2010 Stories of Australian Science

science stories

NCE 2010...STORIES OF AUSTRALIAN SCIENCE 2010...STORIE

contents

welcome

We've put together this publication to give journalists and others with an interest in science a taste of what's happening Down Under.

Welcome to Stories of Australian Science 2010.

Meeting science journalists and television producers around the world we've discovered they have a healthy appetite for Australian science, and Australian wine.

For this collection we invited Australian research organisations to contribute snapshots of some of their current research. The stories illustrate the breadth and depth of Australian science.

You'll read about:

> the astronomy inside the world's Wi-Fi computers and networks

> the benefits of an imaginary friend

> how bacteria from kangaroos are fighting cancer

> breast restoration using your own stem cells

> a milk protein that encourages exercise

> the hidden clock in a grain of sand

> understanding what happened on Black Saturday.

Among the other fifty stories you'll meet the winners of this year's Prime Minister's Prizes for Science, learn about plans for a giant radio telescope and more.

This is our second collection of Australian science stories. The first was put together in 2007 when journalists met in Melbourne for the 5th World Conference of Science Journalists. In December 2009 Melbourne hosts the World Congress of Science and Factual Producers. We welcome you to Melbourne.

In my introduction I mentioned wine. We are keen to get your feedback on this publication. In return I have six bottles of fine Australian shiraz waiting. Each month from December 2009 to May 2010 I'll choose one person from the mailbox and send them a bottle. And you can read about the wines of the future on page 28.

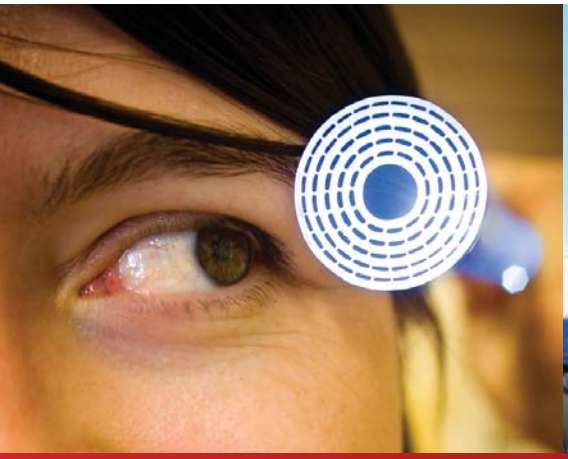
Send me your comments at niall@scienceinpublic.com.au We'll also provide updates and links online at www.scienceinpublic.com.au/stories

If you'd like to receive occasional bulletins about Australian science please also let me know at niall@scienceinpublic.com.au or sign up online.

I invite you to read these stories and to follow up with any organisation whose work captures your interest.

And look out for our next collection of stories—it will focus on Australian astronomy and will be published in April 2010.

Niall Byrne
December 2009



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SCIENCE IN PUBLIC

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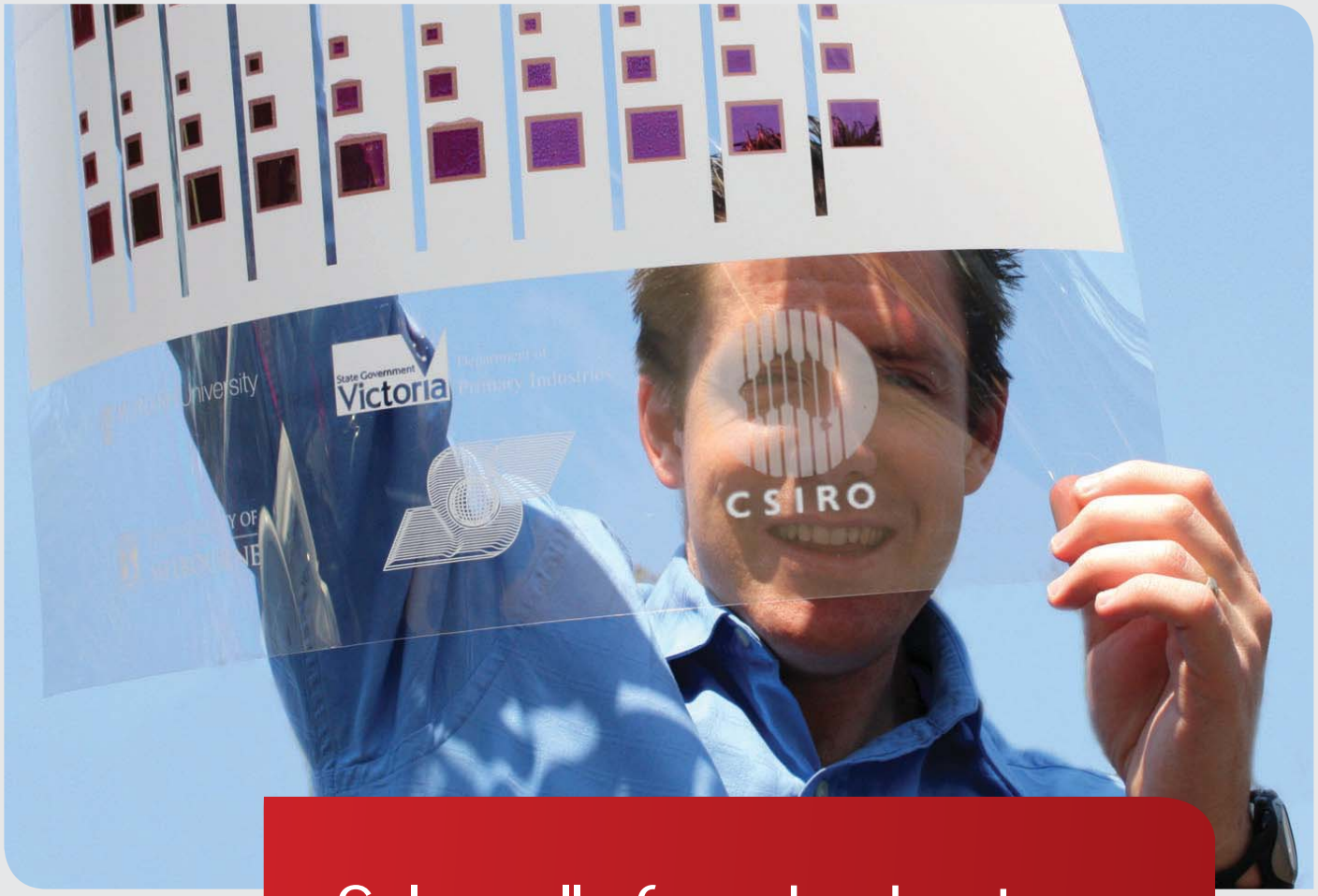

Solar cells from banknotes

CREDIT: TRACEY NICHOLLS, CSIRO

Tomorrow's solar panels are being printed on the same printing presses as Australia's polymer banknotes.

PRINTING SOLAR CELLS.
CREDIT: TRACEY NICHOLLS, CSIRO

From plastic money to plastic electricity

Tomorrow's solar panels could bear an uncanny likeness to Australia's polymer banknotes.

In fact, the first prototypes of a new kind of solar panel are being printed on the same printing presses that print Australia's money.

The research team are confident that within five years these plastic solar panels will start appearing on windows, shade clothes and roofs across Australia.

And that will just be the start.

They say that just ten tonnes of their plastic could produce as much energy as a nuclear power station—once it's converted into 100,000 kilometres of solar cells.

The idea grew from the invention of light emitting plastics also known as organic light emitting diodes (OLEDs). These are now appearing in mobile phones and in a new generation of flat screen televisions. The technology was then reversed—to create low-toxicity light-absorbing plastic electronics.

But how best to road-test the technology? In 1988 Australia started using polymer banknotes. This fraud-proof 'paper' money has proved to be extremely durable and is now used in over 25 countries. So it was a natural partner for the photosynthetic plastics.

The solar cells are being developed by a consortium comprising CSIRO, The University of Melbourne, Monash University and Securency Ltd. The project is supported by the Victorian Government through an Energy Technology Innovation Strategy Sustainable Energy Research and Development grant.

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Kangaroo bacteria fight cancer

Australia's iconic kangaroo may hold the secret for the war on cancer. Assoc. Prof. Ming Wei from the Griffith Institute of Health and Medical Research is using commensal bacteria found in kangaroos to develop anti-cancer agents that are expected to be effective in combating solid tumours, which account for up to 90 per cent of cancers.

The bacteria's spore, injected into blood, can seek out a tumour mass and release special enzymes which soften the tumour. Ming says conventional therapies were unable to penetrate solid tumour mass, thus having a low success rate. "In the labs, we train the bacteria, so they develop their innate ability to colonise tumours, digesting them, and stimulating the body's natural immune system," he says. "The bacteria don't need oxygen to multiply and they grow much faster than the tumour."

Ming says the bacteria were also present in humans and soil but when in kangaroos they contained more protein-digesting enzymes. The theory was tested on tumours in mice, with a 30 to 45 per cent success rate. Clinical trials are expected to start in two years, where this novel approach will be applied together with anti-inflammatory therapy for best results.

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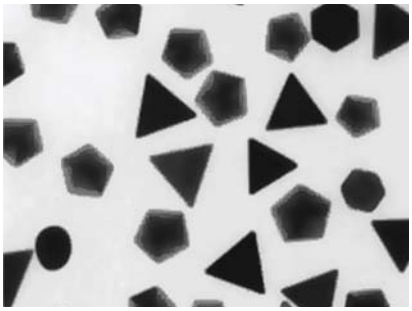

ELECTRON MICROGRAPH OF DIFFERENT FORMS OF GOLD NANOCRYSTALS.

