



# DISCOVERY

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## CEO'S COLUMN

RESEARCH in the national interest - enabling the future



Professor Peter Hoj

Most people in the university research sector and in the publicly funded research agencies (PFRAs) would be aware of the initiatives by the Australian Government to establish a Research Quality Framework (RQF) for assessment of the quality of

government-funded research (see [www.dest.gov.au/resqual](http://www.dest.gov.au/resqual)). For many, this initiative immediately gives rise to two questions—why and how?

The Minister for Education, Science and Training, the Honourable Dr Brendan Nelson MP, is on the record as saying that he currently cannot guarantee that Commonwealth funding is directed at the best possible research<sup>1</sup>. Such statements may raise eyebrows, particularly among long-time researchers and administrators, but it is worth remembering that the Australian Government's expenditure on R&D in its broadest sense is about \$5.3 billion in 2004–05 and that investment on R&D in universities and PFRAs is in excess of \$3.5 billion.

While long-time researchers, myself included, have the advantage of seeing the benefits this investment injects into society, this insight is often harder to gain if you are not part of the R&D scene and perhaps have views on other areas in need of public spending—be it on

infrastructure, schooling, hospitals or other similar worthy causes.

In the absence of a proper articulation of the benefits that flow from the Government's investment in R&D and in the absence of a clear demonstration that the investment is managed optimally, the current \$5.3 billion annual investment can well be seen by some to reduce the possibility of enhancing government expenditure in other competing areas of real and perceived need.

In the long term, investment in the knowledge economy is very likely to create the cash flows that will allow society to invest broadly in areas of need, but it is not sufficient to postulate this link. If possible, we must articulate and demonstrate this better.

Without such action we are less likely to see enhanced investment in R&D and we might even see a reduction from current levels.

Recently, the Minister announced the establishment of an Expert Advisory Group for an RQF. The group, chaired by Sir Gareth Roberts, met in March and endorsed an issues paper recently released for public consultation ([http://www.dest.gov.au/resqual/issues\\_paper.htm](http://www.dest.gov.au/resqual/issues_paper.htm)). The paper raises many issues about how one can best approach the development and implementation of the

framework. I hope that stakeholders have considered the issues paper with enthusiasm and taken the time to make submissions. Such submissions will greatly assist the formulation of a preferred model (or models) for the challenging task the introduction and conduct of an RQF constitutes.

At the ARC, we pride ourselves on conducting a strong peer-review process aimed at funding excellent Australian research, largely in the university sector. Relative to other systems in the world, this appears

*Investment in the knowledge economy is very likely to create the cash flows that will allow society to invest broadly in areas of need*

<sup>1</sup> "As Australia's Minister for Science, I cannot assure the average Australian that we fund the highest quality research in all circumstances." *Science Meets Parliament* speech by the Hon Dr Brendan Nelson MP at the National Press Club, 8 March 2005.

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to be achieved at a low cost (the ARC's operating budget in 2004-05 represents less than 2.8 per cent of our administered grant funds). This lean operation has, quite frankly, meant that notwithstanding some excellent studies, for example in relation to citation rates and the importance of publicly funded research for development of patents (see [www.arc.gov.au](http://www.arc.gov.au)), we have not been able to concentrate sufficient resources to efficiently document the many benefits that flow from excellent ARC-funded research.

The ARC recognises the importance of such activities and we are currently developing a plan to increase performance in this area. Like the challenging RQF exercise, this is not going to be easy, but the importance of the objective means that there is little choice but to engage with vigour and hopefully, as a nation, reap the benefits that follow. We are looking forward to working with our many stakeholders in this regard and are hopeful that the strong support we enjoy from thousands of peers in respect of our grant schemes will also be extended to us in respect of these initiatives.

It has been mentioned in previous columns that the ARC is determined to play an active role in forging links between its grantees and the broader community to ensure that the results of research are not confined to the academic context but are also felt in the broader societal context through economic, social and environmental benefits. That sentiment is also raised in the recently released RQF issues paper referred to above.

In addition to the direct flow of benefits from our *Discovery Projects*<sup>2</sup>, the ARC's *Linkage Projects* scheme is one avenue where links between the primary researchers and so-called *end-users* can be readily established. Compared with our highly prestigious and much needed *Discovery Projects* scheme, which has a success rate of about 25-30 per cent, an added attraction is that application success rates in our *Linkage Projects* scheme have been much greater.

