about consultation workshops are available at www.environment.gov.au/smartgrid. Applications for consortia to deliver the project will be sought when final grant guidelines are released – scheduled for late October.

War and Peace on a pin-head

The Australian research community will soon have access to one of the most powerful nanotechnology instruments in the world, able to write and etch data on particles 10,000 times smaller than the width of a human hair.

The electron beam lithography instrument is designed to write on or mark nano-sized objects and has the capabilities of writing *War and Peace* on a surface as small as a pin-head.

The multi-million-dollar electron-beam lithography (EBL) tool will be unique in Australia and is capable of ultra-high resolution patterning at very high speeds and placement accuracy. It will be housed in the soon-to-be-completed Melbourne Centre for Nanofabrication (MCN), located near Monash University's Clayton Campus, and will be launched in March next year.

MCN interim director Dr Abid Khan said the machine will help scientists and engineers develop the next generation of micro technology by giving them the ability to write words and symbols on a range of surfaces to a size less than 10 nanometres.

"This powerful technique is increasingly being used for applications such as banknote fraud prevention, microtexturing of surfaces, manufacture of microfluidic devices and X-ray optical elements, the latter to support work at the Australian Synchrotron, located adjacent to the proposed MCN facility," Dr Khan said.

Dr Khan said it was essential for Australian scientists to have access to the latest in nanotechnology equipment and that the close proximity of the Centre to the Australian Synchrotron would attract international teams of researchers.

"MCN's goal is to serve as Australia's open access, multi-scale, multi-disciplinary micro and nanofabrication hub. The centre will support and produce research and prototype advances in areas such as

environmental sensors, medical diagnostics, micro and nano actuators, novel energy sources and biotechnology devices," he said.

In addition to the EBL, the purpose-built facility will also host state-of-the-art nanofabrication tools including high-resolution dual-beam focused-ion-beam microscopy, optical and nanoimprint lithography, deep reactive ion etching, plasma and thermally assisted material deposition, and confocal microscopy.

"While the technology lends itself to infinite possibilities, some of the solutions already being realised around the world are improved paints, car and window cleaning treatments and even improved swimsuits.

AIRCRAFT THAT CAN SEE FOR THEMSELVES

Australian researchers have made two important advances in the development of unmanned aircraft capable of seeing for themselves as they fly fast and low over dangerous terrain.

A team from the The Vision Centre and Queensland Brain Institute has developed highly effective new visual systems inspired by honey bees and the way they successfully navigate through the landscape, despite their tiny brains.

The two innovations, one of which provides stereo vision to enable aircraft to 'see' their way around obstacles in very low-level flight, and the other which controls the aircraft's attitude by watching the horizon, offer light, low-cost, highly efficient technologies for use in unmanned aircraft (UAVs).

Unmanned aircraft today have rapidly expanding roles ranging from mineral exploration, mapping, environmental monitoring and coastal surveillance to military applications from scouting and intelligence gathering to interception. In future they are expected to play an important role in the exploration of Mars.

A team of researchers at the University of Queensland node of the ARC Vision Centre, based at the Queensland Brain Institute, have developed a stereo system employing two cameras and two sophisticated, curved mirrors, for observing the terrain as it flows beneath the aircraft. The cameras feed back information on height and distance to the terrain and its obstacles in a steady flow.

They have also devised a new way to keep aircraft 'upright', or to detect their attitude, simply by visual reference to the horizon.

The system compares the blue colour of the sky with the red-green colours of the ground to detect whether the aircraft is pitching up or down, or rolling from side to side.

Both systems have been developed to operate in daylight, but the researchers say they are capable of being adapted to infrared and other forms of visual sensing for operation in the dark or low light. Both are lighter, cheaper and more efficient than radar-based sensing systems.

The research team has collaborated with the US space agency NASA on the use of visual navigation for the tiny unmanned aircraft which are envisioned as the main explorers and mappers of the planet Mars, once exploration begins in earnest.

The Vision Centre is funded by the Australian Research Council as the ARC Centre of Excellence in Vision Science.



Dr Abid Khan

CSIRO sets science path for new telescope

Artist's impression of ASKAP antennas at the Murchison Radio-astronomy Observatory.

IMAGE: SWINBURNE ASTRONOMY PRODUCTIONS AND CSIRO

CSIRO has chosen the major science projects that its Australian SKA Pathfinder (ASKAP) telescope will tackle in its first five years.

ASKAP, being developed for a site in Western Australia, is expected to be fully operational in 2013, with construction due to start later this year.

During the telescope's first five years at least 75 per cent of its time will be used for large survey science projects, each needing more than 1500 hours to complete and designed to take advantage of ASKAP's unique capabilities.

"An international panel of expert astronomers picked the 10 top projects that will take advantage of ASKAP's huge survey speed and large field of view," said Dr Lewis Ball, acting director of the Australia Telescope National Facility. A breakdown of the 10 projects illustrates the international interest in the ASKAP program – Australia and New Zealand 33 per cent, North America 30 per cent, Europe 28 per cent, nine per cent from the rest of world.

Two of the top 10 projects are an Evolutionary Map of the Universe (EMU) and the Widefield ASKAP L-Band Legacy All-Sky Blind Survey (WALLABY). EMU is a deep survey for star-forming galaxies and active galactic nuclei, designed to trace the evolution of star-forming galaxies and massive black holes through the history of the universe. WALLABY is a survey for galaxies containing neutral hydrogen gas over 75 per cent of the entire sky, and is aimed at improving our understanding of galaxy formation.

Other survey science projects will study variable and transient radio sources, the interstellar medium of our own galaxy, magnetic fields in space and pulsars. A complete list of the projects can be found at www.atnf.csiro.au/news/press/askap_survey_science.html.

FUTURE MANUFACTURING FLAGSHIP LAUNCHED

Flexible plastic solar cells that can be printed like money, carbon fibres so thin they can be spun into yarn and a raft of new biomedical products to combat illness and injury are just some of the research breakthroughs being developed by the new CSIRO National Research Flagship for Future Manufacturing.

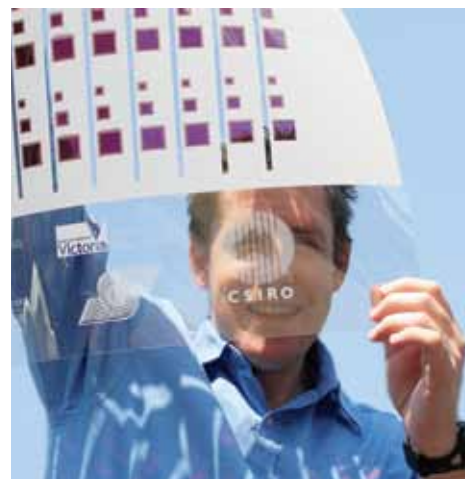
The flagship – a \$36.2 million research program designed to boost Australia's manufacturing capabilities – was launched in Melbourne in September by Innovation Minister Senator Kim Carr.