From Roman nanocrystals to new gold catalysts

Two thousand years ago Roman glass blowers used gold nanocrystals to create vases with brilliant colours ranging from red to purple. Today, gold nanocrystals are being used as catalysts in chemical reactions and may even become high-density data storage devices.

Gold nanocrystals aren't gold in colour. They change colour as their size and shape change.

A team led by Prof. Paul Mulvaney, at the University of Melbourne, is using gold nanocrystals as a colour-coded catalyst.

These catalysts work by speeding up the transfer of electrons between molecules, acting as an electron reservoir. The rate of the chemical reaction depends on the size, crystal structure, shape and composition of each catalyst particle.

Since the number of electrons stored in the catalytic gold nanocrystal affects its colour, the scientists were able to use colour change to trace the steps of the reaction.

"The ability to watch a single nanocrystal as it catalyses a chemical reaction is unprecedented. We can now compare different sizes and shapes of nanocrystals," says Paul. "Eventually, we may be able to study chemical reactions taking place one molecule at a time."

Extending the idea, postdoctoral researcher Dr Alison Funston is researching using colour change to store high-density data in binary code—the language of computers.

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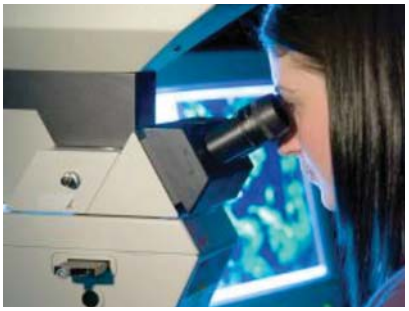
science stories



CREDIT: MARINA ADINOLFI

Imaginary friends, real benefits

Children with imaginary friends are better at learning to communicate than those who do not have one, according to psychologist Dr Evan Kidd at La Trobe University in Melbourne.

In a study of 44 children, Evan and his colleague Anna Roby showed that the 22 children who had imaginary friends were able to get their points across more effectively when talking.

"Children with imaginary friends have a lot of practice at inventing interactions with them," says Evan. "We think that this facilitates development of conversational skills—being in charge of both sides of the conversation."

The researchers have also discovered that adults who had an imaginary friend as a child scored higher on tests of creativity, were more focused on achievement, and were more likely to be absorbed in challenging activities.

The phenomenon of the imaginary friend is misunderstood, according to Evan. They are, in fact, common and associated with positive outcomes.

Kidd also conducts research on languages and language learning. His current projects include studying how children learn various aspects of grammar, and the use and functions of Australian slang.

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H1N1 still a threat

Why does influenza make some of us much sicker than others? What are the implications for swine flu (H1N1)? Australian scientists are looking to past outbreaks for the answers.

In July 2009, the Australian Government responded to urgent global calls to use the Southern Hemisphere's flu season as a catalyst for investigating the severity and global threat of the H1N1 flu strain.

One of the projects to receive funding is using pre-existing data on innate immune responses to other flu strains, including the disastrous Spanish flu from 1918, combined with current data collections on H1N1 to provide answers on why some people will get more severe flu symptoms than others and how we can control these reactions.

The team led by Prof. Paul Hertzog from Monash Institute of Medical Research, along with scientists and clinicians from Southern Health, the Royal Melbourne Hospital and the World Health Organization, is currently screening around 200 H1N1 infected patients and expects to deliver preliminary findings by the end of 2009.

With the Northern Hemisphere entering the winter flu season, it is crucial to pre-empt the H1N1's ability to mutate and adapt. The team also believes this research may help towards producing effective and combative medicines and vaccines that can be adapted to suit the severity of infection for protection.

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Goanna team finds software bugs before they bite

Software bugs are expensive. Typically, software developers waste around a quarter of their time testing and debugging programs. The later bugs are detected in the software development process the more expensive they are, and the more they delay the product launch. This is especially true in the case of embedded systems software which has to be developed at the same time as the hardware. If a bug gets through, it may mean millions of dollars is spent recalling the product.

Goanna is a fast, scalable and precise software solution that detects bugs and other software vulnerabilities automatically at development time, saving money and keeping product launch timetables on track.

Goanna is the realisation of four years of scientific research at NICTA, the largest research organisation in Australia dedicated to information and communications technology (ICT) research.

The patent-pending technology analyses complex C/C++ source code by identifying causal dependencies and estimating all behaviours of a software program. It can pinpoint problems such as memory leaks, race conditions and other software bugs that could result in system crashes or security breaches.

It is the first static code analysis tool for C/C++ source code based on model-checking technology which detects bugs automatically during software development.

Goanna's unique design allows it to analyse software very quickly, often in a matter of seconds. Unlike traditional testing methods, Goanna can be used before code is run, further speeding up the testing process.

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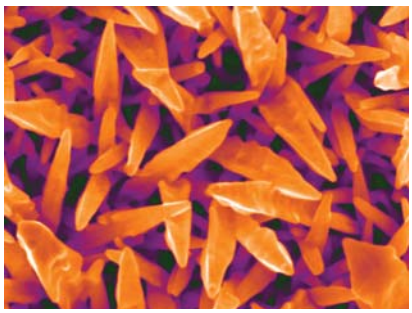

NANO-GOLD SPIKES MAGNIFIED 200,000 TIMES. CREDIT: RMIT

Measuring mercury with a Midas touch

RMIT University researchers have used nanotechnology to create a pioneering sensor that can precisely measure one of the world's most poisonous substances—mercury.

The mercury sensor developed by RMIT's Industrial Chemistry Group uses tiny flecks of gold that are nano-engineered to make them irresistible to mercury molecules.

Efforts to reduce mercury contamination in the environment and associated health risks rely on being able to accurately measuring the toxin, a priority for mercury-emitting industries like coal-burning power generators and alumina refineries.

Prof. Suresh Bhargava, Dean of the School of Applied Sciences, says traditional mercury sensors could be unreliable.

"Industrial chimneys release a complex concoction of volatile organic compounds, ammonia and water vapour that can interfere with the monitoring systems of mercury sensors," Suresh says.

"We wanted a sensor that would be robust enough to cope with that kind of industrial environment but also sensitive enough to give precise readings of the amount of mercury vapour in these emissions."

The RMIT researchers used patented electrochemical processes to alter the surface of the gold, forming hundreds of tiny nano-spikes, each one about 1,000 times smaller than the width of a human hair.

The nano-engineered surfaces are then used with existing measuring technologies to determine the levels of mercury in the atmosphere.

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BARRAMUNDI CAUGHT AT SHADY CAMP FRESHWATER IN NORTHERN TERRITORY. CREDIT: MARCUS FINN

Erosion and dams threaten barramundi and prawn fisheries

Kilometre-wide erosion gullies eating their way across Australia's northern landscape are proving likely culprits as the main source of the sediments that are flushed into the Gulf of Carpentaria each year, possibly smothering prawn and barramundi breeding and rearing habitats.

Researchers involved in the Tropical Rivers & Coastal Knowledge (TRaCK) program are trying to find out more about northern Australia's rivers in the face of demands to develop them as southern water supplies run dry.

Other TRaCK research is looking at how floods into the Gulf affect the catch of prawns as freshwater flooding into the estuaries lowers the salinity and pushes the prawns out to sea where they are harvested.

The natural river flows connecting the tiny headwaters, waterholes, massive floodplains and estuaries are important for maintaining the reproductive and feeding habitats for fish like barramundi that move upstream during the wet season.

If the northern rivers are dammed, or if water is taken out for irrigation, this is likely to upset the natural movements of barramundi and it will mean less freshwater flowing into estuaries, with a probable reduced catch for prawn fishers.

For more information:
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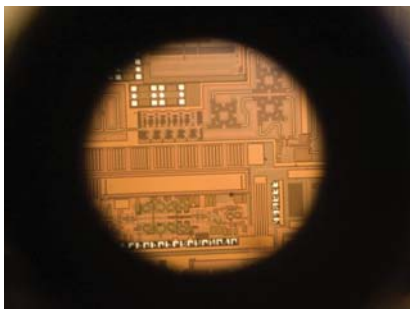

AN EXAMPLE OF THE MICROCHIP THAT WILL BE INSERTED INTO RETINAS TO HELP RESTORE SIGHT. CREDIT: NICTA

From bionic ear to bionic eye

Melbourne scientists gave Australia the first practical bionic ear. Today, over 180,000 people hear with the help of the cochlear implant.

Now, The University of Melbourne is a key member in an Australian consortium developing an advanced bionic eye that will restore vision to people with severe vision loss. This device will enable unprecedented high resolution images to be seen by thousands of people with severely diminished sight, allowing them to read large print and recognise faces.

The new device will use a video camera—fixed to a person's glasses—to capture images which are then translated into electrical impulses that stimulate electrodes inserted into the retina. These images are then sent to the visual cortex and stimulate the same area of the brain usually stimulated by visual cues. Over time the patient then learns to interpret these electrically evoked parcels of light as useful vision.

The device is being developed by the Bionic Vision Australia partnership which unites biomedical engineers, clinical experts and neuroscientists from across the country.

"The new device has the potential to be superior to other retinal implants being investigated by groups throughout the world," says Anthony Burkitt, Research Director of Bionic Vision Australia and Professor of Engineering at the University.

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The University of Melbourne has a fully equipped television studio that enables live crosses to television stations around the world.

Prime Minister's Prizes

The Prime Minister's Prizes for Science: Allan Whittome (for Science Teaching in Primary Schools); Len Altman (for Science Teaching in Secondary Schools); Michael Cowley; Amanda Barnard, Prime Minister Kevin Rudd; John O'Sullivan; Science Minister Kim Carr.