At a time when many research tasks increasingly call for a cross-disciplinary approach, it is likely that companies increasingly will outsource to and/or collaborate with publicly funded researchers as outlined in the influential *Lambert* report on business-university relations<sup>3</sup>. I believe this

constitutes a growing opportunity not only for university-based researchers to secure additional funding for research activities, but also for closer links and hence greater trust and familiarity to be forged between researchers and end-users.

*At a time when many research tasks increasingly call for a cross-disciplinary approach, it is likely that companies increasingly will outsource to and/or collaborate with publicly funded researchers*

In the longer term, this will lead to greater benefits flowing from both government and business investment in R&D and will likely also broaden the support base for public funding for excellent research through bodies such as the ARC. This will be particularly beneficial when it is realised that today's end-user-focused *Linkage Projects* to a large extent

build on skills and knowledge arising from previous investment in less end-user-focused research funded under the highly competitive *Discovery Projects* scheme. I believe it is well worth considering how we can further catalyse evolution of these important partnerships between research providers and end-users of new knowledge.

*Today's end-user-focused Linkage Projects to a large extent build on skills and knowledge arising from previous investment in less end-user-focused research funded under the highly competitive Discovery Projects scheme*

Are these all empty words? I believe not. Recently I was fortunate enough to holiday at one of Australia's most famous wineries. It was a wonderful opportunity to once again see how the application and integration of blue sky and strategic (applied) research combined with strong business engagement lead to enhanced practices. It was particularly pleasing to see that some PhD-educated individuals with former employment in publicly

funded research laboratories form part of the effort. I was reminded why the Australian wine industry and the Australian Government last year jointly increased their contribution to wine R&D yet again and why a well-educated personnel is one of the greatest outcomes of publicly funded research.

Yours sincerely



Professor Peter Høj

<sup>2</sup> See *A Wealth of Knowledge—the return on investment from ARC-funded research* ([www.arc.gov.au/publications/arc\\_publications.htm#wealthof](http://www.arc.gov.au/publications/arc_publications.htm#wealthof)).  
<sup>3</sup> See *Lambert Review of Business-University Collaboration*, December 2003 ([www.lambertreview.org.uk/](http://www.lambertreview.org.uk/)).

## ARC-FUNDED RESEARCHER DEMYSTIFIES PLATYPUS SEX CHROMOSOMES



ARC Postdoctoral Fellow Dr Frank Grützner and his colleagues in Professor Jenny Graves' laboratory at the Research School of Biological Sciences at The Australian National University, with collaborators at Cambridge University

and the University of Newcastle, have discovered an extraordinarily complex system of sex chromosomes in the platypus.

The platypus and the echidna are the only extant egg-laying mammals (monotremes). Scientists have long been interested in monotremes, primarily because of their possession of unpaired chromosomes and a multi-chromosome chain at meiosis (the cell division process in the production of gametes).

Dr Grützner explains that he and his colleagues isolated DNA from individual platypus chromosomes using state-of-the-art molecular cytogenetic techniques and then labelled the DNA with red or green fluorescent dyes.

"When these so-called 'chromosome paints' are applied to male and female platypus chromosomes, they hybridise and paint the respective chromosomes in red or green. This allowed us to identify the sex chromosomes and to follow them through stages of meiosis and in sperm.

"Most mammals have two sex chromosomes—two X chromosomes in females and an XY pair of chromosomes in males. But in the platypus we have discovered that there are 10 sex chromosomes," he says.

Using the 'chromosome painting' technique, the research team was able to observe for the first time how in a male the 10 different sex chromosomes assemble with remarkable accuracy in an XY alternating pattern ( $X_1Y_1X_2Y_2X_3Y_3X_4Y_4X_5Y_5$ ) to form the chain at meiosis and to segregate into  $X_1X_2X_3X_4X_5$  (female-determining sperm) and  $Y_1Y_2Y_3Y_4Y_5$  (male-determining sperm).

"In other words, when an  $X_1$ - $X_5$  sperm fertilises an egg—always  $X_1$ - $X_5$  [female]—a female platypus results, and, when a  $Y_1$ - $Y_5$  sperm fertilises an egg, a male platypus is produced."

