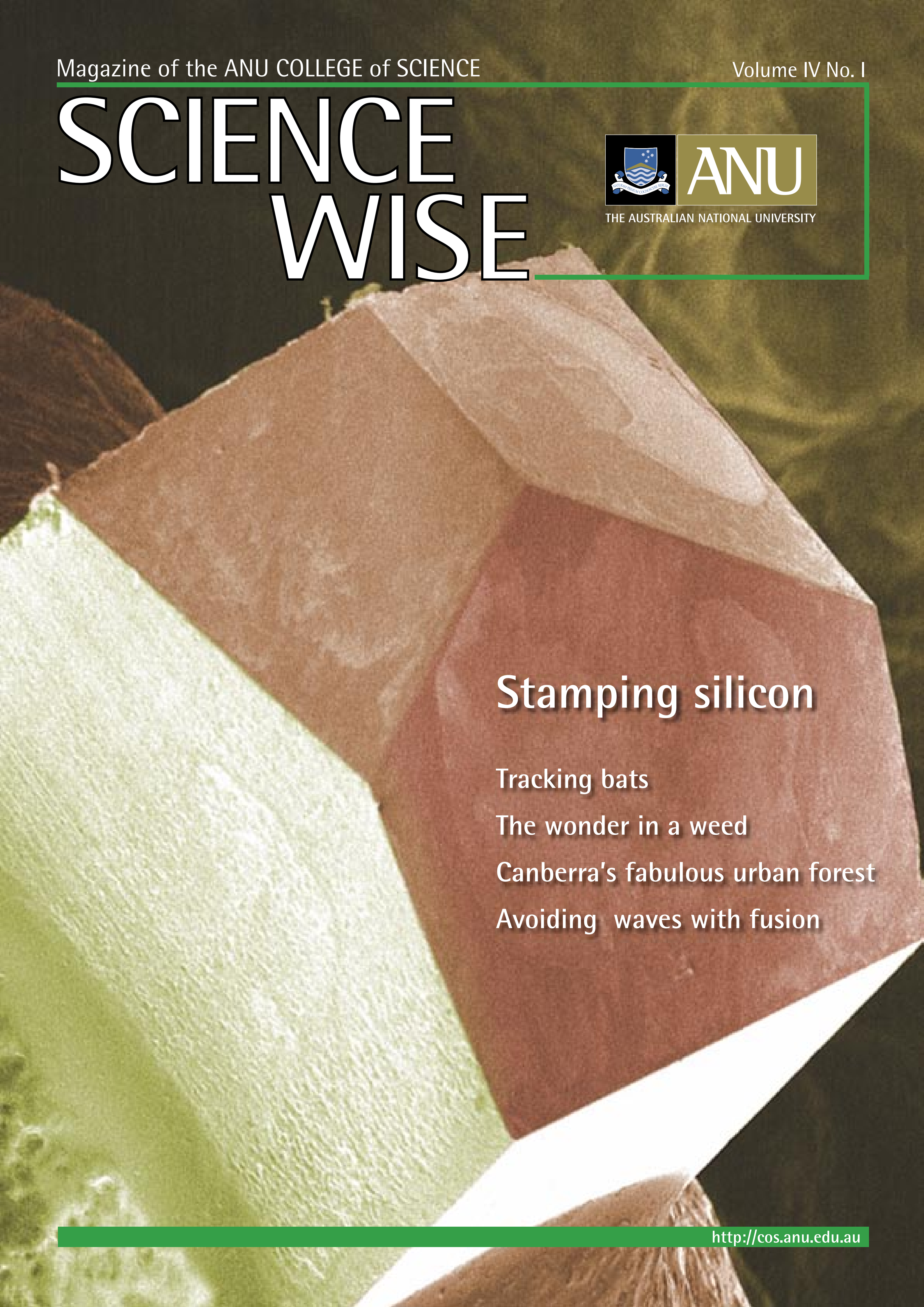
Magazine of the ANU COLLEGE of SCIENCE

Volume IV No. I

SCIENCE WISE

THE AUSTRALIAN NATIONAL UNIVERSITY



Stamping silicon

Tracking bats

The wonder in a weed

Canberra's fabulous urban forest

Avoiding waves with fusion

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We welcome your feedback.

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Cover image:

A diamond tipped indenter used by researchers at the Research School of Physical Sciences and Engineering to modify silicon. See the full story on page 4.

Image by Jodie Bradby.

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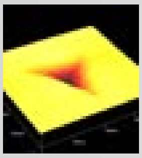
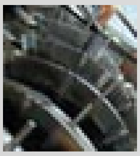


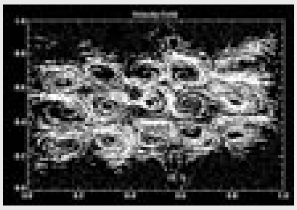


SCIENCE WISE NEWS

UNDERSTANDING VORTICES

ANU researchers have come closer to understanding how energy is retained in turbulent systems that self-organise - such as the atmosphere, the universe and plasma - after designing a simple experiment in their laboratory which creates 900 vortices in electrolytic fluid.

The researchers watched as the 900 mini-vortices 'self-organised' to form one giant vortex. At this high energy state, the fluid developed powerful regions of 'zonal flow' which in turn created transport barriers – the key to reducing energy loss from the fluid.



The finding is particularly exciting for the study of turbulence in plasma - a hot, ionised gas - which is known to self-organise to a high energy state. The loss of energy from confined plasma has been one of the main challenges to making it a source of energy.

A better understanding of how this loss occurs has significant implications for the future of plasma energy sources, such as plasma fusion energy reactors, according to Dr Michael Shats, from the Research School of Physical Sciences and Engineering at ANU.