"Australia's innovative and highly skilled manufacturing industry is one of the greatest hopes for our future prosperity and this flagship is an important addition to its arsenal," Senator Carr said. "Manufacturing not only provides quality jobs, it drives innovation through mobilising new skills and creating new capabilities."

The flexible plastic solar cells were developed with partners in the Victorian Organic Solar Cell Consortium. "The cells will be much cheaper and more efficient to produce, and have the potential to replace silicon in the next generation of solar collectors," said CSIRO Deputy Chief Executive Dr Alastair Robertson.

"This is the kind of transformational, environmentally responsible technology the new flagship has been established to create to support sustainable manufacturing into the future."

The Future Manufacturing National Research Flagship was launched at the recently refurbished, state-of-the-art Flexible Electronics Research Facility at CSIRO's Clayton laboratories in Melbourne.



Future Manufacturing Flagship's Dr Scott Watkins holds a sample sheet of flexible solar cells.

PHOTO: CSIRO



PHOTO: CSIRO

New research ship in 2012

Australia's ocean climate and geoscience research capability will more than double when its new ocean-going research vessel joins the national fleet in 2012, says CSIRO Chief Executive Dr Megan Clark FTSE.

In its May Budget, the Commonwealth Government committed \$120 million to the purchase of a new 85-metre research vessel for the Marine National Facility, together with an additional \$30 million for the operation and maintenance of the current Australian research vessel, *Southern Surveyor*, which the new vessel will replace.

Dr Clark says the Future Research Vessel Project opens new opportunities for science to contribute to the sustainable development and management of ocean resources for the benefit of future generations.

"Through the Marine National Facility the horizons of Australian marine science will broaden in unprecedented ways," Dr Clark says. "It will allow us to track ocean structure, heat and carbon inventory from the ice edge to the equator and, with the new long-range ability, to sample across entire ocean basins.

"All researchers with an interest in ocean science can now consider accessing a ship capable of conducting research much further afield, carrying considerably more scientists and support staff and having first-class on-board facilities.

"When you consider that 60 per cent of Australian territory is ocean but only 12 per cent of that has been mapped, there is still a lot to discover. This investment will enable Australia to maintain its pre-eminent position internationally as a marine science nation and meet future demands for innovative, cutting-edge marine research."

The new vessel will be capable of operating continuously for 55 days at sea, cruising at 12 knots over a range of 10,000 nautical miles.

ANU AND ANSTO JOIN FORCES

The Australian National University (ANU) and the Australian Nuclear Science and Technology Organisation (ANSTO) have entered into a partnership to enhance Australia's international engagement in nuclear science and technology and offer students and researchers greater access to facilities.

Senator Kim Carr, Minister for Innovation, Industry, Science and

Research, said the partnership was a unique opportunity for Australian nuclear research and scientific collaboration.

"ANU and ANSTO are Commonwealth institutions with different sets of skills and scientific capabilities, so bringing them together formally will achieve real benefits for the nation," he said. "Their areas of expertise include the operation of major Australian accelerator facilities, research into future energy sources – such as fusion – and ways for Australia to promote nuclear non-proliferation around the world.

"Educational programs in nuclear physics, nuclear engineering and materials science will benefit from this partnership."

ANU Vice-Chancellor Professor Ian Chubb said the shared infrastructure and facilities which could potentially bring greater benefit to the nation.

"In particular, we will develop a national strategy to coordinate use and development of a heavy-ion accelerator and ion source technology, and undertake collaborative activities that enhance educational programs in nuclear physics, nuclear engineering and materials science."

ANSTO Chief Executive, Dr Adi Paterson, said the deal represented a renewal of nuclear research and collaboration in Australia. "It is important that we engage the next generation in research leadership and innovation," he said.

"To develop the kinds of skills we need to bring the full benefit of nuclear technology in Australia will need commitment, vision and sustained investment. Foundational research and enhanced innovation into areas such as nuclear fusion and environmental challenges using nuclear techniques will underpin our collaboration and its impact," Dr Paterson added.

DSTO CLOCKS UP 70 YEARS AT FISHERMANS BEND

The Minister for Defence Personnel, Materiel and Science Greg Combet officiated at a ceremony at the Fishermans Bend DSTO site in Melbourne in August to commemorate 70 years of defence science at Fishermans Bend.

He noted that Melbourne was the birthplace of defence science in Australia. "Only a few kilometres from here the first defence scientist, Cecil Napier Hake, set up his office in the city 102 years ago and three years later established the first Commonwealth Defence Laboratory at Victoria Barracks on St Kilda Road. That building – which was a guard house – still stands today.

"From there the laboratory moved to Maribyrnong in the 1920s. That DSTO laboratory in Maribyrnong was the oldest Commonwealth working laboratory in Australia till it closed in March 2007 after 85 years.

"This Fishermans Bend site now has the distinction of being the longest surviving defence laboratory in the country," he said.

"While we celebrate the 70th anniversary of this laboratory we are also recognising the contribution that defence scientists have made to the Australian Defence Force over the years.

"Whether they were working on ammunition during the World War I; or producing anti-gas respirators for the World War II; or detecting and deflecting threats during the Cold War; or providing, as they do now, extra protection for our troops on overseas operations – Australia's defence scientists continue to play a significant role in the defence of the nation," he said.



PHOTO: DARRYL PERONI/CSIRO

Minerals research facility opens in Perth

CSIRO has opened a new research centre focused on developing economic and environmentally and socially sustainable processes for Australia's minerals industry. The Australian Minerals Research Centre (AMRC) at Waterford, Western Australia, will help the industry remain competitive in global markets and enhance collaboration between public and private sector research groups.

CSIRO Manufacturing, Materials and Minerals Group Executive Dr Steve Morton said world-class mineral processing research capability was essential to help the industry address challenges such as declining ore grades, increasing costs and greater competition.

"The industry is particularly important for WA – the expertise and facilities offered by AMRC will provide a significant boost to hydrometallurgy research and help address the short and long-term needs of the industry," said the WA Minister for Mines and Petroleum, Norman Moore, at the opening.

WA is the nation's largest producer of alumina, gold, iron ore and nickel. Hydrometallurgical techniques – which use wet processes to recover metals from ores, concentrates or other metal-bearing materials – are used to produce commodities including alumina, cobalt, copper, gold, nickel, rare earths and uranium.

In addition to housing more than 80 CSIRO staff, AMRC houses the headquarters of the Parker CRC for Integrated Hydrometallurgy Solutions, and research staff from Direct Nickel and Nalco, forming a collaborative hub in minerals research.

The Australian Minerals Research Centre

features a large mural entitled 'Metallurgical

Metamorphosis', created by Western Australian

artists Charlie and Joan Smith. The mural depicts

the evolution of technology used in mineral

processing.

AMIRA DRIVES NEW CRC AND NOTCHES UP 50 YEARS

AMIRA International was behind the planning that led to the recent announcement that the proposed Deep Exploration Technologies CRC had been granted \$28 million in funding under the CRC program and a total budget of some \$100 million over eight years.

