Magazine of the ANU COLLEGE of SCIENCE
Volume III No. V

SCIENCE WISE

THE AUSTRALIAN NATIONAL UNIVERSITY

Integrating maths across campus

The Green legacy of John Banks
ITER – the biggest game in town
Probing superatoms

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Cover image:

Some of the minds at the Mathematical Sciences Institute (MSI). From the left are (back row) Professor Michael Barnsley, Professor Alan Carey (Dean of MSI), Professor Richard Brent, and Professor Sue Wilson. In the front row are Professor Rod Baxter and Professor Alan Welsh. (See page 3 for more details.)

Image by Tim Wetherell.

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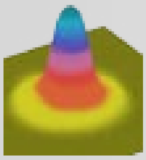

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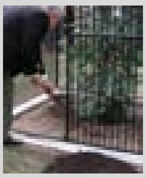

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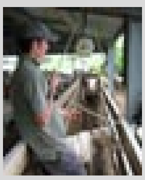

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Can native revegetation on farms benefit grazing sheep by providing forage?

SCIENCE WISE NEWS

NEW OPTICS FOR GEMINI

Earthbound astronomers are a step closer to capturing images of space that rival in detail and size those obtained with the orbiting Hubble Space Telescope, thanks to a new camera created at the Research School of Astronomy and Astrophysics (RSAA).

The Gemini South Adaptive Optics Imager (GSAOI) was designed and built by engineers at the RSAA. The multi-million dollar camera will be shipped to the eight metre diameter Gemini South telescope in Chile in October.

"Star light often looks blurred when we observe it here on Earth, because the rays of lights from these distant suns are affected by the dynamic turbulence in the Earth's atmosphere," says GSAOI project scientist Dr Peter McGregor. "As a result, a large telescope magnifies the blurring, so stars appear like indistinct blobs."

The Gemini Observatory has a major program underway to develop a wide-field adaptive optics system that will correct this blur. GSAOI is the near-infrared camera that will work with the Gemini system to record these images.

Adaptive optics is commonly used on the world's largest telescopes, such as the twin Gemini telescope to which Australian astronomers have access. Previously it has been possible to produce extremely sharp images over only a small area of the sky, but MCAO will do this over a larger region.

"RSAA leads the world in developing sophisticated near-infrared detector systems for astronomy," says GSAOI Project Manager Dr Matt Doolan. "GSAOI uses a mosaic of four detectors that were designed originally for the Next Generation Space Telescope."

Professor Kiaran Kirk (left) with Dr Kevin Saliba

MALARIA'S TASTE FOR SALT

New research on how the malaria parasite survives inside the cells of humans could lead to better treatment for the worldwide disease. A team based at the School of Biochemistry and Molecular Biology (BaMBi) revealed why the malaria parasite - Plasmodium falciparum - increases the sodium, or salt, content inside its host's red blood cells.

"Once they've infiltrated their human host, malaria parasites hide inside the red blood cells to avoid being detected by the immune system," explained Dr Kevin Saliba.

"Scientists have known for some time that once inside the red blood cell, the parasite alters the balance of ions in their host cell, increasing the amount of sodium. Until now it has not been clear whether this is something that is actually important for the parasite. What we've shown is that the increased sodium plays a crucial role in the mechanism by which the parasite takes up a key nutrient", Dr Saliba said.

Dr Rowena Martin, another member of the BaMBi team, described how they have discovered a protein that enables the parasite to exploit the increased sodium levels inside the red blood cell, using the sodium to fuel the uptake of phosphate, a substance required by the parasite for a whole range of biochemical processes.

"This research has revealed yet again just how cunning this parasite is. It manipulates the salt content of its host blood cell and then uses what is essentially a salt-powered vacuum cleaner to steal a key nutrient from its host," BaMBi head Professor Kiaran Kirk said. "If we could block this system we could starve the parasite to death, and this could well be the basis for a new antimalarial therapy," Professor Kirk said.

EUREKA - INFO BREAKTHROUGH

The $10,000 Eureka Prize for Scientific Research was recently given to the team based at the ANU Department of Physics for its quantum cryptography breakthrough, which uses light to convey data that is impervious to hackers and eavesdroppers.

The technology developed at ANU in collaboration with the University of Queensland enables two parties, a sender and a receiver, to generate a secret electronic key. This key can be used by the sender to encrypt a message that only the receiver with the matching key can decrypt.

"Where traditional cryptography is based on complex mathematics, we use instead the laws of physics to guarantee communication security," explains team leader Dr Ping Koy Lam. Dr Lam also won a Eureka Prize in 2003 for his activities on teleportation research.

The ability to guarantee information security would be of great benefit to government and the corporate sector. The researchers are currently collaborating with the Department of Defence, as well as working towards the commercialisation of their technology for other clients.

"Although several groups around the world have quantum cryptographic technology, our group was one of the first in the world to demonstrate the transmission of a completely secret key via bright laser beams and common optics," said Dr Thomas Symul.