"From this experiment we've shown that this process of self-organisation works very similarly in a tank of fluid in the lab and in plasma at temperatures of millions of degrees – it opens up new avenues of discovery."

In their latest paper published in the journal *Physical Review Letters*, Dr Shats and colleagues Dr Hua Xia and Dr Horst Punzmann detail how the powerful zonal flows that create the transport barriers, which in turn restrict the loss of energy from the system, are the result of turbulence self-organisation in plasma.

COLOUR CHANGING SNAKES

The mystery surrounding a snake that undergoes a spectacular colour change has been solved by ANU ecologists who have found that the skin of the green python – which begins life either bright yellow or red – transforms to blend into a new habitat as the snake gets older.

Dr David Wilson and Dr Robert Heinsohn from the Centre for Resource and Environmental Studies at ANU, with Professor John Endler of Exeter University, solved the mystery after a three year study of green pythons at Cape York Peninsula. Their results were published recently in the scientific journal *Biology Letters*.

They radio-tracked a large number of juvenile and adult pythons and analysed their colours using advanced spectrophotometry. To their surprise, they found that the brightly coloured youngsters live in a completely different habitat to the older snakes. The juveniles remained outside the rainforest where they hunted small prey such as skinks and cockroaches, whereas the adults moved into the rainforest canopy to hunt rodents and birds.

The juvenile yellow and red colour allows them to blend in remarkably well with the multi-coloured leaves and grass at the forest edge. The adult green allows them to hide from their predators as they hunt for birds and rodents in the canopy.

"It takes a year before the young ones are large enough to catch bigger prey like birds," says Dr Heinsohn. "They then shed their skins, change to green, and move inside the rainforest to try their luck off the ground."

DROUGHT LINK TO MONSOON

An international team led by researchers from ANU have warned that droughts of greater severity could be in store for Australia and Indonesia if the Asian monsoon system continues to strengthen. The researchers have uncovered new insights into the connection between three major climate engines: the Indian Ocean Dipole, El Niño/Southern Oscillation, and the Asian monsoon. Their findings, based on the analysis of climate records stored in coral reefs off western Indonesia, were recently published in *Nature*.

Lead researcher Dr Nerilie Abram said that by looking at climate behaviour over the last 6,500 years, the team found that stronger monsoons in Asia led to greater ocean cooling in the eastern Indian Ocean, which in turn increased the drought-causing effects of the Indian Ocean Dipole in Indonesia and Australia.

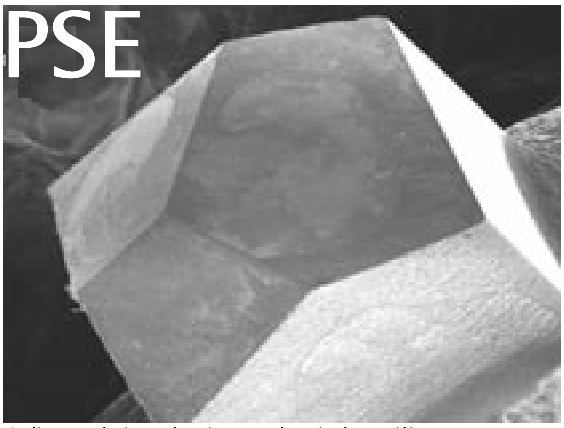
"Chemical analysis of fossil corals allows us to understand, in great detail, how the climate behaved thousands of years ago," says Dr Abram. "The corals show us that drought has always been a key feature associated with Indian Ocean Dipole cooling, but the nature and timing of these droughts were quite different back when the Asian monsoon was stronger than it is now."

Team member Dr Mike Gagan from ANU said this was because the stronger monsoon drove more powerful winds across the Indian Ocean, cooling the surface water and increasing the effects of the Dipole.

"It should be a matter of concern, then, that the Asian monsoon system appears to be growing stronger," Dr Gagan said. "This means we could see a return to those heightened droughts that hit countries around the eastern Indian Ocean 6,500 years ago. Such a change in the timing and severity of droughts in the future could have major implications for Australia and its neighbours."

Stamping silicon at RSPSE

by David Salt



A diamond-tipped point used to indent silicon.

As the Director of the Research School of Physical Sciences and Engineering (RSPSE), Professor Jim Williams doesn't have a lot of time to carry out his own research. The growing complexity of running one of Australia's foremost physics research institutions is an all consuming task yet Professor Williams believes it's essential that he maintain contact with his own research for both his credibility and his sanity. Some ten years ago Professor Jim Williams set about investigating why it was that silicon's electrical properties changed when you stamped it. That research now promises to open up whole new industries, and Professor Williams believes it's an excellent example of the successful approach to fundamental and applied science taken by his research school.

"At **RSPSE**, much of our science is built around team projects, and almost all of those teams work from the fundamental through to the applied," says Professor Williams. "Often those activities extend to commercialisation or a strong interaction with industry. At the applied end, we're often doing work that's built upon excellent fundamental studies. There's a depth to what we do that's often not the case in a lot of research activities that interact with industry. I think that this broad spectrum of activities and the group nature of the research being done in this school lies at the centre of our success.