AMIRA was integral in carrying out the groundwork for the CRC application. The preparation of the bid was managed by AMIRA and funded by a group of companies, including CSIRO, who have provided seed funding of some \$560,000 over two years.

The CRC has as its mission deep ore discovery, by opening up both the greenfields and brownfields search space through quicker, safer and more effective exploration at depth and through cover. To achieve its objectives, the CRC will undertake research in three programs:

- drilling – the development of radical, new hard rock drilling technologies;
- data fusion – down-hole and on-site surface technologies that enable data acquisition in real time; and
- deep targeting – improving imagery of the rock volume at depth.

This initiative was the result of discussions at the AMIRA Exploration Managers' Conference in 2007. The conference is a biennial meeting of senior company executives, technology directors and research leaders from around the world to discuss issues of common interest relating to exploration research. An initiative from an earlier conference led to the AMIRA P843 'GeM' project – the world's biggest integrated geometallurgy research program.

AMIRA has also celebrated its 50th year of service to the mineral industry, dating from a meeting convened at the headquarters of the AusIMM at which AMIRA was inaugurated by the then leaders of the Australian minerals industry. This group included Chief Executive of BHP Ian McLennan, Morris Mawby (Consolidated Zinc, now part of Rio Tinto), George Fisher (Mount Isa Mines, now absorbed into Xstrata) and G. Lindesay Clark (WMC, now absorbed into BHP Billiton).

All of this group were Australian and all were eventually awarded knighthoods for their services to the industry; each played a role in expanding the activities of the companies they headed and in several cases paved the way for the emergence of their companies as global players. The Association they founded has, through nearly 1000 research projects, returned to industry dividends on their research investment of more than a billion dollars. All four were Fellows and stalwarts of this Academy from its earliest days. ATSE's operations became synonymous with Sir Ian McLennan House in Parkville, named after ATSE's founding President, until its recent move to new Melbourne premises.

Rio hits 3b tonnes of iron ore exports

Rio Tinto has exported three billion tonnes of Pilbara iron ore – the figure marked when loading the *Pacific Ruby*, a Cape-size vessel, at Cape Lambert. The 240,000-tonne cargo consisted of iron ore from the Yandicoogina and Mesa J mines, and was bound for POSCO, the largest South Korean steel producer.

Rio Tinto's first shipment of iron ore from Australia – 52,000 tonnes of Tom Price ore – was sent on 22 August 1966. The *Huon Maru* set sail from Dampier, bound for Japan, for eventual steel production by Yawata Iron and Steel (Nippon Steel).

Rio Tinto now operates 11 mines and three terminals at two ports in Western Australia's Pilbara region. In 2009 Rio Tinto plans to export 200 million tonnes of iron ore, virtually all of it from the Pilbara, compared with the 761,000 tonnes exported in 1966.

"The rapid, exponential growth of Rio Tinto's Pilbara operations can be gauged by the fact that we took 25 years to ship our first billion tonnes, 12 years to reach our second billion tonnes and now just six years to post our third billionth tonne," said acting CEO and Managing Director of Pilbara mine operations, Greg Lilleyman.

AUSTRALIAN EXPERTISE TACKLES CHINA'S WATER WOES

Australian irrigation and water technology company Rubicon Systems Australia is helping modernise China's vast irrigation channel infrastructure, following the signing of a Memorandum of Understanding with the Chinese Ministry of Water Resources.

Under the agreement, Rubicon has begun to install and commission its Total Channel Control irrigation network management system in two pilot projects. Total Channel Control is already achieving water delivery efficiencies of up to 90 per cent and Rubicon's technology has been installed in the US, India, Vietnam, Europe, New Zealand and extensively throughout Australia.

"Like Australia, China is facing the serious challenge of water scarcity in many regions and is looking for ways to increase the efficiency of irrigation practices," said Rubicon operations manager Bruce Rodgerson.

"The pilots in the Yellow River Basin, in the Qingtongxia irrigation district of the Ningxia province, and the Yangtze River basin, in the Anhui province, are being established to combat water scarcity issues as a result of drought, and to help modernise China's irrigation practices, which in turn will improve the country's agricultural output."

Rubicon hopes these pilots could pave the way for its technology to become commonplace in China.

"The scale of irrigation in China is incredible," Mr Rodgerson said. "There are about a million water regulator gates in China, compared to about 10,000 in Victoria's Goulburn–Murray Irrigation District, so this opens up a huge growth opportunity in the Chinese irrigation market for Rubicon."

"Total Channel Control's accurate measurement and control capabilities will not only provide irrigators with near on-demand water delivery and high flows, but provide precise location of leakage and seepage losses."

"Chinese irrigation authorities will be able to efficiently use water resources and improve agricultural productivity and the expectation is that, over time, the new system will facilitate a change in the type and value of agricultural production, as well as freeing up valuable water resources for new applications."

Rubicon chief executive David Aughton said the US market was also very promising for Rubicon. "The US irrigation industry is about 10 times that of Australia, so there are huge benefits to be had in modernising irrigation systems," he said.

Mr Aughton said Rubicon now has gates in Europe, Vietnam, India and New Zealand and hundreds in operation in the US, as well as the new trials in China. "Rubicon has supplied more than 5500 gates to irrigation infrastructure renewal projects in northern Victoria in the past two years," he said. "However, these local projects are finite and the Australian market represents just one per cent of the global irrigation market."

"The issues are universal when it comes to global warming, water scarcity for cities and farms, food scarcity and food security, and we see huge opportunities for this technology around the world."

Rubicon Systems is an Australian-owned engineering and technology company providing specialised products and services to enable water authorities manage their operations and water resources more efficiently. Founded in 1995, it employs nearly 200 people in its Melbourne and Shepparton operations in Victoria. Its Total Channel Control system is a world-first technology that is revolutionising the

irrigation industry and achieving water-delivery efficiencies of up to 90 per cent, Rubicon says.

"Total Channel Control creates a fully automated channel network with precise measurement and flow control, resulting in huge reductions in distribution losses. For irrigation farmers, Total Channel Control delivers more accurate measurement, near on-demand delivery, stable water levels and reliable flow rates."

ATSE Fellow Professor Iven Mareels, Dean of the Melbourne School of Engineering, received a Clunies Ross Award in 2008 for his work in developing water-management technology in collaboration with Rubicon.



Rubicon control gates in action.



PHOTO: GARSIDEIMAGES

Greening our roads with mine residues

The new Perth–Bunbury Highway road network is helping to pioneer a breakthrough in the transformation of Australia's mining residues.

Two trials by the Western Australia-based Cooperative Research Centre for Sustainable Resource Processing (CSRP) are using treated mineral residue for road base and nutrient filters. The initiative is part of a technology revolution led by WA researchers to convert a wide range of mining and energy sector wastes to commercial products.

In the first trial, more than 2500 cubic metres of sand was extracted from bauxite residue and used as road base.

CSRP has developed a concept called ReSand® where sand sourced from recovered materials is compared to conventionally sourced quarry sand. The source of sand that is assessed as having the lowest ecological footprint can then be designated as ReSand®. This gives developers, regulators and the community an assurance that the use of these residue materials is in fact the best outcome for the environment and for society.