Other researchers involved in the breakthrough include PhD candidate Andrew Lance from ANU, and Professor Timothy Ralph and PhD candidate Christian Weedbrook from the University of Queensland.

Dr Ping Koy Lam

Integrating maths across ANU

by David Salt

Mathematics may not make the world go around but it's one of the best ways to truly understand why and how it happens. That's because mathematics is the study of universal patterns and structures; it's the quantitative language of the world and underpins the whole spectrum of science and technology.

"Mathematical ideas underlie much of the language we use to talk about science," says Professor Alan Carey, Dean of the ANU Mathematical Sciences Institute (MSI). "Mathematics is the unifying language. In some areas, things can't be described in any other terms. Quantum mechanics, for example, is the science of how matter behaves over very small distances, and you can only relate to it in mathematical terms. There are no verbal pictures; you can't even draw things on the board to show how things work at this level. Only mathematics allows an understanding."

And if mathematics is the unifying language of science, then the Mathematical Sciences Institute is the unifying force for mathematics at ANU. In many ways it's also a shining example of what's possible when a serious effort is made to integrate the university's strengths in research and teaching, something that the ANU College of Science is working hard to achieve.

Some of the mathematical minds at the MSI. In the back row, from the left, are Professor Michael Barnsley (author of *SuperFractals*), Professor Alan Carey (Dean of MSI), Professor Richard Brent (Federation Fellow), and Professor Sue Wilson (Co-Director, Centre for Bioinformation Science, and coordinator of the Network for Applications of Mathematics and Statistics – NAMS). In the front row are Professor Rod Baxter (winner of the prestigous 2006 Onsager Prize and Onsager Medal) and Professor Alan Welsh (one of MSI's leading statisticians). The occasion that drew them together for this picture was an address by Professor Brent for NAMS on 'Pitfalls in Computation' in which he outlined the many ways computers can produce wrong answers and in so doing can sometimes cost lives and hundreds of millions of dollar.

"The Mathematical Sciences Institute is a combination of the Science Faculty's teaching department and the Centre for Mathematics and its Applications," says Professor Carey. "The Centre is the Institute component and it was formed by amalgamating various parts of the mathematically-interested groups from the Institute schools.

"There were many reasons behind this reorganisation. There was dissatisfaction with the separation of mathematics research, which was based in the RSPSE building over by the lake, and the teaching department which was across in the Hanna Neumann Building. Because of that there was a lot of traffic backwards and forwards across campus, and people didn't collaborate very much.

"Then we got an ARC Centre of Excellence called the Centre for Mathematical Analysis and that created a lot of activity on the faculty side of campus. So because of all this interaction and the physical distance between these areas it made a lot of sense to co-locate. Once this happened it made sense to start thinking about a unified structure and this is what happened under the then Dean of Science, Michael Barber, together with Neil Trudinger. And so the Mathematical Sciences Institute was created.

"And it's worked very well, we've been very successful. Though it has to be said that it wasn't so easy in the beginning. It took a few years to sort out the details of how it would function because it was a bit tricky cutting across the boundaries between the schools and the Faculty. However, over the years we've managed to make it work quite seamlessly."

The ANU College of Science, like the Mathematical Sciences Institute, is also attempting to open up new opportunities and create new synergies through a greater integration of the university's teaching and research strengths. In addition to being the Dean of MSI, Professor Carey is also in charge of increasing enrolments of higher degree research students in the College of Science. His experience with the MSI suggests that the new college structure will enhance the University's existing strengths.

"I think the benefits for higher degree research students are pretty obvious because by combining staff from both faculties and institute you open up a whole lot of extra possibilities for supervision. There are also collaborations that will occur as a result of those interactions that will push us into new research areas. We're probably not exploiting them to the best of our capacity at the moment by not being integrated. For example, it's not uncommon for a supervisor to turn down somebody because they have too many students, but under the new college structure it should be possible to come up with co-supervision arrangements.

"The new staff that would come with this greater integration will play an important role in creating new collaborations. As you hire new staff, especially if you make joint appointments, then those new people start making links that wouldn't otherwise occur. That's certainly been the situation for the MSI."

And when Professor Carey talks about collaboration he knows what he's talking about. One of the roles that the MSI was set up to undertake was one of facilitating collaboration with mathematical researchers from around the nation.

"The old ARC Centre of Excellence had a focus of national and international collaboration and it's a role that MSI still carries out," explains Professor Carey. "That's something that makes us quite different to the other mathematics departments from around the country. We have between 100 to 200 national and international collaborators visiting us each year, many of whom come here on their own money. They make the effort because it's a good atmosphere here, a good place to work with people. MSI combines that with a high-level undergraduate program making ANU a fairly special place for mathematical research and teaching. And it wouldn't be possible without combining the Institute with the Faculties. And I'm hoping that is where things will go with the College of Science.