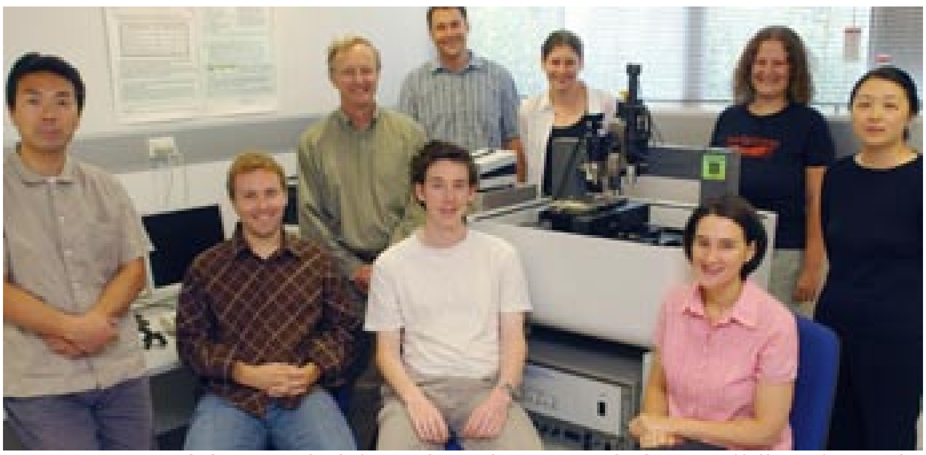
"Now, even though I'm Director, I still have a very strong hand in a research program. Most of what I do is related to nano-indentation of semiconductors. Like much of the research done at this school, this started as a fairly fundamental research activity; it was curiosity driven. We weren't seeking to answer a specific industrial problem but it has led to some important industrial applications.

"It's been known for some time that when you press down on silicon it deforms by changing its phase from one crystal structure to another. Then, when you release the pressure, it changes again to other phases. Why is this, and what can we learn by understanding this? These were the questions we started out answering.

"Some eight to nine years ago we decided to get a good student to work on this question, and that student was Jodie Bradby. As it's turned out we've been remarkably successful, and part of that success is that Jodie is an excellent experimentalist. She has brought to bare a range of analytical techniques that had not been applied to this system before. In so doing we have uncovered some exciting possibilities. We now have 10 people working on the science."

The researchers began by investigating what happens when you press down on the silicon found in silicon chips. This is crystalline silicon with a diamond cubic structure. It's referred to as silicon I (Si-I) and it behaves as a semiconductor.

When you press down on this silicon at quite a high pressure, say over 10 gigapascals of pressure, then the material is compressed and its density increases by over 20%. Under this pressure it changes phase and turns into silicon II (Si-II), a metallic version of silicon with a hexagonal crystal structure.



Nanostampers at RSPSE. From the left are: Dr Naoki Fujisawa, Dr Simon Ruffell, Prof Jim Williams, Mr David Oliver (sitting) Mr Jon Markle (standing), Dr Kallista Sears, Dr Jodie Bradby, Ms Bianca Haberl and Dr Rui Rao.

"While 10 gigapascals of pressure sounds extreme, it's easily achieved when stamping the silicon with a small point of a harder material like a diamond tip," comments Professor Williams. "This is actually what we do with a device known as an indenter. It's tiny diamond tip presses down on the silicon substrate with a known force."

Si-II has the electronic and mechanical properties of a metal and not a semiconductor. However, this phase only persists for as long as the pressure is maintained. As the pressure is released or unloaded (as the diamond tip is raised), the silicon does not return to Si-I but turns into one of two other phases depending on how quickly the pressure is released. If you release the pressure very quickly you end up with amorphous silicon with no crystalline structure – a material that behaves as an electrical insulator.

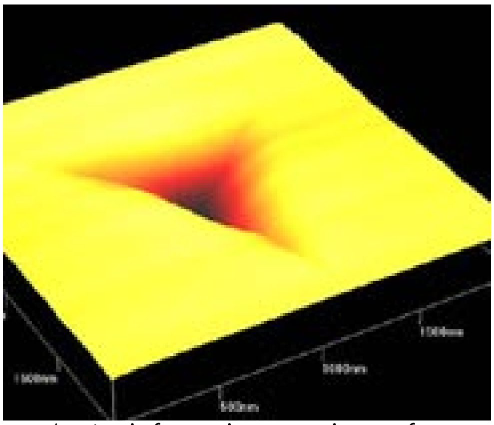
If you unload slowly it will transform into a mixture of two other crystal phases of silicon – silicon-III (a body-centred-cubic structure) and silicon-XII (a rhombohedral structure). One is a semiconductor and the other is a semi-metal though both have yet to be studied to determine their properties.

"We have also found that if you have certain dopant atoms in the silicon to begin with, these two phases can be very conducting," says Professor Williams.

"And the other thing we've found is that if you start off with amorphous silicon and you press down on that you can produce a number of other phase changes. And, if you then heat it up, to say 150 degrees Celsius, you can come back to silicon-I."

Which all adds up to an amazingly flexible and completely new way of working and modifying silicon – the world's most common semiconductor.

"We can start off with a sheet of amorphous silicon and then press down on little bits of



An atomic force microscrope image of an indent on a silicon wafer.

Dr Bradby and Professor Williams with the nanoindentation facility at RSPSE.

it, transform it, heat it up a little bit and indent it back to silicon-I, a semi conducting form," explains Professor Williams. "Or we can start with semiconductor silicon and transform it to an insulator. The beauty of this is that we can cycle between conducting and insulating phases as we like.

"Now if you think about it, this stamping approach offers us a fundamentally different way of working with silicon semiconductor wafers. In the past you've started with a silicon wafer that is all the same, and you've patterned it to locally change the properties by introducing something else onto or into that silicon. Here we're not introducing anything else into the silicon. We're using the fundamental pressure-induced properties of silicon itself to change its properties from a conducting to an insulating phase or phases (or vice versa).

"This opens up a whole new world of possibilities in working with semiconductors. Where ever you want to selectively write lines or patterns of conducting or insulating material on a silicon wafer this technique has applications.

"We can change insulating silicon to conducting silicon for example, which leads to an ability to make little memory cells by changing these properties.