CSRP CEO Stevan Green said the recovery of construction sand from mineral residues would have a range of potential benefits including:

- replacement of increasingly scarce supplies of quarry sand;
- reduction in the clearing of natural bushland for sand quarries; and
- reduction in the demand for expensive waste residue containment facilities.

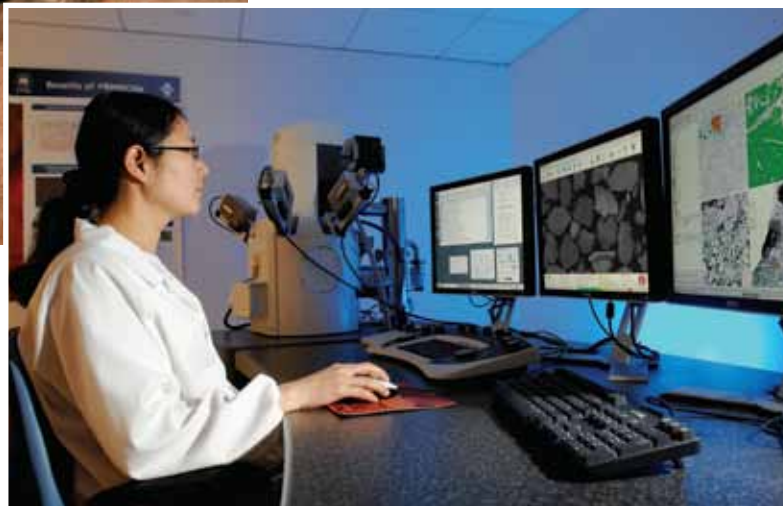
In the second trial, a demonstration 'nutrient trap' has been installed by the side of the new road. The trap collects water run-off and removes nutrients such as phosphates and nitrates, to help prevent algal blooms in the surrounding waterways.

Bauxite residues were used in both of these trials. WA produces more than 25 million tonnes of this material each year.

These trials are only two of several CSRP innovations turning mineral processing residues from Australia's mining and energy industries into useful products like concrete, construction materials (such as sand and aggregates), soil treatments and nutrient traps – all with the aim of improving ecological, societal and economic outcomes.

Tony Bagshaw (CSRP), Evan Jamieson (Alcoa), Alan Jones (Alcoa) and Stevan Green (CSRP) with some of the recovered sand used on the Perth Bunbury Highway project.

PHOTO: CSIRO



Sophia Morrell with the QEMSCAN unit at CSIRO's Australian Minerals Research Centre, in Waterford, Western Australia.

NEW ANALYSERS COULD UNLOCK MINERAL VALUE

Scientists are working on a new range of materials characterisation analysers and techniques that could help unlock the value contained in Australia's mineral deposits and improve processing performance.

Machine-mounted sensors, being developed through CSIRO Minerals Down Under Flagship, could help locate ore deposits, characterise the mining environment, and differentiate ore grades. This could enable automated mining machines to respond 'intelligently' to the changing detail of the environment and offer real-time amendments to the mine plan.

Another prototype in development combines the best features of two existing materials characterisation techniques – X-ray diffraction and D-ray fluorescence – into a new slurry analyser. The new prototype, dubbed XRDF for its dual origins, is capable of measuring both mineralogy and ultra-low elemental composition directly on a process-stream, without the need for labour-intensive, time-consuming and potentially error-prone sampling.

CSIRO scientist Dr James Tickner said the new prototype could offer a number of benefits over existing on-stream analysers: accurate, on-stream mineralogy and the unique ability to detect elements at parts-per-billion levels in an on-stream system.

Dr Tickner and his team are also working on gamma-activation analysis – a new analysis method that may deliver all the benefits of neutron activation without the need for a nuclear reactor. The method is expected to provide accurate, multi-element analysis of mineral samples without extensive sample preparation, and measure very low levels of more than 30 elements in samples weighing just a few hundred grams. The method could significantly improve sampling accuracy.

Apollo Moon dust: from 1966 to 2009

It is now accepted that dust is the number-one environmental problem on the moon and interest has grown since 2004, when President Bush announced plans for human missions to the moon by 2020.

By Brian O'Brien

brianjobrien@ozemail.com.au

The adhesive strength of dust on the Moon, the ubiquitous 'sticky' dust that tormented the Apollo astronauts, changes as the intensity of sunlight alters when solar elevation angle changes.

Dust pulled by lunar gravity fell off a vertical surface by mid-morning as the rising sun shone on it at a more glancing angle. All the dust was gone after the first lunar night.

This finding, greeted by one lunar dust scientist as "remarkable", was one of a suite of discoveries reported 40 years after Apollo, in May 2009 in *Geophysical Research Letters*¹.

The measurements were made by the matchbox-sized Dust Detector Experiments (DDEs) I invented before dinner on National Airlines Flight 58, Los Angeles to Houston, on 12 January 1966. A DDE was put on the moon by Apollo 11, 12, 14 and 15 astronauts, and its measurements every 54 seconds transmitted to Earth.

The DDE was a hitch-hiking, delightfully minimalist experiment.

Three solar cells give output voltages predictable from the reliable light source, the sun. Output decreases by 10 per cent if about 0.5 milligrams per square centimetre mg of lunar dust obscures a surface. The temperature of each cell is also measured. The six measurements provide absorptivity and emissivity values that dictate thermal controls as lunar temperature varies from minus 170°C to 120°C.

Lunar dust thrown up by rocket exhausts of the Apollo 11 Lunar Module contaminated the shiny gold surface of a 47-kilogram seismometer deployed 17 metres away.

The only other active experiment deployed on that historic expedition, a tiny (0.27kg) DDE measured² – and I eventually succeeded in having published³ – the contamination. The seismometer overheated by 50°F and was terminated after 21 days instead of the nominal two years.

In 2006 the NASA website <http://nssdc.gsfc.nasa.gov> on Apollo 11 Dust Detector stated (and states in June 2009), "The original tapes were subsequently misplaced before they could be archived, the only existing data from these experiments are on the plots."

So I advised NASA that I had safely, in Perth, my original principal investigator records, including 100 paper charts, calibrations etc. and 173 digital tapes, with six million measurements. Professor John de Laeter AO FTSE and Laboratory Manager Glen Lawson, of the Department of Applied Physics at Curtin University, had kindly saved the computer 10-inch tapes for me. They are now stored with SpectrumData.

I revisited my personal files, leading to the "highlighted" May 2009 paper, my first publication on lunar dust since 1970.

Now two other papers are in preparation, and NASA asked me to give two talks to the 2nd Lunar Science Forum in California in July 2009. Steps are under way to read once more the outdated seven-track computer tapes in Perth.

Over 40 years there has been a massive change in cultural attitudes to lunar dust.

Before Apollo, science fiction writer Isaac Asimov popularised a view that spacecraft landing on the moon would sink majestically out of sight in deep lunar dust. The lunar surface, unprotected by an atmosphere such as Earth's, has been pulverised for 4000 million years by 25,000-kilometre-per-hour meteors, rocks large and small.