"Also, another big advantage for the mathematical sciences in co-locating was that the Department of Mathematics could have access to much better computing facilities because forming part of a larger group it's more cost effective to do things together. I imagine that's going to be true for other areas at the university as well. The co- location will save both money and provide improved facilities, though it's not going to happen overnight."

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Superfractals

It's something of a first – a serious mathematics book, lavishly printed in full colour with many beautiful illustrations. It's titled *SuperFractals* and has been created by Professor Michael Barnsley from MSI.

Superfractals can be read on two levels, either intuitively or very carefully. Its intended audience is all mathematical scientists, biologists, engineers, computer scientists and physicists. The only necessary background is basic calculus.

SuperFractals is the long awaited successor to *Fractals Everywhere*, in which the power and beauty of Iterated Function Systems (IFS) were introduced and applied to produce startling and original images that reflect complex structures found in nature. This provoked the question of whether there is a deeper connection between topology, geometry, IFS and codes on the one hand and biology, DNA and protein development on the other.

In *SuperFractals*, Professor Barnsley sets out new ideas such as fractal tops and superIFS. The classical deterministic approach is combined with probabilistic ideas to produce new mathematics and algorithms with applications in computer graphics, bioinformatics, economics, signal processing and beyond.

SuperFractals has just been published by Cambridge University Press in Australia.

These pictures illustrate a newly discovered type of geometrical object called a "fractal top". A fractal top contains detailed information about its surface which may be rough and broken at all scales, yet possesses a certain continuity. A fractal top is remarkable because it may possess limitless visual complexity, be described and controlled using a very small amount of data, and computed with the aid of a chaotic dynamical system.

Real-time animated fractal tops can be extraordinarily beautiful and have potential applications in animated movies where they can create an original look and feel. Fractal tops also have applications for image compression and biological modelling. They can even be combined with superfractal technology to provide proprietary products for cell-phones.

ITER – the biggest game in town

by David Salt

The fusion process that underpins fusion energy (the reaction of deuterium and tritium, isotopes of hydrogen) was discovered by an Australian, Sir Mark Oliphant, in 1932. Sir Mark Oliphant founded fusion plasma research at the Australian National University in the early 1950s. Indeed, the present-day centrepiece of the Australian effort is the H-1 Major National Research Facility, established by the Commonwealth Government and The Australian National University.

Dr Boyd Blackwell is the Director of the H-1 National Plasma Fusion Research Facility. He is seen here standing in front of the H1 experiment. It's a helical magnetic confinement experiment, designed to explore magnetic confinement geometries, and provide a test bed for fundamental plasma research. (Photo by Tim Wetherell)

Australia's stake in one of this planet's biggest and boldest research projects was the topic of discussion at a workshop in Sydney this October. The project is called ITER, which means 'the way', and is an international collaboration to build the first fusion science experiment capable of producing a self-sustaining fusion reaction. In continuous operation, ITER will explore the "burning plasma" regime, where the power gain is a factor of 5-10, and total power output is 500 MW. The experimental facility itself will be constructed in Cadarache, in the South of France. In harnessing fusion – the energy source of the Sun – ITER may solve our future energy needs. Fusion is thought to be the foundation of an ideal energy mix, providing base-load energy supply, which will be complemented by renewable energy generation schemes.