"But it's also a patterning process because you can draw conducting lines by drawing a line of dots. Therefore, it's a fundamentally new way of making circuits with a minimum of patterning as you're making the patterning while you're changing the properties.

"There are two distinct areas where this approach has special benefit," he explains. "The first is where the application needs to be cheap. In other words, applications where you can't from a cost perspective undertake the expense of developing the traditional pattern forming processes. However, a simple stamp that in one step defines the region you want to change might be possible.

"Small businesses, for example, might want to have a way for writing information electronically into materials that they can read but it has to be very cheap because they haven't got the infrastructure of Intel and similar sized companies.

"Consider smart cards as an example. If you want a cheap way of writing information into a smart card this might be the way you do it, and it's much much less sophisticated than conventional memory technology. You might have a smart card or something similar that has all the circuitry in there to enable you to do something but what you need to do is to connect a few of those bits to customise the chip with information specific to individual users. Well, to make a specific chip for a person or a business is a pretty costly business. However, with a stamp it might be a simple, cheap and trivial process using your corporate stamp."

"The other set of applications for this stamping method are where you simply can't create what you're after using more traditional techniques. This is where a potential memory technology comes in that works at the nanoscale.

"By pressing down with a diamond tip of an atomic force microscope, for example, its possible to create a domain that has dimensions of less than 10 nanometres. In so doing you're creating a memory cell that is less than that which can be made from conventional silicon chip technology. So, here is a case where conventional technology has a fundamental limit to how small it can get but there's no limit to this new way of making conducting lines on silicon through indentation.

Of course, as Director of the **RSPSE**, finding time to maintain contact with the research is a challenge in itself. However, Professor Williams believes it's critical to make the effort.

"The research revitalises me, indeed it keeps me sane," he says. "I need to have an outlet from the constant grind of administration, and that outlet is research like this.

"I also think that when you're director of a research school it's important that you have research credibility. How can I talk to other researchers at the school about research performance if my performance isn't out there for everyone to see."

"**RSPSE** is a great place for the pursuit of innovative nanotechnology. It has strength and diversity, and a surprising synergy between activities across the school. I think our success lies in the fact that our research programs are all focussed physics activities that go from fundamental research right through to the applied end."

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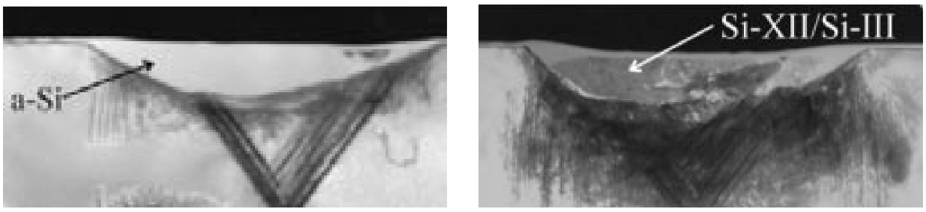

Silicon undergoes several phase changes in structure when stamped. The transformation depends on the amount of pressure and the rate of unloading. These images are cross sections of indentations taken with a transmission electron microscope. They show the different structure resulting from slow unloading (left) and fast unloading (right).

Exploring Canberra's urban forest

by David Salt

How do you transform a collection of dusty, windblown paddocks into a national capital? According to Dr Cris Brack from the School of Resources, Environment and Society it takes more than a few iconic buildings. It needs trees – lots of trees thoughtfully planted and maintained. We take our urban forest for granted but it's an essential part of both our comfort and our sense of place.

Cris Brack: "The urban forest is fundamental to Canberra"

"The urban forest is fundamental to Canberra," says Dr Brack. "Canberra is the garden city or the bush capital, and even as you arrive in Canberra that's the dominant feature of the city – its treescape. And while we think of them mainly for their aesthetic value – ie, they look good – they're important for a wide range of other reasons, too."

For many years now Dr Brack has been researching the many values of our urban forest. And he knows it better than most. He and his students have spent many years measuring its 400,000 trees. In an effort to more effectively understand and manage it, Dr Brack has developed a database and decision-support program called DISMUT (Decision Information System for Managing Urban Trees).

"These days new trees are selected on a range of values including their visual appeal, however the first trees were established with a very practical goal in mind," comments Dr Brack. "The original tree planting had very distinct purposes. Haig Park, for example, was planted to stop the winds and the dust. We had very adverse weather conditions in Canberra so those trees had a very solid, essential purpose; and they worked. I mean this used to be a very windy, cold and dry place – very cold in winter and very hot in summer.

"And our urban forest still serves these functional values today. The treescape is still vital to ameliorate Canberra's weather and climate. The trees redirect the wind, they reduce the impact of dust by reducing the wind and capturing the pollutants on their leaves. There is a shade effect in summer, reducing conditioning requirements while also reducing heating needs in winter. And our urban forest still serves these functional values today. The treescape is still vital to ameliorate Canberra's weather and climate."

Indeed, in a greenhouse-conscious world there is much to commend a sheltering urban forest. According to Dr Bracks the benefits go way beyond the protection it affords us at home.

"Tarmacs on roads and footpaths volatilise in extreme heat and sunshine, and the gases they release are greenhouse sensitive as well as being a general pollutant," he says. "And as these gases are released the tarmac becomes brittle, accelerating it's decline. If you shade them under trees, however, you can reduce the release of these gases. In doing so you get direct financial saving because you don't have to repair your roads as much, as well as providing an environmental saving on greenhouse emissions. In many parts of the US you have to plan the growth of shade trees around the development of car parks before getting permission to build the carpark.