JOHN O'SULLIVAN'S SEARCH FOR EXPLODING BLACK HOLES LED TO FAST, RELIABLE WI-FI. CREDIT: BEARCAGE PRODUCTIONS

How astronomy freed the computer from its chains

When you use a Wi-Fi network—at home, in the office or at the airport—you are using patented technology born of Australian astronomy.

Australia's CSIRO created a technology that made the wireless LAN fast and robust. And their solution grew out of 50 years of radio astronomy and one man's efforts to hear the faint radio whispers of exploding black holes.

Dr John O'Sullivan and his colleagues didn't find the black holes. But they developed a way of cleaning up intergalactic radio wave distortion which became the key to fast, reliable Wi-Fi.

The CSIRO team realised that techniques they'd developed for astronomy and other applications could help solve the problem. Using fast Fourier transformation (a central tool of radio astronomy) and other techniques they created a robust wireless technology and submitted a patent application in 1992. A patent was granted in the US in 1996. Patents are now held in 19 countries.

The ideas in the patent were incorporated by the global standards body IEEE into three of the four standards used for wireless LANs: 802.11a, 802.11g, and the new 802.11n standard.

In October 2009 John, the lead inventor, received the Prime Minister's Prize for Science.

For more information:
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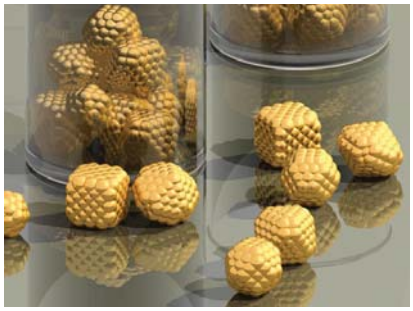

PLAYING WITH VIRTUAL GOLD NANOPARTICLES. CREDIT: AMANDA BARNARD, CSIRO

Supercomputer to test nanoparticles before we make them

Every new technology brings opportunities and threats. Nanotechnology is no exception. It has the potential to create new materials that will dramatically improve drug delivery, medical diagnostics, clean and efficient energy, computing and more. But nanoparticles could also have significant health and environmental impacts.

CSIRO physicist Dr Amanda Barnard is making the particles in the virtual world and testing how they interact in various environments before they get made in the real world.

Amanda has been looking at titania nanoparticles which are used in photovoltaics in solar cells, sunscreens, and on self-cleaning surfaces. She has created predictive 'maps' of how the particles will behave at various sizes or shapes, and in various thermal and chemical environments. She will be able to predict what happens when these nanoparticles wash away into our rivers and oceans.

Amanda's work requires serious computing power so she is a significant user of Australia's National Computational Infrastructure at The Australian National University. With nearly 12,000 high performance processors and 36 terabytes of memory this supercomputer speeds through her simulations.

In October 2009 Amanda received the Malcolm McIntosh Prize for Physical Scientist of the Year—one of the Prime Minister's Prizes for Science.

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MICHAEL COWLEY HAS SHOWN HOW OUR BRAIN TELLS OUR BODY WE ARE FULL. CREDIT: BEARCAGE PRODUCTIONS

Breaking the link between fat and diabetes

Why do we get fat? What's the link between obesity, diabetes and hypertension? Can we break the link? These are critical questions around the world. Prof. Michael Cowley may have the answers.

He's shown how our brains manage our consumption and storage of fat and sugar and how that can go wrong. He's created a biotech company that's trialling four obesity treatments.

Michael has shown unequivocally that losing weight isn't just a matter of will power.

Now with his colleagues at Monash University he is discovering why obesity increases risks of heart disease and diabetes. And he's developing therapies to break the connection between these conditions.

In the latest phase three trial of one of his drugs over a quarter of the 4,500 people in the trial lost at least 10 per cent of their weight. Equally importantly the drug also reduced waist circumference, HDL and triglycerides—important risk factors for heart disease and diabetes.

The drug—called Contrave¬—is designed to act on a specific group of neurons in the brain to suppress appetite and cause sustained weight loss, through a combination therapy.

Contrave combines new formulations of two existing drugs: Bupropion, an antidepressant; and Naltrexone, an addiction medication.

In October 2009 Michael received the Science Minister's Prize for Life Scientist of the Year—one of the Prime Minister's Prizes for Science.

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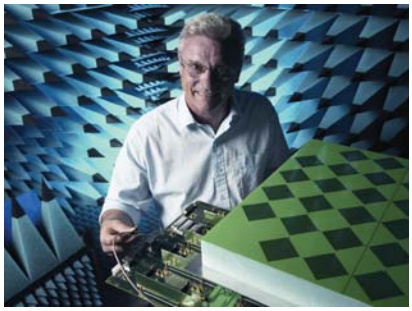
Astronomy

TEAMS FROM AUSTRALIA, INDIA AND NORTH AMERICA ARE COLLABORATING TO CREATE THE MURCHISON WIDEFIELD ARRAY RADIO TELESCOPE IN OUTBACK WESTERN AUSTRALIA. IT IS ONE OF THE MOST RADIO-QUIET REGIONS IN THE WORLD. PHOTO: DAVID HERNE, ICRAR

Collecting information from the whole universe takes tremendous computing power.



JOHN O'SULLIVAN WITH A PROTOTYPE OF THE REVOLUTIONARY PHASED ARRAY FEED FOR THE ASKAP. CREDIT: CHRIS WALSH, PATRICK JONES PHOTO STUDIO

PM's Prize winner working on astronomy pathfinder

CSIRO's Dr John O'Sullivan, winner of the 2009 Prime Minister's Prize for Science, is now working on the next generation of radio telescopes.

John's latest efforts are directed towards the development of an innovative radio camera or 'phased array feed' with a uniquely wide field-of-view for the Australian SKA Pathfinder (ASKAP) radio telescope.

ASKAP is currently being constructed by CSIRO in the superbly radio quiet Murchison Radio-astronomy Observatory site in Western Australia.

To be made up of 36 identical 12 metre antennas working together as one instrument, ASKAP will allow astronomers to answer questions about cosmic magnetism, the evolution and formation of galaxies, and to assist in the discovery of pulsars and possibly gravitational waves. Once built, it will operate as part of CSIRO's radio-astronomy facility for use by Australian and international scientists.

John's 'chequerboard' design for the phased array feed, along with ASKAP's unique three-axis antenna movement, means that the telescope will be able to survey large areas of sky with unprecedented sensitivity.

By increasing its information gathering capacity by more than an order of magnitude, John's work is central to achieving key science outcomes for ASKAP and has the potential to influence the design of the future international Square Kilometre Array telescope project.

For more information:
Australia and New Zealand SKA Project,
Tel: +61 (2) 6213 6000, www.ska.gov.au

ARTIST'S IMPRESSION OF THE AUSTRALIAN SKA PATHFINDER CURRENTLY BEING BUILT IN OUTBACK WESTERN AUSTRALIA. CREDIT: SWINBURNE ASTRONOMY PRODUCTIONS/CSIRO

Australia and New Zealand—the home of next-generation radio astronomy?

Imagine a telescope so revolutionary that in one week it will gather more information than that contained in all the words spoken in human history.

The Square Kilometre Array, or SKA, will be the world's most powerful radio telescope and will dramatically increase mankind's understanding of the universe.

The infrastructure enabling this expansion in knowledge may be placed in Australia and New Zealand, whose proposal to host the SKA has been shortlisted by the international science community. A final decision is expected in 2012.

The candidate core site is located in the Mid West region of Western Australia, at the Murchison Radio-astronomy Observatory (MRO). The original inhabitants have practiced astronomy for tens of thousands of years as part of the world's oldest continuous culture. The SKA continues this ancient tradition.

The MRO provides excellent observing conditions. It is one of the most radio-quiet regions in the world and promises to be to radio astronomy what Chile and Hawaii are to optical astronomy.

Complementing this core will be a series of array stations spiralling across the sparsely populated interior of Australia and out to New Zealand, providing a baseline of over 5,000 kilometres.

This robust configuration will allow the SKA to meet the needs of present astronomers, and will be flexible enough to provide for the ambitions of the scientists of future generations.

For more information:
Australia and New Zealand SKA Project,
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TEAMS FROM AUSTRALIA, INDIA AND NORTH AMERICA ARE COLLABORATING TO CREATE THE MURCHISON WIDEFIELD ARRAY RADIO TELESCOPE. CREDIT: DAVID HERNE, ICRAR

Rapid expansion in NZ and WA astronomy

Western Australia's International Centre for Radio Astronomy Research (ICRAR) is only three months old but is rapidly expanding—much like the early Universe. ICRAR's scientists have ambitious projects ahead contributing to global science and engineering through the SKA.

ICRAR's researchers will marshal new discoveries through large-scale neutral hydrogen surveys, studying the variable universe on short time scales and developing new antennas and other technologies. Their research will be enhanced as pathfinder instruments such as ASKAP and the Murchison Widefield Array (MWA) come online.

Collecting information from the whole universe takes tremendous computing power so another ICRAR objective will be the development of new methods to store and analyse the exabytes of data that are expected to be generated daily.

Meanwhile, the New Zealand SKA Research and Development Consortium has been formed to coordinate New Zealand-wide research efforts. Highlights from current activities include: researchers at Victoria University of Wellington investigating both the science and new image analysis required to detect very faint radio sources; development of a low-frequency transient source detector by a consortium of five universities to contribute to our understanding of variable radio sources; and, construction of a 12 metre dish by Auckland University of Technology for participation in trans-Tasman observations.