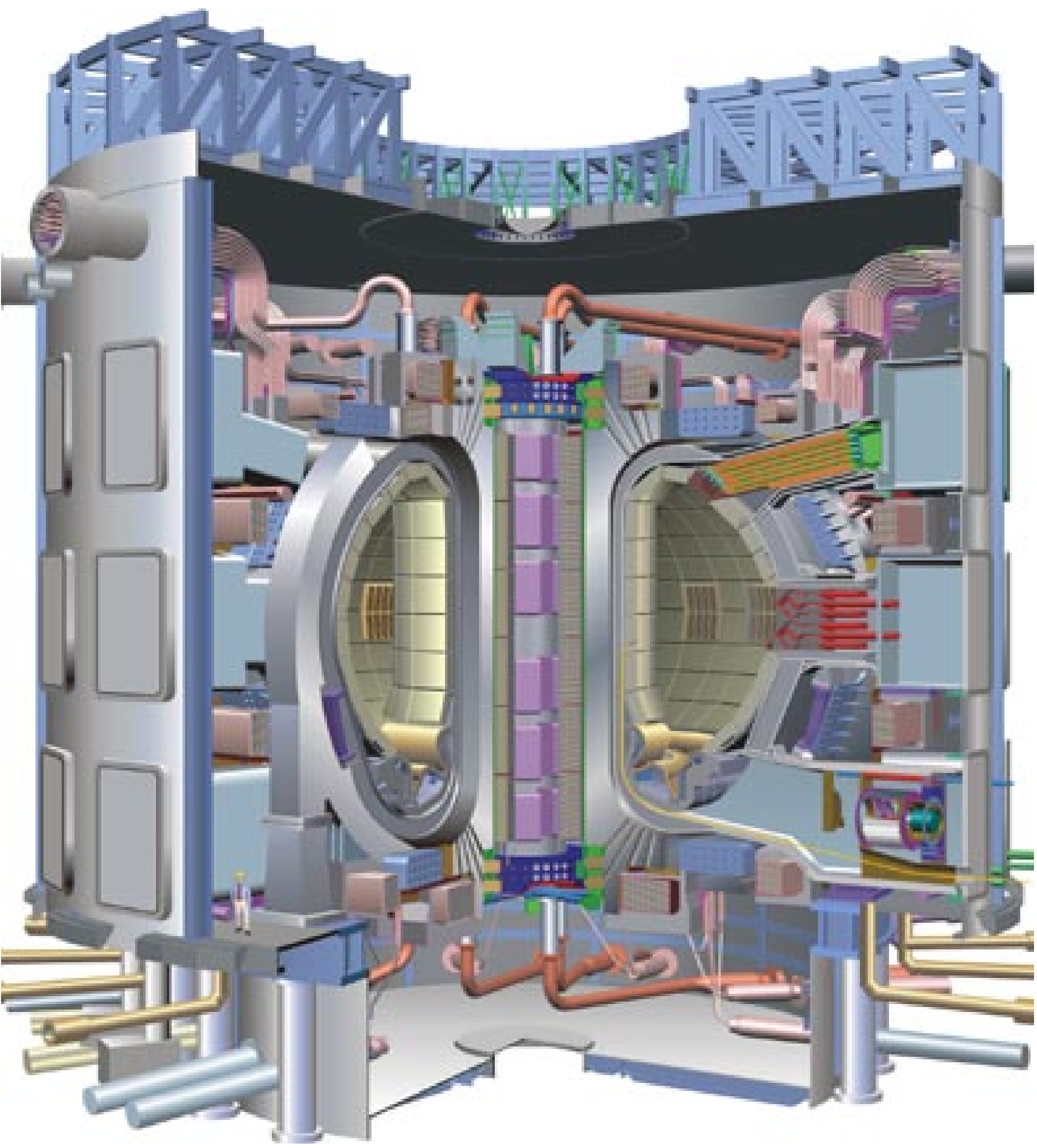
Every way you look at ITER, it's huge. It will cost around $US10 billion (making it the world's single biggest experiment), run over several decades and involve the world's heaviest hitters. Already involved are the European Union, Japan, the Russian Federation, the United States of America, the People's Republic of China, the Republic of Korea and India. As a smaller nation, what could Australia possibly offer and why should we be involved?

Dr Matthew Hole, Chair of the the ITER Australian Forum: "ITER really should be something Australia takes on as a national science priority." (Photo by Tim Wetherell)

"Australia has a lot to offer," says Dr Matthew Hole, a theoretical physicist based at the Research School of Physical Sciences and Engineering. "Australia has had a sustained presence in the area of fusion research for some time, and has had a disproportionate impact in the international fusion community given the nation's size. Maybe this is not so surprising when you remember that it was an Australian, Sir Mark Oliphant, who first discovered fusion back in 1932."

Dr Hole has worked on a variety of fusion related issues over recent years, and for most of the last two years he has served as the Chair of the ITER Australian Forum.

"Despite Australia's founding role in fusion science, Australia is not presently a part of the ITER partnership," says Dr Hole. "That's why a group of likeminded scientists and engineers from around the country have set up the Australian ITER Forum with the objective of advancing fusion science, and securing a role for Australia in the ITER project. The group includes scientists from Sydney



Fusion energy powers the sun and the stars, but it is yet to be tapped by humans. Countries representing over half the world's population plan to construct and operate a large experimental device, ITER (Latin for 'the way'), to demonstrate the feasibility of fusion energy for peaceful purposes. Pictured above is a schematic of ITER experimental device.

Fusion is a process by which two nuclei literally fuse together, and in doing so release considerable energy. Achieving this requires high temperatures such as those that drive the fusion processes which power the Sun. By using magnetic confinement devices it is possible recreate similar conditions on Earth, which are sufficient to generate many fusion reactions, producing energy which may be harnessed to produce large amounts of electrical power. As there are no long-lived hazardous by-products and a plentiful supply of almost universally accessible fuel, fusion power has the potential to produce virtually limitless amounts of power in an environmentally friendly and economically viable way.

University, ANU, Flinders University, the University of Canberra, the University of Newcastle, the University of Wollongong, Murdoch University, the Australian Nuclear Science and Technology Organisation, and the Australian Institute for Nuclear Science and Engineering.

"One of the factors that has accelerated the need for fusion energy is climate change. ITER offers a pathway to sustaining our standard of living without completely destroying our environment.

"We're arguing that given the importance of this project, given its international size and status, it really should be something Australia takes on as a national science priority."

While Dr Hole believes the stakes are enormous, he cautions that the road to fusion energy as a power supply is many decades away - even if things go well.

"Even if construction starts at the end of this year, it will take 10 years to build the experimental fusion device," he says. "It won't be producing fusion plasmas till 2016, and this will be followed by 10-15 years of research on the plasma itself.