The chromosome painting also revealed differences between the five sex chromosome pairs. At one end of the chain is an extremely degenerated  $Y_5$ , suggesting that the  $X_5Y_5$  chromosome pair is the evolutionarily oldest of the chain. At the other end of the chain,  $X_1$  (with some homology to the human X chromosome) shares extensive homology with  $Y_1$ , suggesting that that end is a more recent addition.

"The mapping of a candidate sex-determining gene in birds to the  $X_5$  chromosome in the platypus challenges the accepted view that mammal and bird sex chromosomes evolved independently," Dr Grützner says.

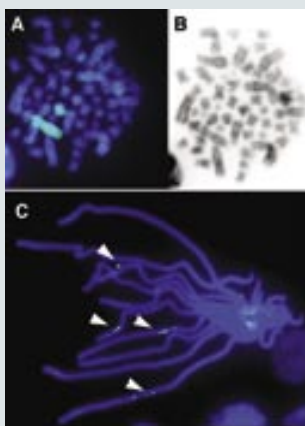
Dr Grützner received 1st prize at the 2004 Human Genome Meeting in Berlin and the 2004 Eppendorf Award for the Young Australian Investigator at this year's Lorne Conference for this research. The work has been published in *Nature* and the *Proceedings of the National Academy of Sciences of the USA*.

Dr Grützner is involved in sequencing the platypus genome, which is underway at the Washington University Sequencing Centre, and is investigating which genes are on the 10 sex chromosomes in the platypus. He is also studying the system of sex chromosomes in the echidna.



Dave Warts

*The mapping of a candidate sex-determining gene in birds to the  $X_5$  chromosome in the platypus challenges the accepted view that mammal and bird sex chromosomes evolved independently*



Painting of platypus chromosomes and sperm:

**A)** DNA isolated from  $X_1$  labelled with a green fluorescent dye paints  $X_1$  and the much smaller  $Y_1$  in males and  $X_1X_1$  in females (not shown).

**B)** The same chromosomes as in A) without painting. Without chromosome painting, it was not possible to identify the sex chromosomes for more than 30 years.

**C)** Unlike human sperm, platypus sperm are vermicular, similar to bird sperm. The great advantage of chromosome painting is that chromosomes can be followed through different stages of cell division. Here a bundle of platypus sperm is 'painted' with  $Y_2$ . The arrowheads show the localisation of  $Y_2$  in the sperm (green dots). About one half of the sperm in this bundle are  $Y_1Y_2Y_3Y_4Y_5$  male-determining sperm.

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## ■ ARC College of Experts

The ARC College of Experts comprises 75 members across a multitude of disciplines. Members, who are considered Australian experts of international standing, are appointed by the ARC Board, with the approval of the Minister for Education, Science and Training.

The functions of the ARC College of Experts include:

- assigning readers to applications
- assessing and ranking ARC grant applications
- providing strategic advice to the ARC Board on emerging disciplinary and cross-disciplinary developments, and innovative approaches to research.

Members of the College of Experts are drawn together flexibly to form groupings of expertise to meet particular needs at different times, such as inter-disciplinary or program-based groupings.

A full list of the members of the ARC's College of Experts is available on the ARC web site ([http://www.arc.gov.au/about\\_arc/expert.htm](http://www.arc.gov.au/about_arc/expert.htm)). New members in 2005 are listed below.

Professor Craig Atkins  
School of Plant Biology  
The University of Western Australia

Professor Alan Atkinson  
School of Classics, History and Religion  
The University of New England

Professor Martin Banwell  
Research School of Chemistry  
The Australian National University

Dr Dorothy Broom  
National Centre for Epidemiology  
and Population Health  
The Australian National University

Professor Allan Canty  
School of Chemistry  
University of Tasmania

Professor Frank Caruso  
Department of Chemical and  
Biomolecular Engineering  
The University of Melbourne

Professor Tsong Yueh Chen  
School of Information Technology  
Swinburne University of Technology

Professor Joe Chicharo  
Faculty of Informatics  
University of Wollongong

Professor Stuart Cunningham  
Creative Industries Research and  
Applications Centre  
Queensland University of Technology

Professor James Dale  
Science Research Centre  
Queensland University of Technology

Professor William Dunsmuir  
School of Mathematics  
The University of New South Wales