In 1966, soft-landing Russian Luna and USA Surveyor missions showed such fears to be indeed science fiction.

Once Apollo engineers were free of that great risk, they largely treated dust as a housekeeping problem for astronauts to manage personally, with brushes and a vacuum system. Yet astronauts on Apollo 17, the last mission, were very dusty indeed (see www.nasa.gov/images/content/327385main_dustcoveredastronaut.jpg.)

It is now accepted that dust is the number-one environmental problem on the moon.

The zero-risk culture of Apollo engineering dominated lunar research of the time, necessarily so because astronaut safety had to dominate scientific research.

The urgency of trial-and-error mitigation of hazardous

effects of dust movements gave no time or resources for science to discover their causes.

Interest in lunar dust has grown since 2004 when President Bush announced plans for human missions to the moon by 2020. While hypotheses and computer modelling of lunar dust are now better funded, for the next few years the only hard data 'ground truth' about surface dust will continue to be mainly from DDEs and hard-learned anecdotal lessons from Apollo.

Apollo 12 astronauts landed blind because of clouds of dust below 40 feet altitude stirred up by rocket exhausts. On the surface, dust was readily kicked up by astronauts. It clung to anything and everything, from Apollo hardware, optics and deployed experiments to spacesuits.

Lunar dust has an average particle size of about 70 microns, about the thickness of a human hair. But many particles can be only a few microns, and grains tend to be sharp and angular. Inhaled they would be a health hazard. They affected chronometers.

With Apollo 12, Alan Bean deployed the scientific package 130 metres from the lunar module. The photo here shows the DDE and what I have called "collateral" lunar dust splashed on Apollo hardware from Alan's spacesuit.

As the Apollo 12 astronauts left the moon, rocket exhausts then cleansed horizontal and vertical solar cells of DDE differently, providing hitherto-lacking insight into the stickiness of lunar dust.

Dust adhesion encountered by overnighing future astronauts in the middle of lunar days may be much greater than with Apollo astronauts who walked there only in early lunar mornings.

A new field of science has grown from the moon being recognised as a unique and fascinating, ever-changing laboratory of "dusty plasmas".

With an atmosphere and magnetic fields only 10^{-15} and about 10^{-3} the strength of those that shield the Earth, during each 350-hour day the moon is bombarded by the solar wind, the hot atmosphere of the sun, with proton densities about 10 per cc travelling at 300km/sec.

By day the moon is also bathed in a dense sea of photoelectrons, knocked out of dust particles by energetic ultraviolet and X-rays in raw sunlight, leaving dust a few volts positive.

At night, the long magnetospheric tail of the Earth, fluttering comet-like in the solar wind, brings other plasmas to the moon, richer in the more energetic electrons and protons that cause the divine writing of auroras in polar regions back on Earth. Cosmic and solar nuclei with even greater energies have unlimited access.

At sunrise and sunset, electrically charged dust may levitate.

We now know a few of the ways that lunar dust is richly mysterious. But as yet we have few facts.

So scientific justifications for exploration of the moon in the 21st century are increasingly energised by dusty-plasma physicists, just as they were in the 20th century by geologists asking Apollo astronauts to bring back special rocks.

Truly we live in interesting times. ◀

DR BRIAN J O'BRIEN is an environmental and strategic consultant, principal of Brian J O'Brien and Associates and Adjunct Professor of Physics, University of Western Australia. He is a former Director and Chair of the Environmental Protection Authority of WA. He took his PhD at the University of Sydney and then worked in the US for 10 years – at the University of Iowa and then as Professor of Space Science at Rice University, Houston, from 1963–68.

1. O'Brien, B.J., 'Direct active measurements of movements of lunar dust: Rocket exhausts and natural effects contaminating and cleansing Apollo hardware on the moon in 1969', *Geophysical Research Letters*, Vol.36, L09201, doi:10.1029/2008GL037116, 2009
2. O'Brien, B.J. *et al.*, "Degradation of Apollo 11 deployed instruments because of lunar module ascent effects", *J. Appl. Phys.*, 41, 4538-4541, 1970
3. Complex issues of the 1966–72 past such as publications of DDE measurements from Apollo 11 and Apollo 12 will be discussed in a later issue. This present paper is focused on the science and the future.

A new field of science has grown from the moon being recognised as a unique and fascinating, ever-changing laboratory of "dusty plasmas".

PHOTO: NASA AS12-47-6927; LABELS © BRIAN O'BRIEN 2007



Apollo 12 Dust Detector Experiment (DDE) on the moon. The vertical east-facing 2cm x 2cm solar cell (VSCE) is full-face far left. Patches (arrowed) of 'collateral' lunar dust were splashed on the Central Station during deployment. Lunar Module (LM) is south-east, in the direction of the shortest arrow.



SPARQ-ed

SPARQ-ed was established following a proposal by 2006 Australian of the Year and ATSE Fellow, Professor Ian Frazer, to Queensland's Minister for Education and Training. In this proposal Professor Frazer said: "Biomedical research in Queensland is world class and yet students are reluctant to consider research as a career option. This unique education facility, by giving students a hands-on introduction to biomedical research, mentored jointly by their science teachers and world-leading research staff, would provide Queensland with a more scientifically literate community."

SPARQ-ed students get into research, mixing a solution to make a gel for running DNA.

Queensland is trialling SPARQ-ed (Students Performing Advanced Research Queensland) – a collaboration between the University of Queensland's Diamantina Institute for Cancer, Immunology and Metabolic Medicine and Queensland's Department of Education and Training (DET).

SPARQ-ed aims to promote excellence and innovation in biological and biomedical education by delivering world-class specialist programs to Queensland school students and their teachers. These programs are based on a model that brings together personnel and expertise from the education and scientific research communities.

The SPARQ-ed facility was established in 2009 within the Diamantina Institute on the grounds of Brisbane's Princess Alexandra Hospital. It features a dedicated teaching laboratory and is coordinated by Dr Peter Darben, a registered teacher employed by DET.

The flagship service offered by SPARQ-ed is the research-immersion program, where senior secondary school students and their teachers undertake a week-long scientific project designed alongside one of the Diamantina Institute's research groups. These programs are based on questions that arise from the work of the research group, and it is expected that the student projects may yield results which can feed back into that research group's work.

Dr Harben designs the programs to complement or enhance work undertaken by senior students in their biology studies. In addition to the experimental work, participants in the research-immersion programs are exposed to the full research experience, attending scientific seminars and learning how to use academic library resources. The week culminates in a research symposium, where participants share their experimental findings with their peers, as well as staff and students of the Diamantina Institute.

To date, three trial research-immersion programs have been conducted with 18 student and five teacher participants. Future participants will be selected through an application process, with the programs being open to statewide applications in 2010. It is anticipated that when fully operational, SPARQ-ed will offer up to 15 research-immersion programs a year, for up to 20 participants at a time.