"In parallel to this will be the development of some form of materials testing facility to test the very high heat flux and neutron flux walls that future fusion power plants will need. In the fast track program, it's envisaged that a demonstration power plant will built in 2030, paving the way for commercial power plants by the middle of this century. Given the urgency of climate change there's a real impetus to accelerate fusion energy development.

Dr Hole believes that not only is ITER vital for the world's future, it's also critical that Australia become fully immersed in the international program, of which ITER is the flagship, if fusion science is to survive in Australia. He says our strength in fusion research has been steadily waning over the past decade.

"Australia currently has expertise and resources in areas that ITER will need," says Dr Hole. "However, there is a real danger that unless something is done fairly shortly to provide opportunity for growth of fusion science in Australia that we will lose the capability to undertake any form of fusion research.

"ITER represents a fantastic opportunity for this to happen. It also represents a golden opportunity for Australian industry. Of the $US10 billion dollars being invested in ITER, four fifths of this will go directly to industry, and there's a possibility that Australia might get a slice of that. But we need to get aboard now. Once the construction phase is locked in then there will be an 8-10 year hiatus during which the facility will be built."

In October, the ITER Australian Forum ran a workshop in Sydney titled 'Towards an Australian involvement in ITER'. "The workshop was opened by the Chief Scientist of Australia, Dr Jim Peacock. It scoped a possible role of Australia in the ITER project," explains Dr Hole. "Present were senior representatives from ITER together with Australian researchers, representatives from industry and government.

"The workshop in Sydney could be critical to Australia's future in fusion science and industry. We had the top ITER negotiators at the same table with government representatives. The aim was to bring all the stakeholders to the table and scope the possibilities. There's a lot riding on the outcome."

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Probing superatoms

by Tim Wetherell

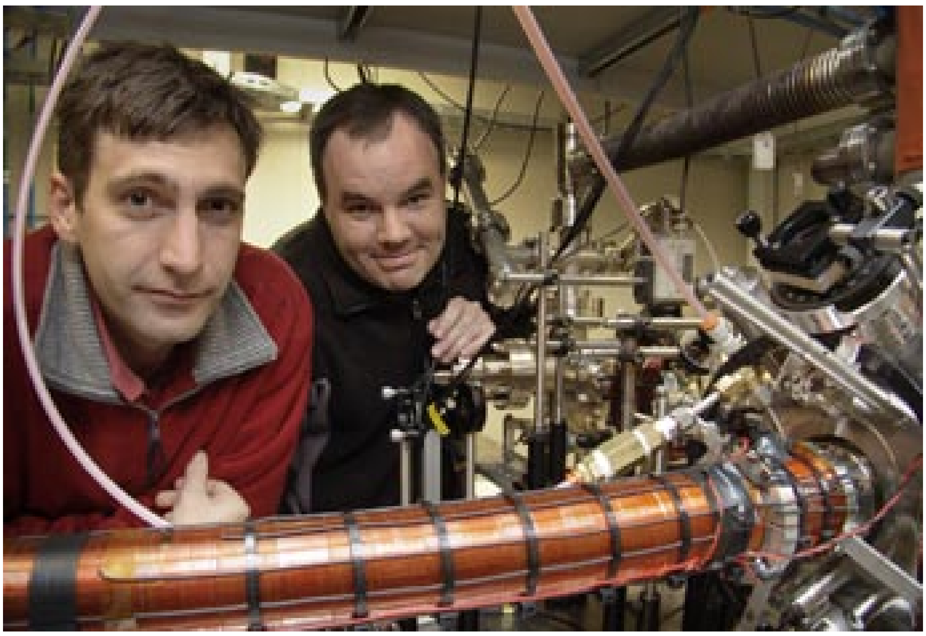
We are used to new technology such as lasers appearing on the market quite suddenly and seemingly from nowhere. However, in reality, the science that underpins such devices has often been developed slowly over many decades. Back in the 1960s the first lasers were exotic devices from the realms of theoretical physics that had seemingly little practical application. Today they form the backbone of telecommunications and data storage and have thousands of other uses in devices that would have been once unimaginable.

Another conceptually new technology only just now making its debut is that of the Bose Einstein condensate (BEC). Originally proposed by Satyendra Nath Bose and Albert Einstein way back in the 1920s, it wasn't until seventy years later that scientists were able to actually create the world's first Bose Einstein-Condensate in the laboratory.

