ScienceWise @ ANU
THE AUSTRALIAN NATIONAL UNIVERSITY

Tim Wetherell

Dr Susan Scott with her art work made using the GRworkbench software, developed in the ANU Faculty of Science. It combines numerical simulation with visualisation, providing an intuitive virtual workspace for experimental exploration of space-times in General Relativity and Cosmology.

(right) Dr Ping Koy Lam pictured with teleportation equipment images taken by the ANU Quantum Optics Group.

Beam me up

Ever thought that 3D chart you're working on was a work of art, or maybe that experimental rig might qualify as an interesting sculpture? All through May many of the top scientists at ANU were happy to put aspects of their research on display in art spaces around town, and let the people decide whether good science could mix it with high art.

It was all part of **metis 2004**, a celebration of art and science. *Beam me up* was one exhibit with a particular ANU focus. It included a range of artists and ANU scientists exploring themes relating to sci fi and time travel. The display was staged at the ANU School of Art Gallery and opened by Dr Ping Koy Lam from the ANU Department of Physics.

The National Institute of Physical Sciences helped curate the exhibition, and was delighted with the positive response it received from visitors. NIPS plans to include more scientific 'art' within these spaces in the future.

More info on Beam me up: Christine.Denny@anu.edu.au

More info on metis: www.metis.com.au

Tim Wetherell

Home theatre for your ears

If you hunger for the surround-sound experience you get at the cinema in your own home then you have almost certainly felt frustrated at the quality of sound your newly purchased home-theatre system gives you. However, thanks to new research by National ICT Australia (NICTA) a remedy may be just around the corner.

"Most people don't get what they hope for because a typical family room or lounge room isn't configured like the idealised room shown in the manual that comes with your home-theatre system," says Mr David Excell, a recent graduate from the Faculty of Engineering and Information Technology. "This is usually a perfect rectangle, with the couch centred in front of the television. Because the real life situation is usually different to this, the audio experience is often well below what you'd experience in the cinema. *(continued next page)*

David Excell ponders the problem of achieving surround sound with home theatre

David Salt

ScienceWise

June 2004

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ScienceWise is a monthly newsletter produced by ScienceANU in association with the science-related National Institutes

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Consequently, consumers are often very disappointed, especially when you consider they may have forked out anywhere between $5000 - $20,000."

Researchers in the Wireless Signal Processing group at NICTA are working towards overcoming this challenge by improving sound reproduction technology.

"Surround sound stored on a DVD or transmitted by digital television assumes that the loudspeakers are placed in particular positions," says Mr Excell. "However, this doesn't always suit the consumer.

"Every family room or lounge room has a unique audio characteristic determined by the carpet, curtains, furniture and people contained within the room. This has a major impact on the sound that's produced."

The system being designed by researchers at NICTA involves moving a small microphone to different locations around the room. The microphone is connected to the amplifier. By interpreting the sound being picked up from the microphone at different locations, it's possible to modify the sound emitted by each loudspeaker to maximise the surround sound experience for a specific region.

"We aim to produce a simple-to-follow process that will enable any user to set up the best possible sound," says Mr Excell. "This will probably become available either as software run on a home computer connected to the amplifier, or as a piece of hardware that can be put directly into the amplifier."

Researchers hope the new technology will be commercially available within the next 12 months.

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What makes a landscape?

by D C 'Bear' McPhail

Cooperative Research Centre for Landscape Environments and Mineral Exploration

The Cooperative Research Centre for Landscape Environments and Mineral Exploration (CRC LEME) is focused on understanding the regolith, that zone of the planet that lies between fresh rock and fresh air. This includes all weathered materials and soils above bedrock, and LEME's research involves a diverse ANU research community.

Over the year spanning 2003-2004, LEME has provided $1.1million for student scholarships, staff salaries and research at ANU. There are presently 25 academics and 29 post-graduate and Honours students, as well as general and technical support staff, involved in LEME research at ANU. The research at ANU includes projects in mineral exploration, geochronology of regolith materials, groundwater, effects of microbiota and plants on the mobility of metals, geochemistry and mobility of gold, copper and other metals, the nature, origin and mobility of salt, and climate change and landscape evolution.