"You can also store a ton of carbon in a couple of trees as they grow. Unfortunately, at the moment there's no established carbon market in which you can trade the value of this locked up carbon. However, it's another real contribution being made by our urban forest."

There's even value in the dead trees and branches in our urban forest, something that Dr Brack is keen for people to see in a more positive light, especially with Canberra's drought causing increased rates of death of many of our trees.

"Trees naturally die, both the whole tree and sections of the tree," says Dr Brack. "In nature, when you get a resource like dead wood or dead bark, something uses it and there's a huge range of native animals even in the city who require that resource. So, for example, you often see birds of prey and other birds that prefer to sit on dead branches because they're high and their view isn't obscured. If you're not preserving dead branches you're disadvantaging many of our native bird species. The same applies to dead wood on the ground.

"Of course, we shouldn't put ourselves or our homes at risk from things like falling branches. But in other parts of the urban forest where these risks are much lower, we could benefit from the effects of the drought on trees by rethinking the values of an urban forest and increasing habitat opportunities."

How Canberra's urban forest will fare in a climate-change world is an open question. However, thanks to the research being carried out by Dr Brack we're better placed to monitor impacts and care for this special resource.

"A system like DISMUT can track the effect of climate conditions on urban trees," he says. "Urban planners could even develop habitat creation practices in suitable parts of our cities and suburbs. An urban forest will always be a valuable resource though the way we manage it may have to adapt to changing circumstances."

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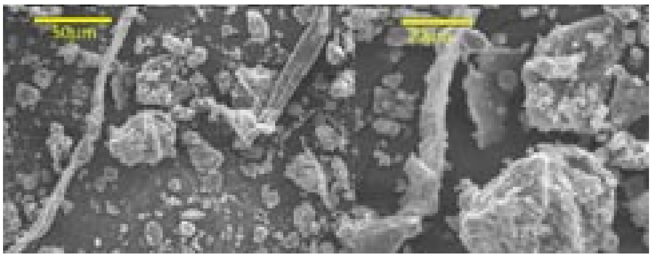
Gone with the wind

by David Salt



A scanning electron micrograph of the dust collected from the big storm in 2002. The grains were mostly angular and there were many fibres in the dust, some of them up to 200 microns in length. Some have suggested that fibres originated from feacal pellets.

A dark presence flowed over Canberra on the night of Tuesday, 22 October, 2002. A fast moving cold front had brought with it not rain but a tremendous plume of dust. A ghostly brown fog enveloped the city coating cars, building and plants in a layer of fine dirt.

"It was an amazing event," says Professor Patrick De Deckker from the Department of Earth and Marine Sciences (DEMS). "We estimated that it deposited around 6 grams of dust per square metre. That's a phenomenal amount of material when you think about it."

Phenomenal indeed. Calculations based on satellite imagery and meteorological data suggest that the dust storm carried one of the largest dust loads recorded in Australia. The dust plume was 2400 km long, up to 400 km wide and between 1.5 to 2.5 km high. It covered an area of around 840,000 square kilometres and carried an estimated load of between 3-5 million tons of dust.

While it was a memorable event for most people it proved to be pivotal for Professor De Deckker.

Patrick De Deckker inspects a sample of dust from the great storm of 2002.

"My interest in dust and dust storms had been kindled several years earlier," he says. "But it was this event that galvanised my studies.

"Professor De Deckker, along with a number of other researchers from ANU, around Australia and across the world carried out a range of analyses on the dust. And what did they find?

"The most common grain size of the dust particles was around 26 microns," says Professor De Deckker. "The grains were mostly angular and there were many fibres in the dust, some of them up to 200 microns in length. Some people have suggested that fibres may have originated from feacal pellets from rabbits or other organisms.

A car parked at ANU displays the evidence of the 'mud fall' of 22 October.

"The dust was also found to contain 4.5 parts per billion of the organic chemical DDE, a breakdown product of DDT."

Numerous other tests were done on the dust including an analysis on pollen, organic chemistry and microbes. All of this yielded interesting results but, of course, the question that everyone was interested in was where did the dust come from. To answer that question you first need to record some form of physical fingerprint of the dust that relates to the physical characteristics of a source area.

To develop a profile or a fingerprint of dust many separate measurements are made. These include powder X-ray (powder) diffraction to work out the mineralogy of the dust particles, and ICP Mass Spectrometry to determine the proportions of major, minor and rare earth elements.

"Strontium, neodymium and lead isotopes are the three elements we particularly focus on in developing a physical profile of the dust," explains Professor De Deckker. "This is because these isotopes are not involved in biological cycles, they are not fractionated by organisms. In other words, they provide us with an accurate guide to the local rock type that was originally weathered down to form the dust. The proportions of these elements have not been altered by biological processes subsequent to it being weathered down."

Having established a fingerprint of the dust, now you need to know the path of the storm. These days there are vast arrays of meteorological data to draw on and some increasingly sophisticated programs available to interpret that data. One program called HYSPLIT allows you to track the airmass anywhere on the planet. Finally, to establish the source of your dust you need to match your dust fingerprint with the fingerprint of rock and sediment types from areas upwind of where the dust ended up.

"As it happened, we have been doing an extensive survey of river clays over the area of the Murray Darling Basin so we could map where sediments found in rivers were coming from," says Professor De Deckker. "We now have a database of fingerprints with which we could compare with the fingerprint of the storm dust.

"Putting all this information together allowed us to conclude that the dust that rained down on us on in October 2002 originated from very close to Cobar, NSW.

"It's really amazing how much we can tell from such small samples of dust," says Professor De Deckker. "And yet we know so little about aeolian (airborne) dusts from around Australia."

Professor De Deckker is now working on the establishment of an extensive monitoring system to trap aeolian (airborne) dust in Australia during future dust storms.