For more information:
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Griffith UNIVERSITY
Queensland, Australia

Can his DNA shed new light on climate change?

Griffith University is going to great lengths to discover the impacts of climate change. One of our research teams is studying Antarctic Adélie Penguins – one of the world's fastest evolving animals. By comparing the frozen bones of 44,000 year old birds with the DNA of the existing populations, the team hopes to learn important clues about their ability to adapt to our changing world.

Griffith University's leading research addresses the key issues of our time.

Griffith experts can comment on:

- Swine flu and epidemics
- Infectious diseases, such as Malaria
- Chronic diseases, such as migraine, diabetes and obesity
- Suicide
- Violence, stalking and alcohol abuse
- Terrorism, security and policing
- Dust storms and melting snow-caps
- Coastal communities, river health and water solutions
- Sharks
- Threatened musical cultures, such as Indigenous music
- Sustainable tourism
- Asian trade and politics
- And of course penguin DNA and much more.

Subscribe to Griffith University News Digest – our weekly news and events update – by emailing s.browne@griffith.edu.au or +61 7 373 56458.

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Gold Coast - Logan - Mt Gravatt - Nathan - South Bank

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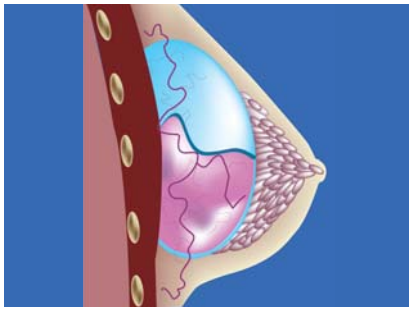

A NEW APPROACH TO BREAST RECONSTRUCTION.

Breast reconstruction using your own cells

Researchers in Melbourne will trial a new procedure to reconstruct breasts in patients following mastectomy. The procedure will use the women's own stem cells instead of silicon.

Focusing on the treatment and recovery of women with breast cancer, the new technique known as Neopec involves the insertion of a customised biodegradable chamber which is contoured to match the woman's natural breast shape. The chamber acts as a scaffold within which the woman's own stem cells are used to grow permanent breast fat tissue.

Where there is insufficient fat, researchers intend to develop Myogel, a muscle-derived tissue that induces fat tissue production—a safer and more natural alternative to silicon.

The Australian Tissue Engineering Centre will lead the project in partnership with Anatomics, Cogentum, O'Brien Institute, St Vincent's Hospital Melbourne, The University of Melbourne and the Victorian Institute of Forensic Medicine Tissue Bank.

Breast cancer patients can experience a range of physical limitations and psychosocial problems following the surgery. Increased self-esteem following breast reconstruction was an important factor in recovery from breast cancer.

Breast cancer is the most common cancer among women in Australia with 13,600 new cases expected this year.

The project is part of the Victorian Government's $41 million Victoria's Science Agenda Investment Fund announced in November 2009.

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SYNCHROTRON SCIENTISTS AT THE '6 STAR GREEN STAR'-RATED MELBOURNE CONVENTION CENTRE.

MCEC hosts the world's synchrotron scientists

Hundreds of the world's leading synchrotron scientists descended on Melbourne in September when the Melbourne Convention and Exhibition Centre hosted the 10th International Conference on Synchrotron Radiation and Instrumentation 2009 (SRI2009).

SRI2009 is the world's most important forum for synchrotron radiation science and technology communities, promoting international exchange and collaboration among scientists and engineers involved in developing new concepts, techniques and instruments related to the production and utilisation of synchrotron radiation.

The Australian Synchrotron opened in 2007. It is a large machine which accelerates electrons to almost the speed of light and produces intense beams of synchrotron light which are captured and used to perform many different types of experiments simultaneously.

In Australia, the use of these beams of light led to the creation of the anti-influenza drug Relenza. Australian scientists are currently using synchrotrons to help premature babies breathe easier, with research into creating a safe, effective artificial lung surfactant.

Australian synchrotron scientists also used synchrotron light to uncover compelling evidence that famous racehorse Phar Lap ingested a single, large dose of arsenic 30–40 hours before his death, revealing that Phar Lap was almost certainly poisoned.

SRI2009 was attracted to Melbourne by the new synchrotron, Melbourne's scientific reputation and the opportunity to use the state-of-the-art '6 Star Green Star' environmentally rated Melbourne Convention Centre.

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LONG-NECKED TURTLES ARE A FAVOURED FOOD SOURCE FOR ABORIGINAL PEOPLE IN NORTHERN AUSTRALIA'S DALY RIVER REGION. CREDIT: CSIRO DARWIN

Understanding how Indigenous people value rivers

Indigenous people value rivers in many ways. Rivers provide bush foods and medicines, they are part of a culturally significant landscape, and have the potential to sustain future water-related businesses and employment.

So it's important to know what impact changing river flow patterns and water allocations could have on Indigenous communities.

As part of the Tropical Rivers and Coastal Knowledge (TRaCK) program in northern Australia, CSIRO is recording Indigenous knowledge relating to water and quantifying the economic benefit to Indigenous people from water-dependent resources.

Results from one region indicate that northern long-necked turtles surpass the more iconic barramundi and magpie geese as the most commonly taken bush tucker food.

The researchers also realised that long necked turtles were an important food for some communities.

Northern long-necked turtles lay their eggs under water along the edge of billabongs, which need to dry and then flood for the eggs to hatch. According to CSIRO's Dr Marcus Finn, turtles had not been not on the radar of most other interest groups. "If billabongs don't fill any more because of water diversions or other land use changes, turtles won't be able to breed and this will affect the food supply of Indigenous communities," he says.

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science stories

NAUIYU COMMUNITY LEADER PATRICIA MARRFURRA MCTAGGART, CSIRO'S EMMA WOODWARD AND MOLLY YAWULMINY WITH THE NGAN'GI CALENDAR. CREDIT: MICHAEL DOUGLAS, TRACK

Representing traditional ecological knowledge in northern Australia

Traditional knowledge can tell us much about the ecology of northern Australia.

The Nauiyu community from Daly River in the Northern Territory have worked with CSIRO's Emma Woodward to create a seasonal calendar.

The seasonal cycle recorded on the calendar closely follows the cycle of annual speargrass (Sarga spp.), with many of the 13 seasons identified named according to speargrass life stages. For example, the season known as 'Wurr wirribem dudutyamu' occurs when speargrass seed heads are swollen and are hanging heavily. The term 'taddo' refers to the sounds of the seed heads knocking together as they start to open up, and indicates that the rainy season is nearing its end.

The Ngan'gi seasonal calendar represents a wealth of traditional ecological knowledge. The development of the calendar was driven by a community desire to document seasonal-specific knowledge of the river and its wetlands, including the environmental indicators that act as cues for bush tucker collection.

The calendar also addresses community concern about the loss of traditional knowledge, as older people from the language group pass away and younger people no longer use Ngan'gi as a first language.

The research is part of a Tropical Rivers and Coastal Knowledge (TRaCK) funded project on Indigenous socio-economic values and rivers flows in northern Australia.

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MORETON BAY. CREDIT: JENNA C

Wake-up call for waterways

The health of southeast Queensland's rivers, creeks and catchment areas are under scrutiny with the release of the 2009 Ecosystem Health Report Card.

This year, Moreton Bay received the lowest ecosystem health rating (D) in more than a decade. Prof. Jon Olley, from Griffith University's Australian Rivers Institute, said the report card results were a wake-up call for Moreton Bay and southeast Queensland.

"In 2008 there were no F ratings for Moreton Bay but unfortunately there are now two areas—Bramble Bay and Southern Moreton Bay—which received an F rating," Jon said.

"This serves as a call to action for everyone living in southeast Queensland, in particular local councils and the State Government, to remain focused on ways of maintaining and improving waterway health," says Jon.

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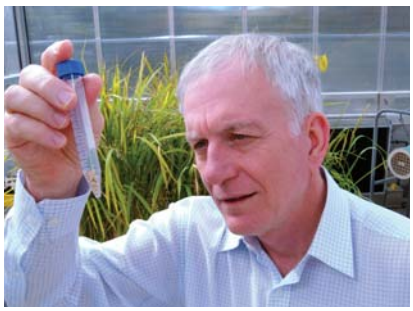

ROBERT HENRY IS LEADING A PROJECT TO USE EUCALYPTS AND OTHER NON-FOOD CROPS AS A SOURCE OF BIOFUEL.

Eucalypts: the fuel of the future

Up to 30 per cent of the fuel needed for Australia's road transport and the aviation industry could be generated through biofuels, creating tens of thousands of jobs and adding $5 billion to Australia's economy.

And one of the prime sources of biofuel, according to Southern Cross University's Centre for Plant Conservation Genetics, could be eucalypts.

Prof. Robert Henry, director of the Centre, believes biofuels can be a significant contributor to transport fuel and make a real difference in terms of reducing greenhouse gas emissions—without adversely impacting on food production or biodiversity.

The Centre, which is collaborating with international food, energy and transport companies in a major research initiative, is developing techniques to use crops such as eucalypts, as well as the waste material from high-yielding plants such as sugar cane, in the production of biofuels.

The research will make a much wider range of plants available as sources of biomass and reduces the risk that biofuel crops will displace food crops. Eucalypts, one of the prime sources of biofuels, can be grown in marginal grazing land providing an alternative income source for graziers.