Although most of the LEME/ANU research is based in the Department of Earth and Marine Sciences (EMS), there is considerable work being done at the Research School of Earth Sciences (RSES), School of Resources, Environment and Society (SRES), the Centre for Resources and Environmental Studies (CRES) and the Research School of Physical Sciences and Engineering (RSPhysSE), which links scientists across campus.

Some highlights of current research at ANU are the dating of regolith materials using palaeomagnetism, isotopes, and optical luminescence (Dr Brad Pillans, Prof John Chappell and others; RSES), geochemical exploration of regolith and groundwater in central and western NSW (Dr Ken McQueen, Mr Dirk Kirste and others; EMS), effects of microbial activity on gold mobility and weathering processes (Mr Frank Reith and Dr Sue Welch; EMS and RSES; Dr John Field and others; SRES) and experimental studies of gold geochemistry in hypersaline brines and copper and zinc sorption on mineral surfaces (Mr Alistair Usher, Mr Chris Gunton (Ph.D. students) and Dr Bear McPhail; EMS).

There are currently opportunities for new researchers to join LEME, including students with strong backgrounds in any science to take up post-graduate scholarships.

More info: http://crcleme.org.au or ring Dr Bear McPhail on 6125 2776.

Ian Roach

What makes a landscape? A granite tor, a bloodwood in the background and a covering of aeolian dust. CRC LEME is working on better understanding it.

A volatile rock man

by Christine Denny

Professor Richard Arculus likes his magma fresh because the magma and its immediate environment will contain more evidence on where it came from and how it formed; and wet because much of the world's magma originates from submarine volcanoes.

Professor Arculus' research focuses on the volatile losses of magma from submarine volcanoes and the formation of oceanic plateaus, particularly around the southwestern Pacific region. This area is strewn with submarine volcanic rifts and cones, that are also rich in hydrothermal activity. And according to Professor Arculus, what we learn in these areas will provide the key to understanding how the world's largest metal ore bodies were formed.

Studying submarine volcanoes is challenging as it requires sampling from ships but the samples that are collected provide vital information. Glass is more commonly preserved in lavas that are quenched in water, and this material is essential for tracking the processes of magmatic evolution. In addition to this, volatile gases released by the magma are trapped in the surrounding water column. This can be sampled and analysed providing additional insights on the processes of changes accompanying the subduction of crustal materials.

Over the past few years, Professor Arculus and his colleagues have successfully recovered suites of young, glassy volcanic rocks and discovered newly active volcanic regions in the Solomons, Coriolis Troughs of Vanuatu, and Tonga.

Students under Professor Arculus' supervision could well find themselves aboard the *RV Southern Surveyor* as part of a research team in the south Pacific where he'll be located during June, September and November this year.

His land office, located in the Department of Earth and Marine Sciences within the Faculty of Science, is an explorer's dream, filled with maps of distant lands, colourful images and rock specimens from all over the world.

For more information contact: Richard.Arculus@anu.edu.au or Christine.Denny@anu.edu.au

Richard Arculus

Professor Arculus likes his magma fresh. Pictured here is the volcano Kavachi exploding. Kavachi is a 1500m high submarine volcano of the New Georgia Group (Solomon Is) whose summit was approximately 1m below sea level in May 2000.

The art and science of cappuccino foam

by Joanne Bright

After much soul searching I recently set up a new society: "Cappuccino Junkies Anonymous". I coined the phrase when I realised, upon spilling out over a thousand dollars on the best machine I could get my hands on, I had become seriously obsessed with the perfect cappuccino.

A cappuccino to most people is a relatively simple beverage: one third espresso, one third steamed milk and one third foam (with some flexibility on those numbers). For me a great cappuccino is a shot of good coffee and a cupful of foam - no mucking around here - no liquid, no clumps: ALL foam. So barring rushing off to look for the best barista we can find, how do we make the foam on a cappuccino and what differentiates between a bad foam, a good foam and a superlative foam?

Despite a convincing majority of coffee drinkers believing that a skinny cappuccino just doesn't cut it, science would say otherwise. While fat produces a more full-bodied beverage and more luxurious feel in our mouth, foam stability actually decreases with increasing fat content. It is minimal at around 5% and then increases again at higher levels (such as found in cream). The milk fat destabilizes the bubbles at the air-water interface and upsets the interfacial layer of milk protein.