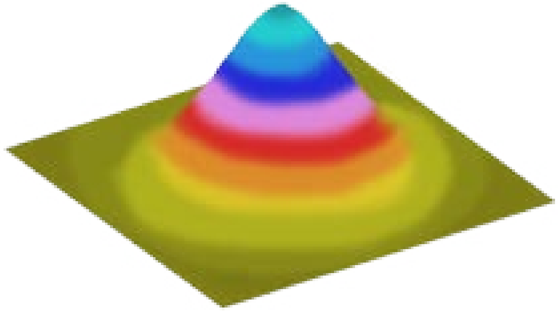
Essentially the theory is that if you make a cloud of gas atoms cold enough, they will slow down to the point that they all begin to occupy the same quantum state. This means that the atoms become identical in the same way individual photons in a laser beam become identical. Collectively, the atoms in the condensate form an entirely new phase of matter not found naturally anywhere in the universe. Even the coldest depths of space are a billion times too hot for a BEC to exist.

When we try to imagine atoms, most of us recall the billiard ball diagrams of old textbooks, a little red lumpy nucleus with blue electron balls spinning round them. However, this is not a very accurate visual picture of the universe at the quantum level. It would be closer to the truth to imagine the particles as little clouds of fog, which were very hard to pinpoint to any precise location in space. The theoretical physics of BECs is very complex but essentially a BEC forms when many atoms condense into a single bigger quantum fog. They loose their individual identity in the same way raindrops falling into a bucket do. They become a sort of super raindrop, and in the same way, scientists sometimes refer to the BEC as a superatom - an indistinguishable amalgam of many atoms.

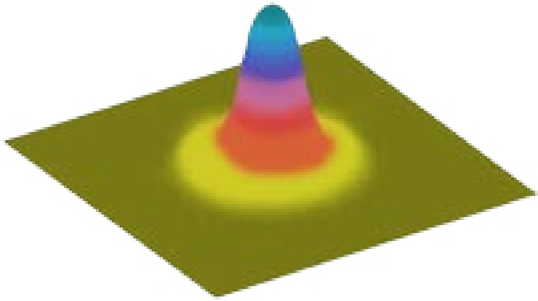
These superatoms have many strange properties that promise future technologies beyond anything we could currently imagine. However, in order unlock their technological potential, scientists need to better understand BECs and especially the process of their formation. Studying the formation process in conventional ground state alkali atom BECs is complicated by the inability to make measurements on individual constituent atoms. Measurements on such systems are limited to averaging over the quantum ensemble.



Researchers Dr Robert Dall (left) with Dr Andrew Truscott with the magnetic gradient coils used to slow atoms en-route to the BEC trap (right).



The spatial distribution of atoms during the formation of a BEC. As the cloud cools it forms a single quantum superatom (lower image).



To get around this, scientists at ANU have recently become one of only four groups in the world to achieve a BEC of metastable helium atoms. This particular atomic configuration of helium has vastly more energy than the ground state and is sufficiently long lived to allow experiments to be performed. The special thing about these metastable excited atoms is that even though they are almost stationary and thus very cold, inside them, stored in the configuration of their metastable state, is a billion billion times as much energy as the same atom would have in its ground state. The practical upshot of this is that when such an atom contacts a metal probe it releases its energy and creates an electron, which can be detected by sensitive electronics. In this way atoms can be detected individually and since atoms in a BEC cloud are all quantum identical, probing one yields a perfect snapshot of the others. The ANU team is hopeful that this newly functioning BEC apparatus will yield vital clues to the mechanism of BEC formation.

The history of physics is full of examples of strange and exotic phenomena that having been developed out of pure curiosity have gone on to spawn unimaginable technological advances. Lasers, X-rays, and transistors all belong to this family and BECs may well be its newest member.

(This research is funded by the ARC Centre of Excellence for Quantum Atom Optics)

More info: www.acqao.org/

Historic earth science excursion

by David Salt

In September a group of earth science students from The University of Tokyo were given a geological tour of a lifetime. They were shown internationally renowned fossil sites around Canberra, given tours over the earth science facilities at ANU (many of which are rated as the best in the world), taken on fossil hunting expeditions during a stay at the university's beautiful Kioloa coastal campus and tutored by some of our finest palaeontologists.

The visit was coordinated by Dr Yusuke Yokoyama from Tokyo University and Professor Patrick De Deckker from the ANU Department of Earth and Marine Sciences. While it was special for the quality of the experience, it was also unique in being the first product of the Global Universities Partnership which ANU signed up to at the end of last year.

The Global Universities Partnership is an agreement between an international group of research-intensive universities that share similar values, a global vision and a commitment to educating future world leaders. The partnership opens up new opportunities for research, teaching and learning through collaboration, exchange and cooperation at all levels of operation. Universities that have signed up to the agreement include The Australian National University; The University of Tokyo; ETH Zurich; National University of Singapore; Peking University; University of California, Berkeley; University of Copenhagen; and Yale University.

"This is indeed a historic occasion," said Professor Tim Brown, Dean of the College of Science, when he welcomed the visiting Japanese students. "You are the first group of students to visit ANU under the Global Universities Partnership. I'm sure you're going to enjoy yourselves and I know you're going to see some amazing things."

Professor Ken Campbell shows the students some rare and fragile Australian fossil fish kept at ANU.