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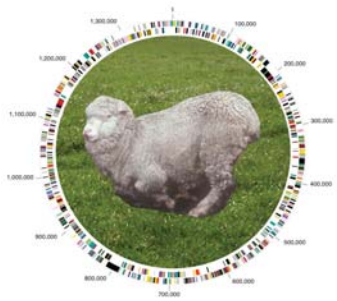

TOUGH ELECTRONICS IS NEEDED TO TRACK STEM CELLS.

Rugged electronic tags to track frozen cord blood and stem cells

Melbourne company bluechiip has invented tracking chips that survive cryogenic temperatures, high temperature sterilisation and irradiation.

Now they're planning to use the chips to track submissions to cord blood and stem cell banks.

Cord blood is a rich source of blood stem cells that could be used in the future for tackling diseases such as bone marrow cancer, leukaemia and sickle cell anaemia.

In order for cord blood and stem cells to be available for use whenever they are needed, they have to be banked, processed, frozen and stored correctly.

The electronic memory chips will be able to passively track and monitor the temperature and condition of cord blood throughout the banking process.

The chips offer a competitive alternative to traditional barcode and RFID tracking technologies for storing and tracking valuable biological materials.

bluechiip is collaborating with Australian Stem Cell Healthcare Pty Ltd and Unique Micro Design Pty Ltd.

The partners in collaboration will work on ways to advance the technology's passive memory and temperature-sensing capabilities to ensure safe and reliable storage for cord blood and stem cells.

This project is part of the Victorian Government's $41 million Victoria's Science Agenda Investment Fund announced in November 2009.

For more information:
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Australia's place in the nanotechnology race

CSIRO researchers are applying nanotechnology to drug delivery, medical body imaging, nerve repair, smart textiles and clothing, medical devices, plastic solar cells (see From plastic money to plastic electricity) and much more.

"Nanotechnology is not an industry—it is an enabling technology," says Clive Davenport, leader of CSIRO's Future Manufacturing Flagship.

"Nanotechnology has the potential to contribute new functionality and benefits to almost every product and manufacturing process. It is the product and its respective market that forms the industry."

"The manufacturing industries that will grow from our inventions are important for Australia," he says.

The Flagship had its official launch in September 2009 with a four year, $36 million program designed to boost Australia's manufacturing capabilities.

CSIRO's nanotechnology research has already led to a number of significant businesses such as: Cap-XX—making supercapacitors for mobile phones; and Ceramic Fuel Cells—producing new ways to generate power where it's needed.

And a number of Australian companies are making an impact including: Starpharma, MiniFAB, AquaDiagnostic, Sapphicon, bluechiip, Dyesol, iGlass, Antaria, Micronisers, Small Particle Company and Xerocoat.

"Our goal is to improve the future competitiveness of Australian manufacturing, delivering a major impact by 2020," says Clive.

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Know your enemy

Diseases such as leptospirosis, fowl cholera, bovine respiratory diseases or footrot in sheep have devastating impacts on livestock industries worldwide. They have a debilitating effect on animals, leading to food shortage and major economic losses.

Many of these diseases have proved difficult to control because we just don't know enough about the enemy. We don't know how various microbes interact to cause diseases such as footrot or bovine respiratory diseases.

Scientists at the ARC Centre of Excellence in Structural and Functional Microbial Genomics are going back to basics to understand how microbes cause disease and how to stop them.

At the core of the Centre's applied research program is the high-throughput microbial pipeline which starts with genome sequencing and proceeds to gene and protein analysis yielding an understanding of the structure and function of key proteins. The goal of the Centre is to identify proteins that will be key candidates to develop diagnostic tests, vaccines or drug targets to combat these diseases.

The work of the Centre has generated leading discoveries, such as uncovering the truth on the culprit toxin in necrotic enteritis in chickens. It is also developing vaccines against diseases such as fowl cholera, ovine footrot and bovine leptospirosis.

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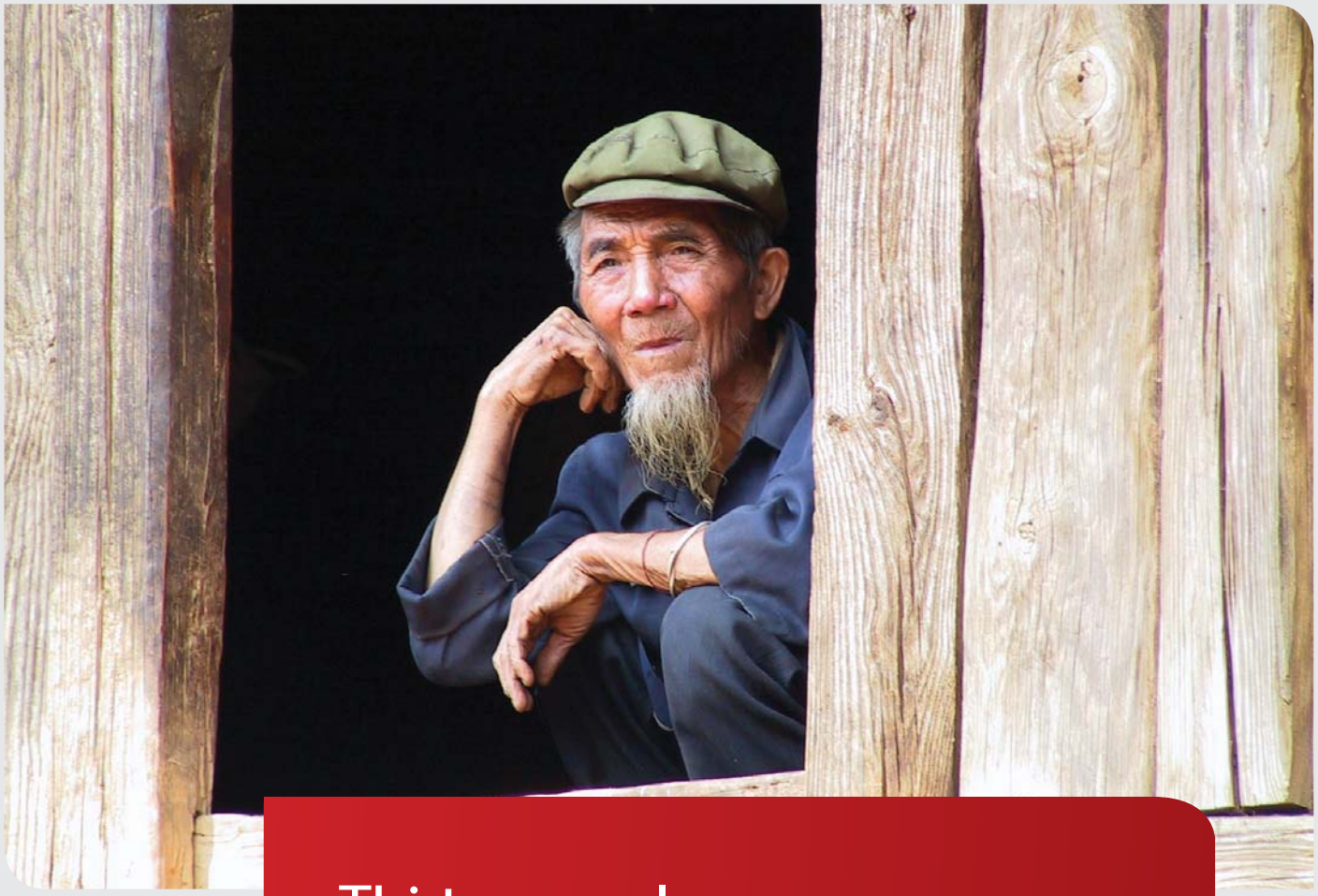

Thirty new languages

PHOTO: JAMIN PELKEY

The people of Yunnan province in China may have as many as 150 languages, the product of centuries of isolation in the mountains. La Trobe University scientists have identified 30 of them.

CREDIT: JAMIN PELKEY

Thirty new languages discovered in China

Thirty new languages in China have recently been described by Assoc. Prof. David Bradley and Dr Jamin Pelkey of La Trobe University and reported by the journal Science.

Jamin described 18 new Phula languages based on work carried out from 2005 to 2006 in 41 mountain villages in Yunnan Province, Southwest China for his PhD. They are now recognised by the International Organization for Standardization (ISO).

David, who has worked in China since 1982, says, "China is one of the last places on earth with large numbers of unreported and undescribed languages. Until the 1980s it was forbidden to suggest that China had more than 55 languages." He suspects Yunnan alone may have more than 150 languages.

Jamin, who now works in Canada, says centuries of isolation in the mountains have widened the gap between various language groups descended from the same parent tongue. For example, the 500 speakers of Alo Phola can't understand speakers of a sister language less than eight kilometres away.

Some communities are uncomfortable with the new linguistic descriptions. David says, "Speakers of some 25 languages of the officially recognised Tibetan ethnic group in Sichuan strongly reject any claim that they're anything but Tibetan, and don't want distinct languages to be identified as such."

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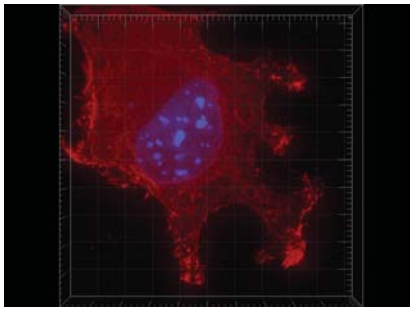

BONE CELL. CREDIT: B. MILTHORPE, UTS

Seeing things that no one ever knew were there!

A new $1.5 million super resolution microscope is producing spectacular images of bacteria and parasites, and making Australia a world leader in microscopy.