Future participants will be selected through an application process, with the programs being open to state-wide applications in 2010. It is

anticipated that, when fully operational, SPARQ-ed will offer up to 15 research-immersion programs per year, for up to 20 participants at a time.

Its backers says SPARQ-ed represents a unique opportunity to engage school communities with the dynamic world of biomedical research. By connecting students and teachers with the world-leading researchers at the Diamantina Institute, SPARQ-ed will light the spark in the next generation of scientists.

Queries about applications through SPARQed@uq.edu.au.

EARTH SCIENCE WELCOMES CURRICULUM MOVES

The inclusion of earth and environmental science as a major study stream for Australian high schools in the new National Science Curriculum has been strongly welcomed by the nation's key earth science bodies.

This will ensure this critical area of science for the 21st century now gets the classroom focus it deserves, according to a joint media statement by the Geological Society of Australia, the Australian Institute of Geoscientists, the Australian Geoscience Council, Earth Science Western Australia, the Petroleum Exploration Society of Australia, the Australian Society of Exploration Geophysicists, the Australasian Institute of Mining and Metallurgy, the International Association of Hydrogeologists and the Teacher Earth Science Education Program.

"The development of the new curriculum by the National Curriculum Board provided a 'make or break' opportunity for Earth and Environmental Science to finally be given dedicated teaching time in Australian senior school classrooms alongside the traditional sciences of biology, chemistry and physics," they said.

"Consequently, the National Curriculum Board's decision to make Earth and Environmental Science a major study stream alongside physics, chemistry and biology for Years 11 and 12 – and to keep earth science as a major study stream alongside biology, physics and chemistry for Years 7 to 10 – is very pleasing.

"The importance of providing future generations of Australians with a rounded education in earth and environmental science cannot be underestimated."

Two Future Fellows from the Academy



Mark Cassidy

Professor Mark Cassidy FTSE, from the University of Western Australia, and Professor Veena Sahajwalla FTSE, from the University of NSW, are among 200 outstanding national and international mid-career researchers named as Australia's first Future Fellows.

Professor Cassidy's grant is to work on 'Engineering solutions for the next generation of offshore oil and gas infrastructure' and Professor Sahajwalla's grant will enable her to work on 'Transforming industrial waste into valuable carbons for iron-carbon alloys: Fundamental investigations of structure, impurity reactions and carbon dissolution'.

Professor Cassidy joined ATSE in 2008 and Professor Sahajwalla became a Fellow in 2007.

"The Government established the ARC Future Fellowships scheme to address the gap in opportunities for mid-career researchers in Australia, which forced many of our talented researchers to search for work overseas," the Minister for Innovation, Industry, Science and Research, Senator Kim Carr, said when he announced the awards. "This first round of the ARC Future Fellowships scheme will see 159 of our best and brightest continue their world-class research at home, boosted by the four-year fellowship, worth up to \$740,000.

"I am also very pleased to announce

that 41 Future Fellows will come to Australia to pursue their research – 19 Australians lured home by the scheme and 22 international researchers bringing their talents to our shores.

"All 200 Future Fellows will conduct research into areas of national priority and will advance Australia's international research and innovation standing.

Nearly a quarter of the Future Fellowships (42) were awarded in biological sciences and a further 37 in medical/health sciences. Engineering/technology (25), chemical sciences (16) and physical sciences (14) were the other biggest categories.

(Fellows will receive up to \$135,000 for each of the four years – administering institutions will receive up to \$50,000 a year for associated infrastructure and other costs.)

Terry Cutler becomes CSIRO Deputy Chair

Dr Terry Cutler FTSE has been appointed Deputy Chair of the CSIRO Board.

Dr Cutler joined the CSIRO Board in 2002 and was recently reappointed for a further three-year term. The Deputy Chair position became vacant when Professor Suzanne Cory's term expired in June.

The Minister for Innovation, Industry,

Science and Research, Senator Kim Carr, announced the promotion.

"I am delighted by the appointment of Dr Cutler, who will provide important continuity in his role as the CSIRO Board's longest-serving member," Senator Carr said. "Dr Cutler has made a valuable contribution to the work of the Board over the past seven years and his considerable knowledge of the workings, responsibilities and interests of the Board will be of ongoing benefit to CSIRO.

"The Government is backing Australian science and research through its Super Science Initiative, which aims to support CSIRO and other organisations so that they can continue delivering high impact outcomes in areas of national importance.

"It is an exciting time for science in Australia."

CSIRO Chairman Dr John Stocker AO FTSE welcomed the appointment.

Other ATSE Fellows on the CSIRO Board are Dr Megan Clark FTSE (Chief Executive), Hon John Kerin AM FTSE, Mr Doug Rathbone AM FTSE and Professor Tom Spurling FTSE.



Terry Cutler



Celebrating China's 60 years

(From left) Madame Guo Xiaojuan, Senior Education Consul, Melbourne Chinese Consulate, with ATSE CEO Dr Margaret Hartley and ATSE Executive Manager, International, Mrs Elizabeth Meier. The Academy was a guest of the Consulate to celebrate the 60th anniversary of the founding of the People's Republic of China.



Phil Playford at the launch of his latest book.

Devonian Reef Complexes of the Canning Basin Western Australia can be purchased for \$77 (including GST) plus postage, from the Department of Mines and Petroleum's Information Centre by calling 08 9222 3549, or online at www.dmp.wa.gov.au/ebookshop

Phil Playford launches new book – with more to come

Dr Phillip Playford AM FTSE, the former Director of the Geological Survey of Western Australia, has launched a new book, which compiles more than 50 years of research and mapping of one of the world's best preserved ancient barrier reef systems.

Dr Playford – geologist, hiostorian, photographer, writer and sometime treasure-hunter – together with co-authors Roger Hocking and Tony Cockbain, has written *Devonian Reef Complexes of the Canning Basin, Western Australia*.

The reef complex has been described as a spectacular belt of rugged limestone ranges that extends for 350 kilometres along the northern edge of the state's Canning Basin, from near Derby to east of Fitzroy Crossing. The area is host to five zinc-lead mines and several small oil fields at Blina.

The complex is now known as the Devonian Great Barrier Reef and is regarded as a model for similar reefs that host prolific oil fields elsewhere in the world.

Dr Playford, a Fellow since 1992, has been studying the geology of the reefs for more than 50 years, having graduated from the University of WA and secured an early job with West Australian Petroleum (WAPET) – the pioneering joint venture between Caltex and Ampol that made the ground-breaking Rough Range oil discovery in 1953.

He joined the WA Geological Survey in 1962 and, aside from a brief stint with Abrolhos Oil, has largely been involved with the Survey since, including a stint as Assistant Director-General of the WA Mines Department and later Director of the Geological Survey of WA.

The book contains more than 400 colour photographs, about 95 per cent of which were taken by Dr Playford. "Photography has been something I am keenly interested in and photographs are the best way to explain geology," he said, also explaining that his interest in geology stemmed from his childhood collection of rocks and fossils.