Dr Yokoyama from Tokyo University is no stranger to ANU. He carried out research for his PhD at the Research School of Earth Science working with Professor Kurt Lambeck on climate change and variations in sea level over geological time in the Australasian area. He's hopeful that this excursion will be the first of many, and that ANU students will also participate in the cultural exchange by making reciprocal visits to Japan.

The group from the University of Tokyo pose with staff and students from ANU at Pointer Gap on the South Coast.

"Overall, the visit was a great success and I think they had a fantastic time," says Professor De Deckker. "While at ANU they were shown over the university's extensive earth science research facilities and lectured by some of our leading geologists.

"We also showed them some world-class fossil sites around Canberra and down at the coast. This included sites near Yass showing evidence of a shallow reef system from the Devonian when this part of Australia was located in the subtropics. Renowned ANU palaeontologists Ken Campbell and Dick Barwick showed them the original fish fossils collected from these sites.

"Down on the south coast we stayed at the ANU Kioloa campus and spent two days examining evidence of a "cool Earth" system when Australia was located closer to the south pole during the Permian.

"And, as a result of this experience the Japanese academics who organised this group want to formalise an agreement for further exchange between our respective institutions. They look forward to taking our students out into the field in Japan. While they may not have extensive Devonian fossil sites to share with us, they do have a range of volcanic rocks the likes of which aren't available in Australia.

Dr Yusuke Yokoyama from the University of Tokyo organised the tour from the Japanese end. He's pictured here with a fossilised coral, part of the subject matter he researched when he studied at ANU for his PhD.

"We're already planning their next trip out to Australia. We think that might include a tour of the Flinders Ranges and the Great Ocean Road."

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Professor Patrick De Deckker explains how rocks formed in the cold Permian sea.

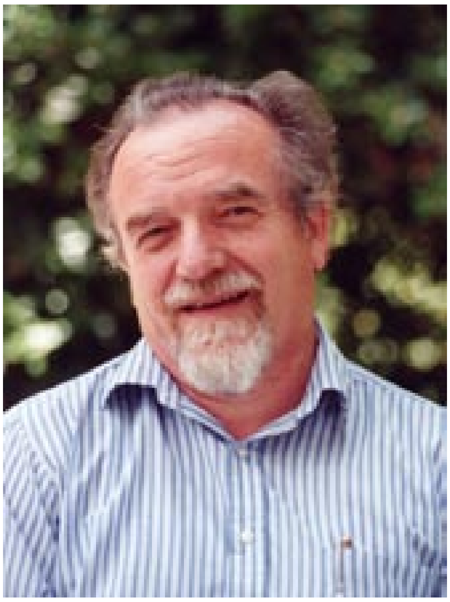
A green legacy

by David Salt

Two years ago one of the university's best loved and longest serving forestry lecturers died suddenly following a short illness. Dr John Banks had served The Australian National University for 35 years, and was well known for his work on the classification of trees and his active promotion of urban trees and treescapes. While the man is gone you can still enjoy a part of his rich legacy by taking a leisurely stroll around the Forestry Building, home to the School of Resources, Environment and Society (SRES). In the courtyard next to the building, now named in honour of Dr Banks, and the surrounding pathways you'll find a greater concentration of strange and wonderful trees than are to be found anywhere else on campus.

The pathway next to the Forestry Building is part of the Linday Pryor Walk. It was created in honour of Professor Lindsay Pryor, one of the botanical fathers of Canberra's urban forest and a long time friend and collaborator of Dr Banks. The walk celebrates Professor Pryor's life by winding its way past 20 different species of tree selected by Dr Banks. A stroll along this path will take you past a wonderful assortment of specimens including a lace-bark pine, a Chilean soap tree, a willow oak and a Nepalese alder.

The John Banks Courtyard also contains a diverse range of trees selected by Dr Banks for both their beauty and their teaching value. Among them you'll find specimens of the maidenhair tree, the Norway maple and the Himalayan alder. But possibly the strangest and most striking specimen you'll find in the courtyard was not selected by Dr Banks but bears his name. It's a specimen of Wollemi pine, one of the famous dinosaur pines discovered in Wollemi National Park in 1994, and this one is called John Banks.



Dr John Banks left ANU a rich legacy of trees.

Vice-Chancellor Ian Chubb with Margaret and Lynette Banks, Dr Banks' wife and daughter, at the World Forestry Day planting of the John Banks Wollemi Pine (in the protective cage behind them). The planting marks another wonderful addition to a diverse range of trees to be found in the John Banks Courtyard.

Dr Banks' connection with the pine relates to his research work in the area of dendrochronology, the use of tree ring data to age trees and interpret historical patterns of growth in trees and forests. One of the species he worked on in the year before his death was the Wollemi pine. His work helped age the group of trees discovered in the wild. His contribution was valued by the businesses propagating the species, and hence one of the parent trees from which plants were propagated was named after Dr Banks. As an interesting aside, another one of the parent trees was named after the botanical father of the nation – Sir Joseph Banks, who just happens to be a kinsman of Dr John Banks.