The DeltaVision OMX 3D-Sim Super-Resolution Microscope, recently acquired by the University of Technology, Sydney (UTS), is one of only two in the world.

Speaking at the launch, UTS Chancellor Prof. Vicki Sara said, "As I understand it, I can fiddle with the genes in a cell, grow them up, put them on the microscope and I can actually look at the cellular effects that genetic manipulation has produced."

"Not only that but I can directly stream all the results and images to my colleagues over in Stockholm so we can have true international collaboration in real time."

The OMX microscope allows scientists to study the sub-cellular structures of bacteria and parasites, and their interactions with host cells, at a resolution twice as sharp as other light microscopes. It can also analyse the space between proteins in cells and how they are distributed in three dimensions.

The OMX is just one element in the suite of imaging instruments within the Microbial Imaging Facility. This PC2 facility will boost Australia's capacity in biotechnology, health, biological and physical sciences research.

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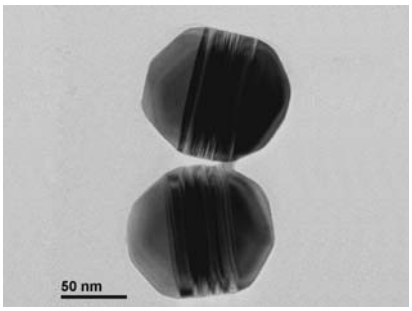

NANO-CRICKET BALLS OF SILVER PRECISELY ENGINEERED WITH DEFECT USING SPINNING DISC PROCESSING.

Nano-magnets to guide drugs to their target

Microscopic magnets ferrying drugs through the bloodstream directly to diseased tissue are a new 'green chemistry' product which will improve health and the environment.

A team led by Prof. Colin Raston, of the University of Western Australia fabricated the nano 'bullets' which can be directed by an external magnetic field to specific parts of the body. The new technology will enable doctors to send the drugs directly to the disease site, leaving healthy tissue intact and minimising toxic side-effects.

"It will also minimise the amount of drugs getting into the sewage system when patients excrete them," Colin says.

The magnets are one example of a range of nanoparticles developed using a new technique developed by Colin.

"Because of the difficulties in manufacturing at the nanoscale, nanotechnology has often failed to live up to early expectations," says Colin. He's developed a spinning-disc processing system based on a centrifuge and a lot of fluid dynamics know-how.

By changing the concentration of the feed chemicals and the rate of spin of the disc he can control the dimensions of the particles. The production process is scalable and works with cleaner reaction pathways, e.g. using water rather than organic solvents. And the continuous flow processing system uses less time, raw material and energy than does batch processing.

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Big expectations on a miniature scale.

From within the spectacular new Resources and Chemistry Precinct at Curtin, Professor Julian Gale is rebuilding the fundamental structures of some of nature's most complex creations to see what makes them tick.

Throw the word 'nanotechnology' into polite conversation, and you're likely to get a variety of reactions, many following a general pattern of apocalyptic prophecy and the 'grey goo' theory. But, as Professor Gale describes, there's much work to be done on even understanding the fundamentals of how our world is put together on a molecular level.

"Working on a scale of individual atoms, we're looking at how we can use virtual models and computing to solve physical science problems," he explains. "Broadly, what we do is computational nanoscience. Within that, we have three main foci; clean energy, minerals and water."

These three areas are some of the most hot-button topics in the scientific world right now. From solid-state batteries to technologies for a hydrogen economy, the computer simulations developed by Gale and his team have the potential to instigate new developments in hundreds of future technologies.

"The beauty of computer models is that you can look at hypothetical possibilities," he explains of his work's potential. "The experimentalist might say you're living in cuckoo land, you're off looking at fantastical things that can't be made; but occasionally you come up with ideas that inspire them to go away and do something different and actually make these things in the real world."

The disconnect between physical experimentation and virtual simulation has long been constrained by two important factors: computing power and the age of the field itself. But Professor Gale is excited by the many recent successful applications of virtual computer models to real-world experimental science, and expects a surge of this technology in the coming years.

"Where computational nanoscience is starting to come into its own is in its application to specific real-world problems. Take the desalination plant at Kwinana. We have a situation where impurities in the seawater can collect on the reverse osmosis membrane. For example, dissolved carbon dioxide can grow into a limestone scale. This means the filter needs downtime to be cleaned, and more electricity to run it because the water needs to be forced through these blocked pores. But if we can understand how this problem occurs on the tiniest molecular level, we could potentially design a better membrane to suppress this process, or prevent it completely. It's about being smarter about how we do things through thinking small."

Curtin University of Technology

science stories

MILK CONTAINS A PROTEIN THAT BUILDS MUSCLES IN MICE. CREDIT: VICCI CROWLEY-CLOUGH

A milk protein that encourages exercise?

Victorian scientists have discovered a milk protein with the potential to treat metabolic syndrome and chronic muscular and bone diseases.

The protein, when given daily to mice, caused them not only to build more muscle but also to want to exercise. The findings also showed an increase in muscle in mice not given exercise.

Researchers from MG Nutritionals (a division of Murray Goulburn Co-operative Co. Ltd) and Victoria's Department of Primary Industries (DPI) discovered the protein which they've called Regeneration Inducing Peptide for Tissues and Cells (RIPTAC).

The researchers are joining with Deakin University, Barwon Health, University of South Australia and the Geoffrey Gardiner Dairy Foundation to collaborate to develop and test the product on people before commercialisation.

The proposed product could benefit approximately 4.8 million Australians at risk of age-related deterioration of lean body mass, and those with metabolic syndrome who are at significantly increased risk of developing type-two diabetes and cardiovascular disease.

If successful, the project will be a coup for public health—significantly improving the quality of life of the ageing.

With an estimated burden of over $2.5 billion annually, diseases including osteoporosis, sarcopenia and metabolic syndrome significantly reduce the quality of life of sufferers.

This project is part of the Victorian Government's $41 million Victoria's Science Agenda Investment Fund announced in November 2009.

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ZENOBIA JACOBS, UNIVERSITY OF WOLLONGONG. CREDIT: TIMOTHYBURGESS.NET

Reading the hidden clock in a grain of sand

Dr Zenobia Jacobs wants to know where we came from, and how we got here. When did our distant ancestors leave Africa and spread across the world? Why? And when was Australia first settled?

Zenobia has developed a way of accurately dating when individual grains of sand were buried with human artefacts. And that technique (optically stimulated luminescence or OSL) is transforming our understanding of human evolution.

Working in South Africa she found a community that had been living relatively sophisticated lives—harvesting shellfish and using ochre pigments for decoration—more than 160,000 years ago, about 120,000 years earlier than previously thought. And recently she and her colleagues identified the earliest evidence of engineering—some 72,000 years ago.

Now her work has brought her to the University of Wollongong to work with Prof. Bert Roberts, one of the team who discovered the Flores 'hobbit'.

She plans to track the movement of the Aboriginal people into and throughout Australia.

"It's of incredible relevance to the whole 'Out of Africa' theory. When did our ancestors leave Africa? Why? Which routes did they chose and how quickly did they disperse?"

In 2009 Zenobia received one of three L'Oréal Australia For Women in Science Fellowships.

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TAMARA DAVIS IS LOOKING FOR DARK ENERGY. CREDIT: TIMOTHYBURGESS.NET

L'Oréal Fellow looking for dark energy

In 1998 astronomers made an astonishing discovery—the expansion of the Universe is accelerating. The discovery required a complete rethink of the standard model used to explain how the Universe works.

"Now we know that stars, planets, galaxies and all that we can see make up just four per cent of the Universe," says Dr Tamara Davis, a University of Queensland astrophysicist.

"About 23 per cent is dark matter. The balance is thought to be dark energy, which we know very little about."

Tamara is on the hunt for this dark energy. By using the Australian National University's new telescope SkyMapper to measure the movement of supernovae, she hopes to gain a better understanding of dark energy.

Using the SkyMapper data generated over the next couple of years, Tamara hopes to detect invisible dark matter by observing the effects of its gravity.

"We can use the position and motion of supernovae to measure the 3D distribution of all matter in the Universe, not just galaxies," she explains. "This will allow us to measure previously unexplored properties of dark matter and dark energy."

In August 2009 Tamara received a L'Oréal Australia For Women in Science Fellowship. She is using the $20,000 Fellowship to pull together an international team of scientists to work on this project.

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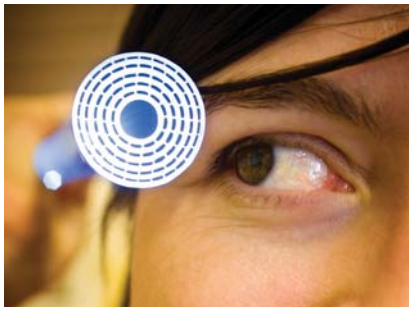
Sunscreens go nano

The experiments are investigating whether the nanoparticles have long-term harmful effects and what could be done to reduce these effects.



Detecting aircraft fatigue

The only way to find out whether the internal structures of an aircraft are corroded is to pull the plane apart and look. But new nanotechnology-based techniques being developed by Prof. Tanya Monro, Director of Adelaide University's Centre of Expertise in Photonics, in collaboration with the Defence Science and Technology Organisation, could make costly visual inspection in preventive aircraft maintenance a thing of the past.

Tanya and her colleagues are developing a sensor that uses unique optical fibres to pick up signs of corrosion in areas that are hard to access, such as joints. "Once the aircraft is assembled, we can inspect these areas by sending a light signal through the fibre and detecting the changes in characteristics of the light," she says.