Professor Geoffrey Evans  
School of Engineering  
The University of Newcastle

Professor Ruth Fincher  
Faculty of Architecture,  
Building and Planning  
The University of Melbourne

Professor John Foster  
School of Economics  
The University of Queensland

Dr Elizabeth Jazwinska  
Johnson & Johnson Research Pty Ltd

Professor Peter Koopman  
Institute for Molecular Bioscience  
The University of Queensland

Professor Warren Lawrance  
School of Chemistry, Physics and  
Earth Sciences  
The Flinders University of  
South Australia

Ms Phillipa McGuinness  
University of New South Wales Press

Dr Els Meeusen  
School of Veterinary Science  
The University of Melbourne

Professor Gerard Milburn  
School of Physical Sciences  
The University of Queensland

Professor Mats Olsson  
Department of Biological Sciences  
University of Wollongong

Professor Nicholas Oliver  
School of Earth Sciences  
James Cook University

Professor Michael Reeder  
School of Mathematical Sciences  
Monash University

Professor Anthony Roberts  
Department of Mathematics  
and Computing  
University of Southern Queensland

Dr Francis Rose  
Chief Scientist  
Defence Science and Technology  
Organisation

Professor Teresa Seddon  
Faculty of Education  
Monash University

Professor David Smith  
Department of Civil and Environmental  
Engineering  
The University of Melbourne

Professor Julio Soria  
Department of Mechanical Engineering  
Monash University

Professor Peter Sullivan  
Institute for Education  
La Trobe University

Professor Phyllis Tharenou  
Dean of Research,  
Business Divisional Office  
University of South Australia

Professor Michael Wesley  
Griffith Asia Institute  
Griffith University

Professor Robert White  
School of Social and Cultural Studies  
The University of Western Australia

Professor Liangchi Zhang  
School of Aerospace, Mechanical and  
Mechatronic Engineering  
The University of Sydney

# ARC PROFILE

## PUTTING THE 'E' IN E-RESEARCH

**Professor Ah Chung Tsoi, ARC Executive Director for Mathematics, Information and Communication Sciences, has set himself an ambitious goal to make e-Research a commonplace way of conducting research in Australia.**

Leading the way through the introduction of an ARC pilot program to fund e-Research projects, Professor Tsoi actively encourages his peers to embrace the new technology.

Professor Tsoi's enthusiasm for e-Research comes from his experience in the practical applications of information technology. Before joining the ARC in February 2004, he was the University of Wollongong's foundation Pro Vice-Chancellor (Information Technology and Communications). His work in artificial intelligence is internationally known and he is one of few experts in the world working in the area of adaptive processing of data structures.

According to Professor Tsoi, e-Research will enable inter- and intra-disciplinary collaboration among researchers anywhere in the world based on existing information technology infrastructure.

"The power of high-capacity distributed computing and the vast distributed storage capacity, which is increasing daily, has made e-Research possible," Professor Tsoi says. "It will revolutionise the way we do research, assisting multi-disciplinary teams from across the world to solve research problems."

E-Research has amazing potential. Professor Tsoi cites, as an example of effective use of the technology, a researcher being able to instantly access databases held at different universities around the world and collaborate with researchers in other disciplines, all through his or her own computer.

"To have information from a number of sources at your finger tips and to be able to analyse these data with other researchers around the world is a very powerful way of doing research," he says.

*E-Research will revolutionise the way we do research, assisting multi-disciplinary teams from across the world to solve problems*



Professor Ah Chung Tsoi.  
You can undertake e-Research anywhere, as long as you have the IT infrastructure.

E-Research will facilitate:

- face-to-face meetings with 'global' peers using Access Grid, a powerful multi-way video conference system which allows simultaneous multi-to-multi communications
- a single authentication process allowing the researcher access to many databases available on the internet
- virtual laboratories recording the research process
- access to, and sharing of, very large data collections
- access to, and sharing of, distributed sensing systems, such as water levels in a catchment
- complex simulations, such as simulated motor vehicle accidents
- high-performance visualisation, for example, in virtual reality environments

"The possibilities for e-Research appear endless to me. I hope in another two years, when I finish my term with the ARC, that e-Research will play a fundamental role in the conduct of Australian research," Professor Tsoi says.