And how did a specimen named John Banks end up in the John Banks Courtyard?

"It was the idea of Mr Andrew Carter, one of Dr Banks' former forestry students," explains Professor Peter Kanowski, Head of SRES. "Andrew thought an appropriate way of honouring John would be to purchase one of the first Wollemi pines being auctioned at Sotheby's last October. With money donated by a wide range of former colleagues and students, Andrew acted as our agent there.

"There were a number of trees from the original "John Banks" parent in the auction, and bidding was fierce; but we were successful in securing an excellent specimen. Vice Chancellor Ian Chubb and Margaret Banks, John's wife, formally planted the tree in the John Banks Courtyard earlier this year on World Forestry Day.

"It seems to all of us that to have this special tree, which evokes John's memory in a number of ways, planted in the courtyard that bears his name adjacent to the building in which he spent most of his professional life, is very fitting, and a great legacy – not just in John's memory, but as a contributor to the beauty and interest of the campus, and to assist student learning, as John would have wished. It's also appropriate that the planting took place on World Forest Day, a date that recognises the contribution that forests and forestry make to environment and society."

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Wattles, wethers and weight gain

by Sue Streatfield, Graham Fifield and John Field

Loss of biodiversity and increasing land degradation has prompted many land managers in south east NSW to undertake broad-scale direct seeding of native trees and shrubs. It is known that sheep benefit from native revegetation through shade and shelter, and that those with access will feed on acacia foliage and pods (referred to as acacia browse). What we don't know is whether this seasonal foraging makes for healthier, fatter sheep.

It was this uncertainty that led Greening Australia (Australian Capital Region) to ANU in search of a student willing to take up an investigation that might provide an answer. Enter Graham Fifield, an Honours student from the School of Resources, Environment and Society (SRES). With the assistance of Dr John Field from SRES, Mr Fifield set up three separate field trials at Binalong, Boorowa and Ginninderra that examined changes in sheep weight on traditional pasture paddocks versus revegetated paddocks. In so doing he soon found himself driving across remote paddocks; fencing, wrestling and weighing sheep; pruning wattles and even getting bogged.

Deep-rooted acacias have the advantage of being less susceptible to seasonal climatic variations than traditional pasture plants. These pasture plants may contain as little as 8% protein at maturity whereas acacia browse commonly contains between 10% and 20%. Unfortunately, it also contains high levels of tannin, which limits the digestion of protein by sheep. Animal trials undertaken by other researchers have shown that 44-69% of foliage and seed pods are typically digested by sheep.

Graham Fifield weighing sheep at the Binalong Farm

Paddocks in the Binalong trial that have been direct seeded during rehabilitation.

Using acacia browse as a protein supplement to complement low quality pasture is a relatively new avenue of research. A small number of studies have shown that acacia browse can improve the performance of sheep relative to those without the supplement. The protein in the browse improves the digestion of poor quality roughage and stimulates intake.

At one of his main sites at Binalong, both pasture and 'acacia' sheep displayed similar growth rates during the spring months, suggesting that pasture growth and availability were not limiting to animal growth during this time and that acacia browse had a negligible impact. During the summer months, both groups also displayed similar growth rates per unit area (though the experiment was run in a time of above average rainfall and this might not apply in a more typical year).

Interestingly, during this trial, two sheep from the pasture paddock became ill due to parasite infestation, while no sheep in the acacia paddock displayed these symptoms. After the trial, 13 sheep from the pasture paddock died from Barber Pole worm. Sheep in the acacia paddock displayed some symptoms of illness, however none were fatally affected. This experience suggests that sheep with access to acacia browse are less susceptible to illness or death due to internal parasites. This is supported by laboratory and animal trials in the literature, which indicate that condensed tannins, such as those contained within acacia browse, reduce the number of viable parasite larvae in sheep.

An important finding of the study was that previously saline degraded land, rehabilitated through direct seeding, is equally productive as non degraded pasture land during an above average spring/summer rainfall period. The observed pasture loss due to shading and competition from trees did not reduce the relative productivity of sheep in treed paddocks. Losses in pasture production may have been offset by the provision of seed pods, which sheep were observed consuming, or through the beneficial affects of improved shade and shelter. The quantity of dried acacia pods that fell as litter at one study site (2.6-4.0kg/day/ha) suggest that they may constitute a valuable addition to the diet of sheep during the summer and autumn months.

This research supports the conclusion that the forage from local acacia species is palatable, sought after and not toxic to Merino sheep. In addition to this, sheep with access to acacia browse were less vulnerable to internal parasites. Anecdotal evidence of land managers support the notion that sheep consuming supplementary acacia browse will display greater production compared to those consuming poor quality pasture alone. All of which adds to the growing pool of evidence that rehabilitating the land benefits both the environment and productivity.

The project was also a good example of research collaboration. In addition to inputs from ANU and Greening Australia, significant assistance was provided by CSIRO Plant Industry in the form of access to land, livestock and labour.

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