Protein itself proves to be the key controlling factor in producing a good foam. The whey and casein proteins present in milk provide a viscous film that stabilizes foam by providing a protective layer around the bubbles. The polypeptide chains denature partially and as a result expose hydrophobic groups to the favourable medium of air and promote foam stability by maintaining resistance against compressive and shearing forces at the surface. In the absence of this layer the bubbles cause the foam to collapse.

Liquid milk fat possesses a lower surface tension than protein and hence is more likely to form protective film layers, however the film layers it produces are less stable and hence it has a negative influence on foam production.

It's the cows that have the final say on

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how frothy your milk can be - changes in feed, low nutrition and late lactation can all influence the properties of a cow's milk. In some cases hydrolysis of the milk fat can occur producing free fatty acids and glycerols that prevent foaming despite all efforts to maximise other foam-favouring factors.

In addition to fat content, there is also temperature to consider. Lactose is the milk sugar that imparts sweetness to milk. It is a disaccharide of glucose and galactose, and while less soluble than sucrose its solubility increases with temperature. For a good foam it is important not to go to overheat the milk. If the protein becomes overheated it denatures completely, precipitates out of solution and the milk won't foam (temperatures > ~ 140F). It is thus essential to perform the foaming phase of milk steaming before the milk becomes too hot (i.e. start with cold milk!). A good cappuccino machine can help at this point - the higher the velocity of the steam produced through the steam wand the greater the mixing action on the milk liquid.

Now that we have covered some of the science behind a good cappuccino foam I can offer my advice on achieving it.

✸ Chill your milk and use a large stainless steel vessel, about one third full, for foaming. Choose good beans and don't let the water overheat (produces a bitter taste in the finished coffee).

✸ Start your foaming near the surface of the milk and gently lower and raise your steam tip to produce small bubbles and fine foam.

✸ Lower the tip further into the milk to gently steam. Turn off the steam before the milk overheats (ca. 145F)!

✸ Repeat again. And again. And again (sounds like science after all…). And again. Keep going till you get it right.

(Reproduced from the RSC Staff News.)

The Gender-Water Network

by Tane Power

How will climate change affect women's lives? What are the impacts of privatisation of water services on women? How will women cope with floods and droughts in the developing countries of the Asia-Pacific region? These are some of the issues being considered by the Gender-Water Network, a new network established as a follow up to the very successful *Fluid Bonds* workshop in 2003. The network, like the workshop, is proudly supported by the National Institute for Environment.

The Gender-Water Network is coordinated by Dr Kuntala Lahiri-Dutt, Dr Sara Beavis, Dr Marjorie Sullivan and Dr Merrilyn Wasson. Projects currently being planned include:
- the development of a database of 'water and gender' professionals working in Australia and the Asia-Pacific region,
- the creation of a regular information circulation system,
- the organisation of a symposium for September 2004 as follow on from *Fluid Bonds*, and
- the establishment of contacts with government (ministers and officials) and civil society bodies working at international, national and local levels to sensitise them on gender-water issues.

The new network has already generated substantial enthusiasm on the theme of gender and water, and Dr Lahiri-Dutt has been invited to give presentations at the Commonwealth Department of Environment and Heritage and other government departments, and interviews on community radio.

Membership of the network is free and open to everyone. It includes academics, representatives from the government (AusAID, DFAT, DEG and ACIAR), NGOs and institutions such as Regional Women's Advisory Council (which advises the government on women's affairs) and UNIFEM, Australia. The network encourages Doctoral and Master's level students to join up.

The Gender-Water Network is based in the Resource Management in Asia Pacific Program at the Research School of Pacific and Asian Studies, ANU.

More info: Kuntala@coombs.anu.edu.au (ext 54343)

Engaging students from far and wide

By Christine Denny

These days recruiting students is a serious business and the Faculty of Science doesn't just wait for potential undergraduate students to come to it, it has a program in place which complements the University's Student Recruitment activities.

History has shown that students from rural Victoria show a healthy interest in pursuing a science education. This has prompted the Faculty to make sure ANU is showing its science credentials at Year 12 higher education information days in many areas of rural Victoria.