"We'll characterise the biological, physical and chemical nature of the dust and carry out a range of surveys looking at the effects of the dust on marine life, terrestrial ecosystems and humans."

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How to avoid making waves

by Tim Wetherell

The fusion of deuterium and tritium, to isotopes of hydrogen, to create helium in large-scale fusion reactors offers the promise of vast quantities of electricity with almost no greenhouse gas emissions. The most practical way to achieve this is to magnetically confine a ring or loop of plasma within a reactor and heat it to tens of millions of degrees.

In order to make the process as efficient and elegant as possible, one would like the fusion reactions themselves to heat the plasma rather than having to use an external heating method such as high power microwaves. Theoretically, this is possible since one of the fusion products is helium in the form of highly energetic alpha particles. These alpha particles could in principle, transfer their energy to the remaining deuterium and tritium fuel. There is however a significant obstacle to implementing this idea in practice.

Electrically conductive fluids, such as plasmas, have special properties resulting from the electrical and magnetic forces generated by their many moving charges. One such property is the presence of so called Alfvén waves – a travelling oscillation of ions along magnetic field lines. As coincidence would have it, the speed of the alpha particles produced by fusion is close to that of the Alfvén wave modes.

Confined superheated plasma is a turbulent, unstable and delicate thing and the presence of any large amplitude Alfvén waves could easily disrupt the flow to the point where the plasma dissipates and the reaction ceases. Because of this, an understanding of the physics of Alfvén waves in confined plasmas is of critical importance to the international efforts to develop viable fusion power. Prototype fusion power reactors are multi billion dollar undertakings designed for efficiency and robustness, which generally makes them far from ideal to conduct experiments on the impact of different coil configurations on Alfvén waves. However, this is where Australia is able to make an important contribution to the international fusion effort.

The ANU hosts the only large-scale stellarator plasma confinement facility in the southern hemisphere, the H-1NF. Although the plasma contained within H-1NF does not undergo fusion reactions, the confinement system does have a highly flexible design coupled with sophisticated and innovative diagnostic systems. This allows different coil configurations and containment parameters to be tried with comparative ease. This flexibility coupled with highly advanced diagnostics allows more accurate measurements to be made on parameters such as plasma rotation and density profiles than any other plasma device in the world. And it is precisely these factors that are so critical to the physics of Alfvén waves.

A view along the magnetic confinement coils inside H-1NF. (

But generating the data is only half the battle. Moving superheated plasma is such a complex system that the signals produced by the multitude of sensors are extremely hard to interpret. A substantial part of the research effort is the development of advanced data mining algorithms to filter key features from the mass of individual measurements. Recent results are beginning to clearly show characteristic Alfvén wave signatures in the data, which is an exciting beginning. Director of the H-1NF, Dr Boyd Blackwell sees such strong collaboration between mathematical scientists, theorists and experimentalists as the key to developing an improved understanding of the physics of plasma confinement.

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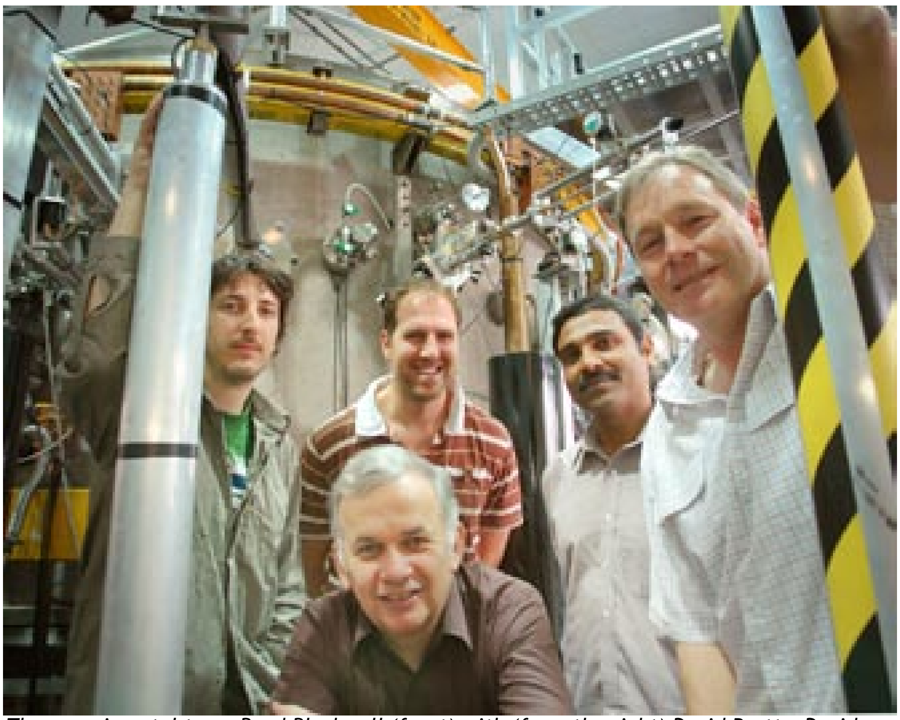
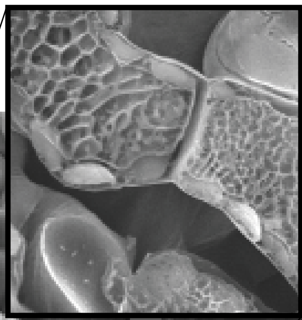
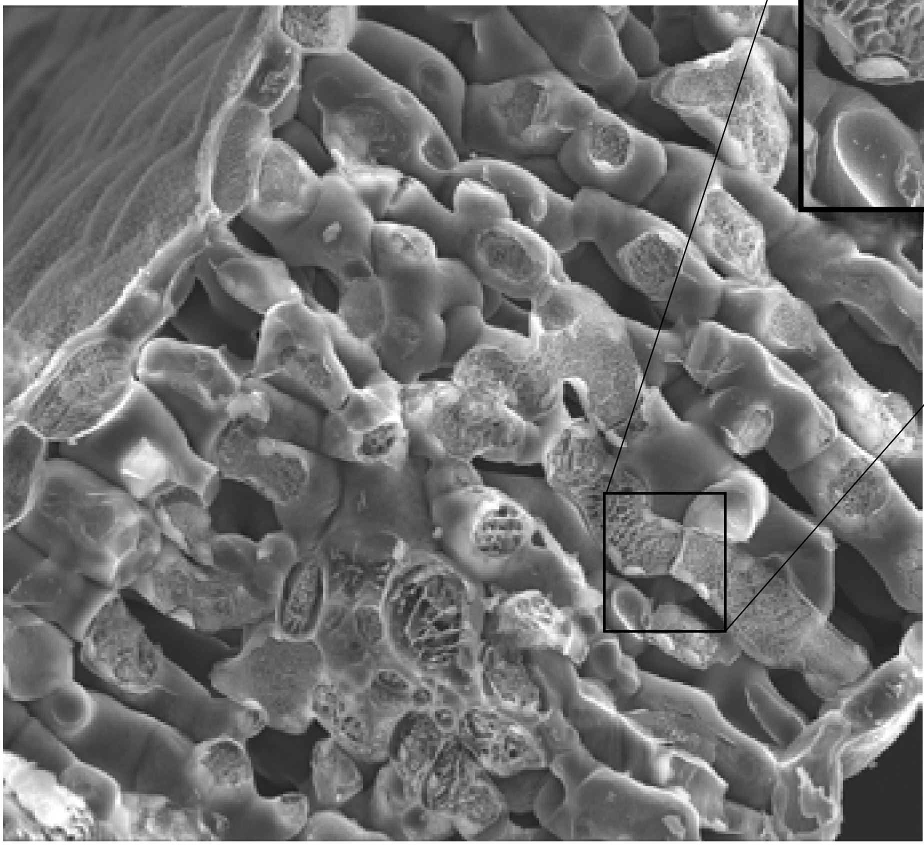