His Order of Australia award acknowledged his contributions to both geology and history, notably including his role in finding the wreck of the *Zuytdorp*, the Dutch East India Company's vessel that sank off WA's remote Murchison coast between Kalbarri and Shark Bay in 1712. He became involved in the search for the wreck in 1954 after a stockman showed him Dutch silver coins minted in 1711 – a mystery tale which in recent years has involved arson and the looting of the wreck.

Dr Playford wrote about it in his book *Carpet of Silver – The Wreck of the Zuytdorp*. Another book, *Voyage of Discovery to Terra Australis: by Willem de Vlamingh in 1696-97*, charted the voyages of one of the earliest European explorers of Australia.

He has two further books in preparation – one on aboriginal art and culture in the Kimberley and another on the geology of Shark Bay.

Chemeca Medal to Michael Dureau

Professor Michael Dureau FTSE was awarded the 2009 Chemeca Medal at the recent Chemeca annual engineering conference in Perth, hosted by Engineers Australia, the Institution of Chemical Engineers, the Royal Australian Chemical Institute and the Society of Chemical Engineers New Zealand.

The prestigious award recognised "his outstanding achievements and service in the chemical engineering profession in Australia and New Zealand, as well as his passion for humanitarian issues and mentoring of young engineers."

After graduating as a chemical engineer from the University of Sydney, and attaining a Master of Applied Science from the University of NSW, Professor

Dureau's highly successful career in the chemical, water, controls and power industries included his appointment as CEO of ALSTOM Power, from which he retired in 2003.



His current roles include Adjunct Professor of Engineering at the University of Sydney, the Executive Director of the Warren Centre for Advanced Engineering and member of the Industry Advisory Network of the University of Technology, Sydney. He has been a Fellow since 2001.

Professor Dureau has always had a passion for mentoring and promoting the interests of young engineers. He has initiated and always supports programs designed to enhance the development of young engineers. He is Chairman of RedR Australia, which offers a specialist register that enables aid agencies to find volunteer professionals in water and sanitation, shelter, logistics, public health, surveying, project management and social work to assist with international disaster relief.



Trade talks – from left Rodney Hall,
Kim Dalton and Mike Miller.

Mike Miller leads TV trade mission to South Korea

Professor Mike Miller AO FTSE, a board member of the Australia–Korea Foundation, led a trade mission to South Korea in September to promote Australian expertise in children's television production, along with AKF Board members Kim Dalton (Director of ABC TV) and Dr Rodney Hall (a leading Australian author).

South Korea is Australia's sixth-largest two-way trading partner and Free Trade Agreement talks between the nations began in May this year.

The mission was looking for opportunities to partner with Korean companies to deliver content through a range of emerging digital platforms – including mobile phone technology. Korea is a 'test market' because of its rapid uptake of new technology. About 80 per cent of households are connected to the internet.

Trade Minister Simon Crean said Australia had a proud record in children's television programs, with successful shows such as *Bananas in Pyjamas*, *The Wiggles*, *Hi-5*, *Play School*, *Blinky Bill* and *Magic Mountain*.

"The world is hungry for television content and we have some of the best children's shows in the world and some of the most creative people," Minister Crean said. "A partnership with Korea could help deliver Australian children's programs to a wider Asian and global audience."

"South Korea is a high-tech nation with a strong animation sector which means there

are big opportunities for Australian children's content production."

There is great potential in children's television production. In 2005 *The Wiggles* were named Australian exporter of the year and in 2007-08 they grossed \$45 million.

Professor Miller said that, based on feedback from the 24 delegates, the mission was an outstanding success – it attracted more interest in Korea than on previous missions and included more than 120 one-on-one business matching meetings between Australian and Korean companies, many of which look likely to lead to future co-production and other collaborative deals.

Professor Miller also took the opportunity to reinforce Academy links with Korea during the visit.

Lance Endersbee served engineering for more than 40 years

The Academy is saddened to note the death on 1 October 2009 of Emeritus Professor Lance Endersbee AO FTSE, aged 83. Professor Endersbee had been a Fellow since 1984. A church service to celebrate his life was held on 6 October.

Professor Endersbee graduated from the University of Melbourne as a civil engineer in 1949 and achieved a Master of Engineering in 1967. He spent 27 years in engineering practice and 13 years at Monash University.

He worked in progressively more senior

roles with the Snowy Mountains Hydro-Electric Authority from 1950 to 1958.

He served with the Hydro-Electric Commission in Tasmania from 1958 to 1976, latterly as Group Engineer on major projects, before taking up an appointment as Dean of the Faculty of Engineering at Monash University, and serving as Pro-Vice-Chancellor in 1988-89 before his retirement.

His fields of specialisation included the management of planning and design of major economic development projects, energy engineering and transport engineering. He was associated with the design and construction of several large dams, underground power station projects and other major civil engineering and mining projects in Australia, Canada, Asia and Africa.

Professor Endersbee took a special interest in rock mechanics and was Vice-President of the International Society for Rock Mechanics. He was also President of the Institution of Engineers, Australia (1980-81) and held several other senior roles in the Institution.

His professional awards included the Chapman Medal, the Warren Memorial Prize and the Peter Nicol Russell Memorial Medal.

Other roles included chairing a major review of national energy issues conducted by the Institution of Engineers – the Task Force on Energy;

member of the Australian government's National energy Advisory committee; and member of the Energy Council of Tasmania.

Lance Endersbee loved sailing, music and gardening and continued throughout his retirement his research of issues facing the world today in the areas of water, energy and climate change. He contributed an article on climate change to *ATSE Focus* in August 2008.

He is survived by his wife, Margaret, three sons (one deceased), four daughters-in-law and 11 grandchildren.

Lance Endersbee



Alan Billings was UWA Foundation Professor

The Academy notes with sadness the death of Emeritus Professor Alan Billings AM FTSE, who died on 26 September, aged 84. He joined the Academy in 1977.



Alan Billings

Born and educated in London, he lectured at the University of Bristol for seven years before moving to Perth in 1959.

Professor Billings was the Foundation Professor and Head of the Department of Electrical Engineering at the University of Western Australia when the department was established in 1959 and held this position until 1990, when he became Emeritus Professor and Senior Honorary Research Fellow at UWA.

He was awarded the Norman Hayes Memorial Medal in 1965 and was a former Chairman of the Advisory Committee of the Solar Energy Research Institute of WA, the Australian Telecommunications and Electronics Research Board and the Radio Research Board.

He was a Director of the Minerals and Energy Research Institute of WA and the WA Product Innovation Centre.

He was a member of the Rees Committee, which reported in 1980 to the Federal Government on the Defence Science and Technology Organisation, and served on the Australian Research Grants Committee.

Alan Finkel goes to Better Place

Dr Alan Finkel AM FTSE, Monash University Chancellor and ATSE STELR project leader, has resigned as a Director of ATSE following his appointment as Chief Technology Officer, heading the engineering function, for Better Place Australia, the electric car infrastructure company.

Dr Finkel will continue as Monash

Chancellor and as STELR champion, but will resign his other positions.