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- ARC *Linkage International Fellowships* awarded under the Memorandum of Understanding between the ARC and the Alexander von Humboldt Foundation in Germany have been renamed *ARC Linkage International Ferdinand von Mueller Fellowships*. The new name is the result of a proposal put to the ARC Board by the Australian Association of von Humboldt Fellows, which suggested renaming the



Ferdinand von Mueller

fellowships after a significant German-Australian.

Von Mueller is recognised as a major figure of nineteenth century Australian science and, arguably, the best known German émigré to Australia. His contribution was prolific, far exceeding the normal expectations

of his roles as Foundation Government Botanist of Victoria and Director of the Botanic Gardens of Victoria. Von Mueller's lifelong collaborations, especially with the then German states, were a feature of his extraordinary productivity.

- Applications have opened for *Linkage Infrastructure Equipment and Facilities (LIEF)* grants for funding in 2006. Applications must be submitted by 5.00pm AEST on Friday, 27 May 2005.
- The ARC has received 586 applications for grants under *Linkage Projects Round 2* for funding commencing in July 2005. The applications are from 37 administering organisations seeking a total of \$146,856,594.
- The *Australian Research Council Strategic Plan 2005-2007* has been tabled in Parliament and is available on the ARC web site ([http://www.arc.gov.au/publications/strategic\\_plan.htm](http://www.arc.gov.au/publications/strategic_plan.htm)).



- The ARC has received 3,766 applications from 52 administering organisations seeking \$1,627,924,993, in the call for *Discovery Projects* proposals to be funded in 2006. The applications were allocated to readers at the April meeting of the ARC's College of Experts and will be assessed for funding at its August meeting.

- The ARC, the National Health and Medical Research Council (NHMRC) and the Australian Vice-Chancellors' Committee (AVCC) have begun a joint review of the national guidelines for ethical conduct in research involving humans. When finalised, the revised guidelines will replace the *NHMRC National Statement on Ethical Conduct in Research Involving Humans* issued in 1999.

A copy of the draft guidelines and information about how to make a submission can be found at <http://www.nhmrc.gov.au/issues/natstrev.htm>

- The ARC, NHMRC and AVCC have established a Joint Working Group to review the *NHMRC/AVCC Statement and Guidelines on Research Practice* and propose an *Australian Code for Conducting Research* containing standards for research practice across all disciplines.

A copy of the draft code can be found at <http://www.nhmrc.gov.au/research/general/accr.pdf>

Information about the review and how to make a submission can be found at <http://www.nhmrc.gov.au/research/general/code.htm>

- The ARC and the NHMRC in association with the Australasian Research Management Society (ARMS) will host a seminar in Canberra on 26 and 27 May 2005 for Australian research administrators.

The seminar will cover:

- ARC and NHMRC strategic directions
- general issues relating to ARC and NHMRC funding schemes
- the roles and responsibilities of the ARC and NHMRC staff
- ARC and NHMRC program and business operations
- major ARC and NHMRC funding scheme issues (pre-application, eligibility, assessments, rejoinders, funding agreements/deeds of agreement, feedback, progress, final and end of year reporting, IT issues, public relations)

For more information, email [anne.abbott@arc.gov.au](mailto:anne.abbott@arc.gov.au)

## ■ Swinburne scientist close to growing a heart valve

Six years ago, the world woke to images of a mouse—with what appeared to be a human-shaped ear growing on its back—splashed across newspapers and television screens. As an experiment in tissue engineering, this weird construction by bio-engineers at the University of Massachusetts captured the public imagination. It demonstrated that growing anatomical structures in the laboratory was possible and seemed to suggest the dawning of a 'bionic' age.

In reality, it was a premature dawn. The ear was not functional and it consisted of a pre-formed polymer scaffold in the shape of an ear implanted under the skin of a nude mouse.

Tissue engineers at Swinburne University of Technology's Industrial Research Institute (IRIS), however, are involved in a project that will create a living, tri-leaflet heart valve structure from a combination of polymers and cells.

Diseased or deformed heart valves are not uncommon in young children and their replacement is problematic. Current replacement valves are either mechanical devices or tissue structures usually manufactured from pig heart valve tissue. Mechanical valves tend to create blood clots and tissue valves are not very durable and are prone to calcification. Also, in growing children the valve must be regularly replaced to cope with a larger aorta and blood capacity.