Ms Patricia Rennie is the Faculty's Marketing and Development Coordinator. She has had experience in engaging and interacting with students from all over Australia. On a recent road trip to the Victorian areas of Bendigo, Seymour and Alexandra the interest in science definitely outweighed other disciplines. The Faculty's Undergraduate Student Guide proved very popular, and students were very interested in finding out what ANU had to offer.

For more info on the Faculty's marketing activities contact: **Patricia.Rennie@anu.edu.au**

Victorian Year 12 students were very interested to find out what ANU has to offer in the way of science degrees.

Stroke - limiting the fallout

by David Salt

It's a killer, the third biggest in the Western world, and there's evidence to suggest it might be on the rise. The culprit is stroke, and the hunt is on for treatments that can minimise its impact.

"Over the years we've had some success in reducing the incidence of stroke through the more effective treatment of high blood pressure and reductions in smoking," says Dr Rosemary Martin, a neuroscientist in the School of Biochemistry and Molecular Biology and the Medical School. "High blood pressure and smoking are probably the greatest risk factors connected to stroke. Unfortunately, recent data suggests that the incidence of stroke is again on the rise, and the hunt is on for further treatments. One of the possibilities we and others are examining is the use of drugs to protect neurons from death following a stroke."

A stroke occurs when a blood vessel that carries oxygen and nutrients to the brain is either blocked by a clot or bursts. This starves surrounding brain cells (neurons) of blood and oxygen. These neurons begin to die causing brain damage, a loss of body function and, frequently, death. In Australia, stroke is a leading cause of disability. It affects about 40,000 people every year.

"At the moment treatment for people who suffer a stroke is limited," says Dr Martin. "In some cases it might be possible to use a clot-buster drug to speed up the removal of the clot that caused the stroke. However, it isn't appropriate for some stroke patients and may even increase the likelihood of a patient experiencing another stroke through a burst blood vessel."

So, the hunt is on for other ways of limiting the damage caused by strokes. The big focus at the moment is on neuroprotectants – drugs that save some neurons from dying following the stroke. While they won't save the neurons in the zone immediately around the damaged artery, it's been shown in preliminary research that they can reduce neuronal death further away from the damaged site, thereby alleviating the impact of the stroke.

"If we can do anything to limit neuronal death following a stroke," comments Dr Martin, "we could make a significant contribution to reducing the difficulties faced by stroke victims while alleviating the enormous burden that stroke places on the broader community."

Dr Rosemary Martin: "some drugs can protect neurons from death following a stroke."

David Salt

Dr Martin believes the anti-rejection drug cyclosporin A holds considerable promise. "Because it's had a long history of use in transplant operations, we know a lot about its side effects and how it's best administered.

"One area that we're working on is how cyclosporin A performs when the stroke victim has a high body temperature. This is often the case and it could impact on the efficacy of the drug. There's still a lot we have to learn."

Even if a neuroprotectant is released on the market, to be effective it will need to be given to the stroke victim within hours of the attack. So the best advice for a stroke victim will remain as it is today: if you think you've had a stroke, get to hospital as soon as you can.

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Internships in Earth Science

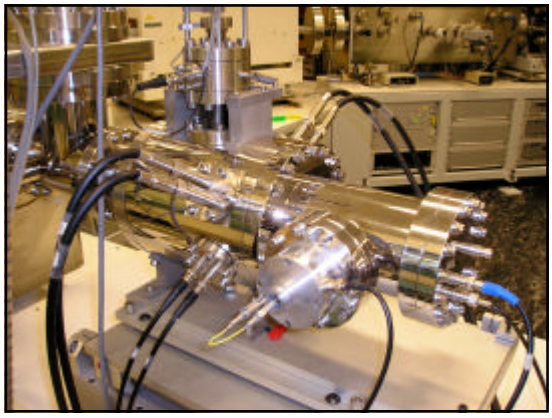
by Christine Denny

Are you interested in researching stardust separation, megafauna dating or analysing rocks that originated 100 km deep in the Earth? If the answer is yes and you're an undergraduate student then you should consider the 'Undergraduate Student Research Internships' run by the Research School of Earth Sciences. The Internships have been designed to broaden students' knowledge of various Earth Science disciplines while training with sophisticated equipment, computer technology and attending short courses and field trips.

As an intern, the visiting students are employed to work as research assistants in the School within a field that complements their current studies .