Better Place is building the infrastructure and intelligent network to deliver a range of services to drivers, enable widespread

adoption of electric vehicles, and optimise energy use. Based in California and privately held, Better Place has operating companies in Israel, Denmark and Australia.

Dr Finkel brings more than 25 years' experience in engineering, education and business management

to Better Place Australia. He is a highly regarded neuroscientist, entrepreneur and philanthropist.

In the newly created CTO role, Dr Finkel will be responsible for driving technology implementation and localisation for the Australian market, and leading engagement with local manufacturers and utilities on engineering and technology issues. He will also focus on standards setting and compliance with safety regulations for electric vehicle charging and battery switch technology in Australia.

Warren Centre previews PPIR project to supporters

Academy Director Peter North AM FTSE has recently finished a national roadshow previewing the launch of the Warren Centre's report on its PPIR (Professional Performance, Innovation and Risk) project in Sydney in November.

The pre-publication briefings in state capitals, hosted by Engineers Australia, were targeted at project sponsors and supporters, of which ATSE is one, along with the Association of Consulting engineers, Australia; the Australian Institute of Project Management; and the Association of Professional Engineers, Scientists and Managers Australia (APESMA).

The project presents a protocol for PPIR in Australian engineering practice. It has been undertaken by a team of leading engineering professionals, backed by sponsors representing a wide range of engineering industry and profession stakeholders. The project has included workshops and consultation with more than 200 practicing

professional engineers from all fields of engineering.

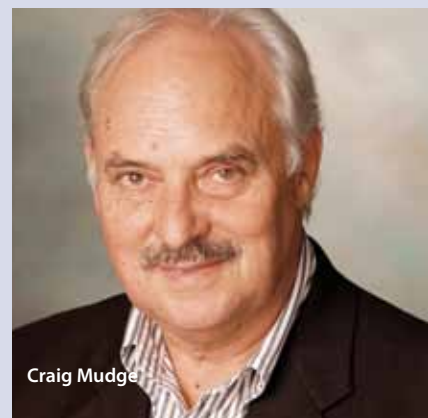
It has explored the role of professional engineers, in particular:

- the performance, innovation and risk management aspects of the engineer's role;
- community and client expectations of the engineering professional;
- contemporary commercial and professional realities impacting on engineers;
- the effects of "the complex minefields of law and liability that govern everyday engineering";
- engineering risk and responsible risk-taking; and
- the relationships between professional performance, innovation and risk.

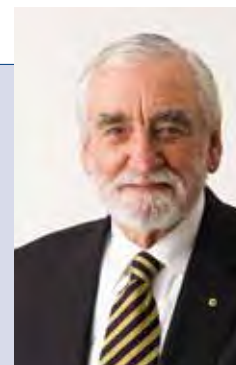
For more information go to www.warren.usyd.edu.au/front_page.html (select 'Projects' from the top right-hand corner of the page, then 'Professional Performance, Innovation & Risk' on the left-hand side of the page).

Craig Mudge to address CPAs

Dr Craig Mudge, Chair of the ATSE working group on Cloud Computing at Peta-scale, will address many of Australia's accountants at the CPA Congress in Canberra in November. His keynote address will explore innovative responses being developed to the ever-expanding volume of information that professionals receive daily.



Craig Mudge



Peter North



32ND ATSE NATIONAL SYMPOSIUM

SOFITEL HOTEL BRISBANE, 16-17 NOVEMBER 2009

FUTURE - PROOFING AUSTRALIA

Rising to the Challenge of Climate Change

Governments are introducing policies and targets aimed at substantial reductions in greenhouse gas emissions. This Symposium will focus on a crucial issue – the practical potential of current and future low-emission technologies, land management and abatement strategies to enable us to meet these targets.

The Symposium will draw on the experience and insights of eminent industry leaders and researchers from the UK, USA, Europe, Asia, South Africa and Australia.

Key speakers include:

- **Dr John Loughhead**, Executive Director, UK Energy Research Centre
- **Dr Zhengrong Shi**, CEO and Chairman, Suntech Power Holdings Co Ltd, China
- **Dr Adi Paterson**, Chief Executive Officer, ANSTO
- **Dr Peter Cook**, Chief Executive, CO2CRC

The ATSE Symposium will be of particular interest to key industry stakeholders, researchers, decision makers from government departments and the broad range of professionals contemplating new business in the carbon area.

The Australian Academy of Technological Sciences and Engineering urges you to attend.

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RESEARCH EXCELLENCE

The UQ Foundation Research Excellence Awards are part of UQ Research Week and pay tribute to emerging research leaders, recognising their outstanding performance and leadership potential.

The University of Queensland congratulates the following winners:

2009 UQ Foundation Research Excellence Award Winners

Dr Zhi Ping (Gordon) Xu (Australian Institute for Bioengineering and Nanotechnology) is researching how to combine novel nanomaterials with biomolecules to enable gene and drug delivery.

Dr David Morrison (TC Beirne School of Law) is studying baby boomers and the state of their investments amid the global financial crisis. The aim is to make recommendations for legal reform to improve means of dealing with financial distress.

Dr Korneel Rabaey (Advanced Water Management Centre) is researching new ways of producing energy-rich biofuels from wastewater and biomass from industries such as sugar and brewing.

Dr Timothy Carroll (School of Human Movement Studies) is researching the

complex activities that occur in the human body so that people can accurately reach towards objects, which holds promise for improved treatment of stroke patients.

Dr Abdullah Mamun (School of Population Health) is researching obesity and what is the optimal timing of primary prevention for people when they are most prone to putting on weight, such as in pregnancy and as teenagers.

Dr Jacqueline Batley (School of Land, Crop and Food Sciences) is researching why some canola crops are attacked by the Blackleg fungal pathogen while others remain completely unaffected. It is hoped to discover disease resistance genes in wild species that can be applied in commercial crops.

Dr Karen Moritz (School of Biomedical Sciences) is researching why some pregnancy complications can make an individual more susceptible to heart disease and kidney failure, along with the effects on the way babies' hearts and kidneys develop.

Dr Craig White (School of Biological Sciences) is researching the insect world for some clues to adapting to a changing environment. Insects are discontinuous breathers and this may have an evolutionary advantage to survive in different climates and environments.

Dr Joshua Mylne (Institute for Molecular Bioscience) is researching a new type of natural machinery in sunflowers that can be used to manufacture small circular proteins for use as therapeutic drugs.

2009 Award for Excellence in Research Higher Degree Supervision Winner

Professor Paul Hodges (School of Health and Rehabilitation Sciences) is the Director of the Centre for Clinical Research Excellence in Spinal Pain, Injury and Health, and is being recognised for his sustained and innovative contribution to excellence in research supervision. His supervisory philosophy strives to harness the productive potential of clinical practice combined with research.

Photo left to right: Back: Professor Paul Hodges, Dr David Morrison, Dr Joshua Mylne, Dr Timothy Carroll, Dr Jacqueline Batley, Dr Zhi Ping Xu. Front: Dr Korneel Rabaey, Dr Karen Moritz, Dr Abdullah Mamun, Dr Craig White.