They have created a new class of optical fibre using soft glass. These optical fibres with minute holes have thousands of potential applications in industry, health, agriculture and defence.

Examples include polymer optical fibres with lines of tiny holes to guide terahertz radiation—low frequency waves on the electromagnetic spectrum—which may find application in high-speed computing, security scanners and medical imaging.

Another novel function is real-time pathology tests for diseases such as HIV or bird flu—the fibres will be coated with antibodies to specific diseases and will fluoresce if the virus is present.

Contributed by the National Enabling Technologies Program of the Department of Innovation.

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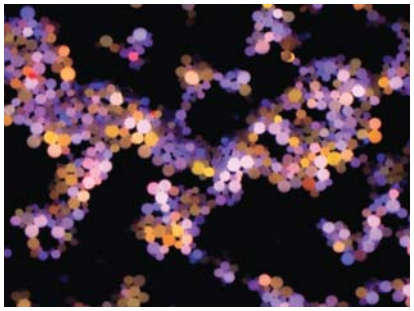

THESE OPTICALLY BARCODED NANOPARTICLES COULD TRANSFORM CANCER DIAGNOSIS.

Tiny particles could assist in breast cancer screening

Blood tests using nanoparticles carrying molecules which can detect breast cancer biomarkers could save millions of lives and open the way to mass screening for many cancers.

Prof. Matt Trau, of the Australian Institute for Bioengineering & Nanotechnology at the University of Queensland, and his team are using a combination of nanotechnology and molecular biology in the project, funded by a five-year $5 million grant from the National Breast Cancer Foundation.

Over a million new cases of breast cancer are diagnosed each year and the number is rising. "Early detection is a life saver," says Matt. "About 90 per cent of cancer patients will survive beyond five years as long as the cancer is detected and treated early. In the late stages of the disease, that figure can drop to 10 to 20 per cent.

"By the time a lump in the breast becomes obvious, it is often too late," he says. "We also need new technologies to detect the recurrence of the disease after treatment, and also to personalise treatment depending on the specific type of breast cancer which the patience has."

Matt is collaborating with Prof. Susan Clark, of Sydney's Garvan Institute, who is investigating specific epigenetic biomarkers in genes which are considered the smoking gun of some cancers.

Matt's nanoparticles are coated with optical and chemical 'barcodes' which react with the epigenetic gene sequences. A simple reader then provides the results.

Contributed by the National Enabling Technologies Program of the Department of Innovation.

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Sunscreens go nano

CSIRO scientist Dr Maxine McCall is testing sunscreens containing nanoparticles to assess the safety of these products.

Sunscreens have long contained bulk particles of zinc and titanium oxides as their active ingredients to absorb or reflect damaging ultraviolet light. In contrast to chemical absorbers, such as octyl methoxycinnamate, the oxides work over most of the ultraviolet band. These oxides appear white on the skin, but at a nanoscale they are clear.

There are concerns that these nanoparticles could be harmful. In vitro tests have demonstrated that they can penetrate human cells. However there are gaps in the knowledge. We don't know for example, if these nanoparticles are absorbed through the skin.

Maxine and her colleague Prof. Brian McCall of Macquarie University, Sydney, are carrying out the first study of human volunteers under real-life conditions—a five-day study to see whether zinc from sunscreens applied to the skin shows up in the subjects' blood or urine.

In a three-year experiment, Maxine and her team will test three commercially available sunscreens on hairless mice, doing pathology and molecular tests on internal organs. "That experiment represents a worst case scenario because mouse skin is more penetrable than human skin," Maxine says.

The experiments are investigating whether the nanoparticles have long-term harmful effects and what could be done to reduce these effects.

Contributed by the National Enabling Technologies Program of the Department of Innovation.

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science stories

JOE SHAPTER IS DEVELOPING A NEW KIND OF SOLAR CELL.

CREDIT: RICH CHARLES

Windows—the next solar panels

Nanotube coatings on windows could deliver green energy to homes and offices in a few years.

Silicon, which is used extensively in solar cells, can conduct electricity and, after some processing, can convert light energy directly into electrical energy. However, this processing is very energy intensive and it currently takes solar photovoltaics about ten years of service to produce the energy required to make the device.

So Prof. Joe Shapter and his team at Flinders University, South Australia, looked to nature. They have designed a system based on a molecule that acts like the chlorophyll in plants.

They have attached a porphyrin compound, incorporating the metal ruthenium, to carbon nanotubes on a silicon wafer base, making an array of microscopic antennas just hundreds of nanometres high. Each antenna holds porphyrin molecules up to the sun and channels electrons from the porphyrin into the silicon substrate.

The ruthenium porphyrin is like molecules in the green pigment chlorophyll, used by plants to convert light, carbon dioxide and water to food through photosynthesis. It is much more efficient in its energy conversion (at 80 per cent) than even the best laboratory prototype solar cells (40 per cent). The silicon need not be of high purity, so it is less energy-intensive to produce than conventional solar cells.

A prototype, used as a coating on the sheet glass of a window, should be available within two years.

Contributed by the National Enabling Technologies Program of the Department of Innovation.

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Algae that make biofuels and hydrogen

An Australian researcher is leading an international team of scientists developing a clean source of energy from microalgae. The team have developed one algae that not only makes oil for biodiesel production but also generates hydrogen. Commercial hydrogen production uses fossil fuels and produces carbon dioxide.

The discovery is an important achievement for the Solar Biofuels Consortium, 70 researchers led by Assoc. Prof. Ben Hankamer from the Institute for Molecular Bioscience in Brisbane, and Prof. Olaf Kruse and Prof. Clemens Posten from the Universities of Bielefeld and Karlsruhe in Germany.

Algae naturally capture sunlight and store it as biomass which can be used to produce biofuels, feedstock for plastic production and high-value products, including medically important molecules. Microalgal systems also have the potential to assist in carbon dioxide capture and storage.

The focus of the consortium is now on enhancing efficiencies, reducing costs and refining pilot plant scale designs to facilitate the development of commercially viable systems.

To grow the algae the group is developing solar-powered bioreactors which can be placed on non-arable land and use much less water than conventional biofuel crops. Many algae varieties can also be grown in salt water, creating sustainable and economic opportunities for Australia.

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Kangaroos a high point in evolution

People who live outside Australia often regard kangaroos as strange, specialised, relic animals. Not so, says palaeontologist Dr Ben Kear at La Trobe University in Melbourne.

They represent a high point in mammal evolution, he says, a generalised body plan that has adapted to a wide variety of environments, from rainforest to deserts, from rocks to trees. "Some may even have been carnivores."

Ben and his colleagues have recently been integrating all the information—from bone specimens to DNA—that has been gathered on the 70 living species and similar number of extinct kangaroos.

Their data shows a diverse group of marsupials which has adapted to, and thrived, in all that climate change has thrown at it as the Australian continent went from being wet to increasingly arid.

Ben has a particular interest in the earliest fossil species, Nambaroo gilespieae, which lived about 25 million years ago. The Nambaroo was the size of a small dog and adapted to life in a tropical forest. Its hind limbs show that it probably did not even hop, but bounded on all fours like a possum.

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BALANCING THE RISKS AND BENEFITS OF TRADE AND PESTS.

MARNIE BLEWITT WANTS TO UNDERSTAND HOW GENES ARE CONTROLLED. CREDIT: SAM D'AGOSTINO, SDP PHOTO

Are forests really the carbon sink we need?

Evidence is building to suggest that our forests may not be the climate change 'get out jail free' card we all want.

Australian Rivers Institute's Assoc. Prof. Peter Pollard has researched rainforest lakes and rivers to test a provocative theory. The respiration of bacteria living and 'breathing' in these freshwater ecosystems is a major pathway for the return of rainforest carbon back to the atmosphere as the greenhouse gas carbon dioxide.

His concern is that we are underestimating the rate of return of these greenhouse gases to the atmosphere.

"A rainforest ecosystem has a carbon 'budget'. That's an equation that tells us how much carbon dioxide is removed from the atmosphere which should add up to the amount fixed back into the earth in trees and vegetation during photosynthesis, plus that returned via respiration," he said.

"The enigma is that these numbers don't quite add up – it's almost as if there is a line item on this balance sheet missing. Hence rainforests are seen as 'sinks' of the greenhouse gas carbon dioxide — but are they really?"

"For years there has been a major gap in our knowledge of the global carbon cycle – it's like we're environmental accountants unable to reconcile the carbon budgets."

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Two million containers—but how many pests?

Every visitor to Australia quickly learns that we take quarantine seriously. Our country is free of many pests, weeds and diseases that are widespread overseas. Our relative disease-freedom is good news for our people, for agriculture and for the environment.

Visitors' luggage is screened at the airports. But what about the two million shipping containers that enter Australia each year? How do we strike a balance between open trade and quarantine?

It's all about risk. Quarantine officers inspect the outside of every container. But how many, and which containers need more detailed inspection?

The Australian Centre of Excellence for Risk Analysis was set up in 2006 at the University of Melbourne to answer these kinds of questions. They're building state-of-the-art risk analysis methods, and are developing risk interpretation tools. And their first target is biosecurity.

Statistician Dr Andrew Robinson has reviewed the inspection regime for air and ship containers entering Australia and has developed a series of risk recommendations which will help the Australian Quarantine and Inspection Service to better deploy its people to the higher risk imports. The recommendations range from setting up a risk team to prioritise work through to data mining—using techniques similar to those used by financial regulators to track the movement of money.

For more information:
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Reading the genome

Dr Marnie Blewitt wants to know how a human being is made: how does a single fertilised egg develop into an adult with millions of cells performing a myriad of different functions.