The experimental team Boyd Blackwell (front) with (from the right) David Pretty, David Oliver, Santhosh Kumar, and John Howard in the H-1NF lab.

Wonder in a weed



A freeze fracture through the leaf reveals the arrangement of cells and even the arrangement of some organelles (such as chloroplasts) within the cells.



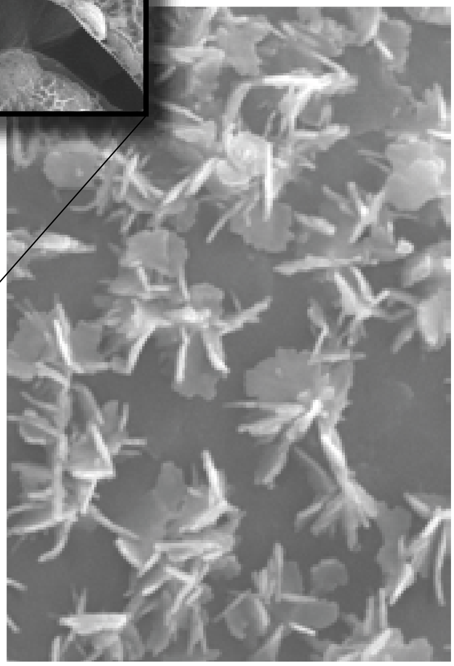


Plate-like wax covers the surface of the leaf.

by David Salt

"It's really quite an interesting image," says Dr Cheng Huang, a Senior Technical Officer at the ANU Electron Microscope Unit. He's describing a recent micrograph he took of a plant leaf using the unit's new Hitachi 4300 Field Emission Scanning Electron Microscope (FESEM). That image is pictured above. "The image shows the arrangements of plant cells in the different levels of the leaf while simultaneously revealing the location of some chloroplasts within the plant cells. They are the little white bodies just inside the cell wall.

"From the same specimen I captured another interesting image of plate-like hairs covering the leaf's top surface.

"What makes the images of interest is how easy they were to create. I simply took my specimen leaf and plunged it in liquid nitrogen, and then snapped the leaf in two. It was then just a matter of letting our new FESEM do it's job. The new electron microscope is easy and quick to operate, and records superb images.

"The thing that makes this process so straightforward is that we now have a cryo-stage attached to the machine," explains Dr Huang. "This allows us to carry out a wide range of research dealing with any hydrated specimens, like plants, frozen food, emulsions, polymers and meat products. Samples will be kept at liquid nitrogen temperature during the observation."

When fully configured the new FESEM will also incorporate a cathodoluminescence detector and energy dispersive X-ray facility making it a flexible workhorse for a broad range of electron microscopy.

And what was the plant that Dr Huang chose for this test run with the cold stage?

"You know, I'm not sure what species it is," he says. "I simply plucked up a weed growing out in the courtyard. What it shows, however, is that there is fascinating biology happening all around us all the time. You can find Nature's wonders everywhere, even in a lowly weeds.

Cheng Huang with the cryo-stage attachment on the Hitachi 4300 Field Emission Scanning Electron Microscope. The cryo-stage makes it possible to work with hydrated and frozen specimens.

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Celebrating Australia's space heritage

by David Salt

Michael West is a young man going places. He's been to the outback searching for Mars-like sites to assist with astronaut training in the future. He's designed, constructed and tested two different experiments that have been launched aboard surface to air missiles from the Woomera Rocket Range. And he served as an intern in the United States in 2005 at the SETI Institute in California.