The Internships are held each summer and as RSES has accommodation on site, the students spend less time commuting and more time working with RSES's world class researchers and equipment. Internship projects on offer include the fields of Earth chemistry, Earth environment, Earth materials and Earth physics.

This exciting program is open to undergraduate students currently studying Earth Science related subjects who are Australian or New Zealand residents presently enrolled in university in their second year of study (or third year if undertaking a double degree program). Applications will be accepted at any time during the year.

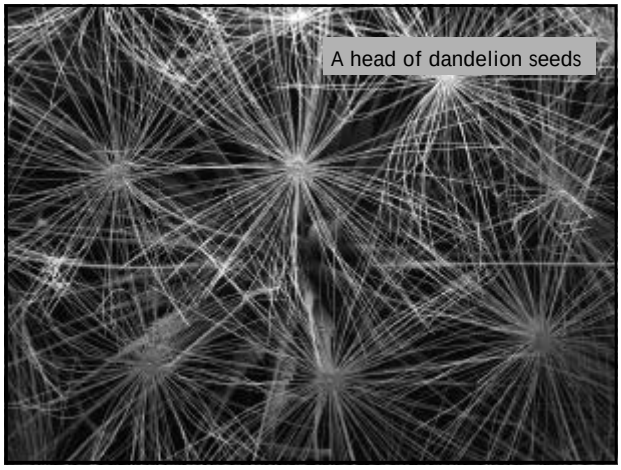


Student Interns are able to use the School's famous equipment such as the Sensitive High Resolution Ion Microprobe (SHRIMP)

More info:
http://rses.anu.edu.au/rses/Interns.html
or email
student.admin.rses@anu.edu.au

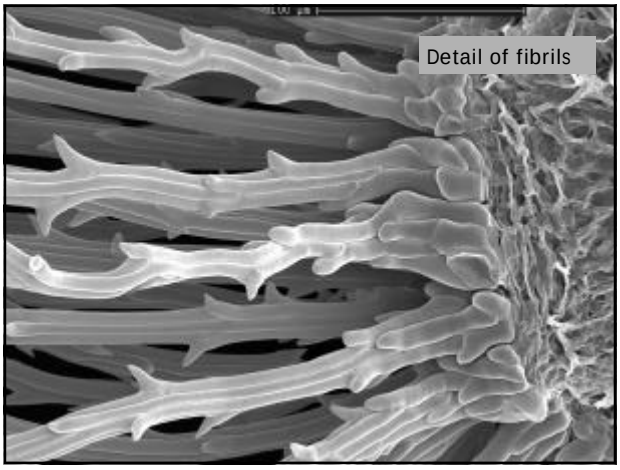
Blowing in the wind

Dandelion seeds ride the wind on a parachute of tiny hairs or fibrils. These three scanning electron images shown here were taken by Dr Roger Heady at the Electron Microscope Unit. Dr Heady would be interested in speaking with anyone who knows the function of the tiny barb-like outgrowths sticking out from the fibrils.

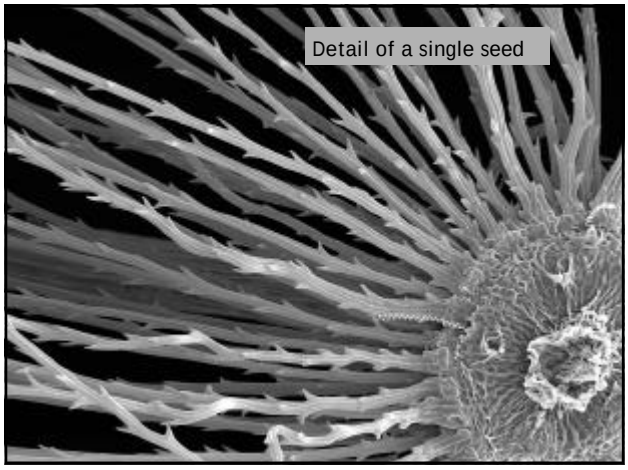


A head of dandelion seeds

"It's believed they provide a spinning action that gives more stability to the little wind rider," says Dr Heady. "But, no-one's quite sure." **More info: Roger.Heady@anu.edu.au**



Detail of fibrils



Detail of a single seed

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