The basis of the work at IRIS is to create a structure able to grow with the host. Although team leader Professor Yosry Morsi says a realistic, functional valve for humans is about 10 years away, the project has shown such promise that it has received sustained funding from the ARC.

"We've brought together engineers, mathematicians, chemists, cell biologists, vets and surgeons in a collaborative effort to engineer live replacement tissues to replace, augment or maintain diseased or damaged tissues," Professor Morsi says.

"The tissue engineering team at IRIS has established collaborations with many local surgical units, including the Cardiac Surgical Research Unit at the Alfred Hospital, the Oral and Maxillofacial Surgery Units at the Royal Children's and Royal Melbourne Hospitals and the Department of Vascular Surgery at the Royal Melbourne Hospital."

Professor Morsi says that, to date, the team has been able to construct anatomically correct valve scaffolds from polymers to support cell adhesion and growth.



Above: Professor Yosry Morsi is growing cells onto scaffolds made of polymers to create living body parts

Below: Model scaffold of a sheep aortic valve produced by fused deposition modelling from computer tomography scan data

The scaffolds are fabricated via fused deposition modelling, a form of rapid prototyping technology. This involves obtaining computer tomography (CT) scans of natural valves and using software to convert the CT data into a computer-assisted drawing program.

Once the valve scaffold is constructed, it is seeded with fibroblast cells that produce connective tissue. Endothelial cells, the type of cell that lines all blood contacting surfaces in the body, are then grown over the connective tissue to provide a thrombo-resistant lining to prevent blood clots forming.

Because the patient's own cells are used to construct the living replacement tissues, rejection is minimised. Professor Morsi says the work has many other possible applications and the potential to revolutionise reconstructive and plastic surgery of all kinds.

"If recent developments in stem cell technologies are combined with advances in genetic engineering, biomaterials and micro- and nano-manufacturing technologies, it is possible that the viable use of tissue-engineered, patient-specific heart valves will be a clinical reality in the foreseeable future," he says.



*We've brought together engineers, mathematicians, chemists, cell biologists, vets and surgeons in a collaborative effort to engineer live replacement tissues*

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Article submitted by Swinburne University of Technology's Corporate Marketing Department.

# Networks

## NETWORKS

### KEEPING AUSTRALIA SAFE

The ARC is investing \$1,950,000 over five years in a new knowledge-sharing network of Australian and international researchers whose focus is to develop ways to protect critical infrastructure from natural disasters and terrorist attacks.

Led by Associate Professor Priyan Mendis from the University of Melbourne's Department of Civil and Environmental Engineering, the ARC Research Network for a Secure Australia (RNSA) is Australia's most comprehensive network in the multi-disciplinary areas related to critical infrastructure protection.

In particular, the network will concentrate on four main areas:

- physical infrastructure security, such as fire safety, smart buildings, and protective materials and systems
- surveillance and intelligent systems, such as audio, remote, video, robotic and telecommunications technology
- information infrastructure security, such as secure software engineering and testing, and
- common research opportunities, such as understanding system interdependencies, risk assessment and management, threat detection and response, communication and control systems, counter-terrorism, and emergency management

The network includes more than 300 researchers and professionals from 25 Australian research organisations and



Left to Right: Prof. Ed Dawson, RNSA Hub Coordinator; Prof. Peter Høj, ARC CEO; Assoc. Prof. Priyan Mendis, RNSA Convenor; Mr Gary Nairn, Parliamentary Secretary to the Prime Minister; Prof. Elim Papadakis, ARC Executive Director; Mr Philip Ruddock, Attorney-General; Dr Lynn Booth, Dept of the Prime Minister and Cabinet; and Prof. Joseph Lai, RNSA Hub Coordinator.

industry groups. A number of international collaborators in the US, Europe, Africa and Asia will also participate.

The network was launched at Parliament House, Canberra in February by Attorney-General Mr Philip Ruddock. Parliamentary Secretary to the Prime Minister Mr Gary Nairn represented Education Minister Dr Brendan Nelson at the launch.

### SUBMITTING ARTICLES

The ARC welcomes suggestions and articles for *Discovery*. Articles may be edited for style and length. Edited articles are referred to authors before publication for correction and feedback. There is no guarantee that all submitted articles will be published. Submissions should be sent to [fiona.skivington@arc.gov.au](mailto:fiona.skivington@arc.gov.au)

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