He's passionate about space travel and about Australia's past, present and future in space. So committed is he to supporting Australian space science that he co-founded a company, Astra Australis, to promote space to the wider community. Astra Australis runs Space Education Workshops for school teachers and educators which showcase the wonders of space exploration, technology and science.

But this is just what Mr West does in his spare time because he's now studying for his PhD at ANU. He's part of the team at SP3 (Space Plasma, Power and Propulsion group), led by Professor Rod Boswell, which is working on a next generation plasma propulsion system for spacecraft. Called the Helicon Double Layer Thruster (HDLT), it's believed that this technology may one day propel humans to the Moon, Mars and beyond. It's also Australian-made and based on the recent discovery of a current-free double layer by Dr Christine Charles, also from the SP3 group.

Michael West with 'Ned Kelly' at the Tabulum Australia Day festivities. Mr West was invited to attend as an Australia Day Ambassador.

Michael's project involves testing the prototype of the HDLT in a space simulation chamber and measuring its thrust and efficiency. It's a tough task given that the thrust produced by the HDLT is on the order of a few milli Newtons, about the weight of a sheet of paper in your hand. But how is such low thrust useful?

The Helicon Double Layer Thruster in operation inside the space simulation facility at the SP3 laboratory.

"Thrust is important, but exhaust velocity is even more important," explains Mr West. "The higher the exhaust velocity, the more efficient the thruster. A chemical rocket expels particles at about 300 metres per second, the HDLT does so at around 10000 metres per second. That is an enormous increase in efficiency which is crucial for long duration space missions."

With such dedication to the cause (that cause being Australia and space) it was hardly surprising that Mr West was a NSW finalist in the 2006 Young Australian of the Year Awards. And that experience led to him being made one of 350 Australia Day Ambassadors nominated to help make Australia Day 2007 something special.

"As an Australia Day Ambassador I attended the Australia Day Celebrations in Tabulum in northern NSW," says Mr West. "It's in the Kyogle Shire between Casino and Tenterfield. Over 200 people attended the celebrations, which isn't bad when you consider Tabulam's population is only 150."

He attended the official festivities, presented the Citizen of the Year Awards, gave the local primary school a space pack full of resources to help with the teaching of space at school, and delivered an Australia Day address to the assembled VIPs, guests and members of the local community. And what did he speak about – Australia's rich history in space exploration, and the role of Woomera.

"Most people aren't aware of it, but Australia was the fourth country in the world to launch a satellite from its own territory," exclaims Mr West. "First was the USSR with Sputnik, then the United States, then France and then Australia. The satellite was called WRESAT and was launched from Woomera in 1967. It was built in less than a year, a remarkable achievement, and orbited the Earth 624 times collecting data about the upper atmosphere.

"The story of the people who worked on WRESAT and the numerous other projects at Woomera is truly inspiring and is testament to the hard work, innovation, dedication and ingenuity of so many Australians. It is also a prime example of our nation's excellence on the world stage and I believe the achievements at Woomera are one of the reasons we are known internationally as the 'clever country'.

"Whatever the future holds I know that the spirit of discovery, exploration and determination that marked the scientists and engineers at Woomera, along with so many others, that same spirit that is part of what it is fundamental to being Australian, will be evident in the next generation of Australians, our future."

And with such passion it seems certain that Michael West will be playing an important role in that future.

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Tracking bats

By David Salt

The two lads pictured above are discussing the pros and cons on how they'll attach a tiny radio transmitter to a small bat. Radio telemetry is a common practice these days but back in 1984, when this image was taken, it was still a bit of an emerging art.

Dr Chris Tidemann, on the left, is the researcher studying the bats and he's seen here with Mr Jim Bishop, a Senior Technical Officer. Both were in the Department of Botany and Zoology. Mr Bishop had just returned from an overseas trip to learn about the latest radio technology for biotelemetry.

"Jim's holding a radio transmitter, and I've got a Gould's Long Eared Bat," says Dr Tidemann. "That picture was actually taken over in the vehicle compound of what's now the School of Resources, Environment and Society. That area contained a large aviary where we kept a number of bats in a captive colony.

"It was part of an ecological study we were carrying out and we were looking at their activity, or lack of activity, over winter. When it gets cold they hibernate for part of the time, and we were looking at the relation between activity and temperature.

Dr Chris Tidemann today. He's till interested in the biology of bats (that's a bat skull he's holding) but he no longer climbs trees to find them.

"What I was doing was radio tracking these things to find out where they were roosting. So, I'd catch wild ones out in the bush and glue those little transmitters onto them with superglue and they'd stay on for about 10 days. That'd be long enough to find where they were roosting.

"I used to climb up the trees to find out where the roosts were. You can triangulate from the ground and find out reasonably accurately where the signals coming from, and then I'd fire a sling shot line up the tree and pull up a rope ladder up."

Dr Tidemann is now a Visiting Fellow at the School of Resources, Environment and Society. He's one of Australia's leading experts on microbats, flying foxes and in recent years he's devoted much of his time to research ways of managing the Indian Myna, a highly adaptable pest bird that is a significant threat to native birds and mammals because it out competes them for limited nest hollows in trees.

Is he still climbing trees looking for bats?

"No way mate," he says. "I fell out of a tree about 10 years ago which was a rude shock to the system. I remember as I was falling out I was thinking to myself that I don't fall out of trees – I don't climb trees anymore."

The photo was provided by the ANU Archives Program. It was taken by Ivan Fox and originally appeared in the *ANU Reporter*. For more info on the ANU Archives Program see www.archives.anu.edu.au/

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