"How does a cell know which of its 30,000 or so genes should be active and which should be dormant?" says Marnie, a researcher at the Walter and Eliza Hall Institute of Medical Research.

The key, she says, is in the punctuation—the genome is labelled with tags and flags to indicate which genes are active and which are not. This 'epigenetic' information seems to be what guides the cell to turn genes on and off.

Marnie is using the X chromosome to try to understand epigenetics. The X chromosome is unusual because in males there is only one copy of this chromosome, while in females there are two copies. One of these copies has to be turned off for normal development.

"The second copy of the X chromosome has to be completely inactivated. We know it is packaged away and silenced through a number of steps during development from a fertilised egg into an adult. I'm using it as a model system to help unravel the complex story of epigenetic control," says Marnie.

In August 2009 Marnie received one of three L'Oréal Australia For Women in Science Fellowships.

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science stories

WOMB STEM CELLS COULD HELP REGENERATE A DISEASED LIVER

Womb of life

What if the very thing that assists a fetus to grow in the womb could also prevent disease in a fully grown adult?

Monash Institute of Medical Research scientists have discovered that stem cells from the womb have the potential to treat inflammatory diseases such as lung fibrosis and liver cirrhosis in both children and adults.

The stem cells come from the amniotic membrane which is attached to the placenta and secretes the amniotic fluid that surrounds the baby while in the womb.

The World Health Organization estimates that over 450 million people worldwide suffer from alcohol- and hepatitis-related liver fibrosis. To date, the only cure for advanced disease is organ transplant.

A team led by Dr Ursula Manuelpillai from Monash Institute of Medical Research and Assoc. Prof. William Sievert, Director of the Gastroenterology & Hepatology Unit at Monash Medical Centre, has studied animal models that mimic lung and liver fibrosis in humans.

There is a good chance that their research will enable placental tissues, normally discarded at birth, to be used to reduce inflammation and help regenerate a diseased liver.

The team is aiming for clinical trials for treatments within the next two to three years.

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NATIVE GRASS AUSTROSTIPA SCABRA. CREDIT: JANUSZ MOLINSKI/ROYAL BOTANIC GARDENS MELBOURNE

Invasion of the grasses

DNA barcodes could help farmers and conservationists identify wanted and unwanted grasses.

Identifying grasses is difficult especially when they're not flowering. But identification is important. Australia's agriculture and ecology are threatened by invading grasses, such as Chilean needle grass (Nassella neesiana) and serrated tussock (N. trichotoma). And efforts to re-introduce native grasses can be hampered if you can't tell the grasses apart.

Heavy infestations of invasive and unpalatable species reduce productivity, cause injury to stock and reduce the value of wool and hides. Millions of hectares are infested with these weeds, and the cost to farmers runs into the tens of millions of dollars each year.

Scientists at the Royal Botanic Gardens Melbourne are developing DNA barcoding techniques to identify a grass from any part of a sample: leaves, roots, stems or seeds. It's in collaboration with the Victorian Department of Primary Industries and is one of the first projects to DNA barcode Australia's flora.

But DNA barcoding will only be reliable if there's a good reference collection. Fortunately, the National Herbarium of Victoria has an extensive and well-verified collection of grass samples and access to further reference collections worldwide. The long term goal is to develop a library of DNA barcodes to offer a cheap, reliable and fast molecular identification service for grasses—helping to conserve native grasses, and to fight the war on invading grasses.

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Building water sensitive cities

Staff in a Monash University-led project, called Water Sensitive Cities, believe the time is right for a bold idea that could produce 20 to 30 per cent of Melbourne's future water needs.

Annually, almost as much stormwater falls on Melbourne as its citizens use, but only a fraction is captured and reused. Billions of litres of stormwater literally go down the drain and into Port Phillip Bay, degrading the ecological health of Melbourne streams and the bay.

The project will harness stormwater to overcome water shortages, reduce urban temperatures and improve the landscape and liveability of Australian cities.

"Our cities must become resilient to the climate and social pressures that confront them. We must find new, more integrated solutions that can address the problems thrown up by climate change and population growth," says Monash's Prof. Ana Deletic.

Most models involve capturing stormwater in neighbourhood parks and creeks, letting nature clean it through bio-filtration, then reusing it in toilets, for washing and on gardens. The stormwater treatment systems would also help cool our increasingly hot cities and protect the health of urban waterways.

The systems can be adapted to most major cities and the team is currently running pilots in Israel and Singapore. The group is also an invited partner on a seven million Euro project for the European Union on adaptation of urban water systems to climate change.

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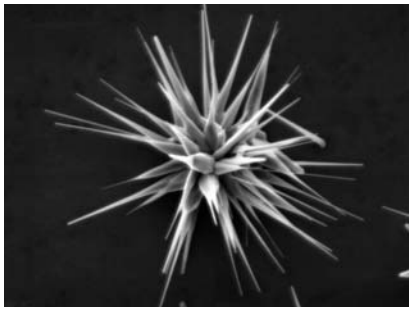

ZINC OXIDE CRYSTAL. CREDIT: MATTHEW FOLEY, UTS

The lighting revolution has only just begun

LED lighting is sweeping the world. It's energy efficient, long lasting, and could save users billions of dollars worldwide and dramatically reduce carbon emissions. But it's still a young technology. Much more efficient lights are on the way.

The bright clear traffic lights that guide and frustrate drivers in our cities use a fraction of the energy of conventional light globes. Each traffic light has 140 or so LED lights producing a strong directed light. And the lights last a decade or so. Scientists at the University of Technology, Sydney (UTS) contributed to improving the performance of the man-made crystals at the heart of these LED lights.

"The light in LEDs is produced by crystals of gallium nitride and zinc oxide," says UTS researcher Assoc. Prof. Matthew Phillips. "These crystals don't exist in nature. They're made by creating sandwiches of thin layers of materials—one atomic layer at a time."

The crystals are made at high temperatures and often have structural and chemical defects that affect performance. Remove these defects and you can make even more efficient lights.

And that's what Matthew's doing. Just by optimising manufacturing processes he believes that LEDs could be six times better than they are today.

And that's just the start. He's working on new materials that could lead to even better performance.

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LAKE MUNGO'S ANCIENT LANDSCAPE.

Lake Mungo reveals ancient human adaptation to climate change

Aboriginal Elders from the Traditional Tribal Groups in the Willandra Lakes World Heritage Area are collaborating with researchers to produce the first integrated account of the history of human settlement, landscape evolution and past environmental change for Australia's foremost 'Ice Age' archive.

Lake Mungo is renowned as the site of the world's oldest known cremation and ritual ochre burial, as well as the longest trail of ancient human footprints. But until now little was known about the lives of the people who settled in this area more than 45,000 years ago.

The dunes bounding Lake Mungo preserve hundreds of rare, snapshot images of Australia's earliest history: hearths lit to cook a single meal of fish and wallaby, a cluster of freshwater bivalves representing a midday snack, or debris from the manufacture of stone tools.

In contrast, most archaeological sites contain jumbles of debris from many unrelated activities that cannot be disaggregated to trace the manufacture of individual tools.

This unique record offers insights into the strategies used by the first settlers. It also helps illuminate the technological, economic and social strategies that people devised to accommodate long-term and dramatic changes in landscape and environment in this climatically sensitive, semi-arid setting.

The 2,400 square kilometre Willandra Lakes region is located in the southwest corner of the Murray-Darling Basin, in far western New South Wales. It was inscribed on the World Heritage Register in 1981.

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ADÉLIE PENGUIN. CREDIT: GRIFFITH UNIVERSITY

Penguins hold missing pieces of evolutionary puzzle

Antarctica's humble Adélie penguin is helping scientists shed new light on the process of evolution and may even hold the secret of how animals adapt to climate change.

Griffith University's Professor of Evolutionary Biology David Lambert used genetically pristine Adélie penguin populations to reach back further in DNA history than thought possible, analysing DNA from living mothers and chicks alongside their ancestors from 44,000 years ago.

David suggests problems in accurately measuring change in DNA led to miscalculations in the past. "If you don't know the relationship of the ancient animals you're studying to the modern ones, it's easy to misinterpret how fast DNA sequences change," he said.

"Breeding colonies of Adélie penguins have been free of interference from humans in the Antarctic. They have probably returned to the same breeding sites for hundreds of thousands of years. The extreme cold and dry conditions preserved the DNA enabling us to reach back 44,000 years."

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Surviving in the city

PHOTO: JANUSZ MOLINSKI/ROYAL BOTANIC GARDENS MELBOURNE

Why do some plant and animal species thrive in the city while others disappear?

ARCUE IS WORKING TO UNDERSTAND HOW PLANTS AND ANIMALS ADAPT TO URBAN LIFE. CREDIT: JANUSZ MOLINSKI/ROYAL BOTANIC GARDENS MELBOURNE

Surviving in the city

Why do some plant and animal species thrive in the city while others disappear?

Most ecological studies are done in natural environments not in towns and cities so we lack information on urban ecology.

A team from Melbourne's Royal Botanic Gardens is changing that.

They've been exploring a wide range of issues including:

- how to design wildlife tunnels and bridges to reduce wildlife road deaths
- how traffic noise affects birds in roadside habitats
- how the pitch at which frogs croak changes in cities
- why flying foxes have spread into urban Melbourne
- the importance to wildlife of leaf litter in urban parks and gardens.

Our cities are growing. And over 60 per cent of the world's population will be living in urban settlements by 2025. So we need to know just what's happening if we are to preserve and restore urban biodiversity and maintain ecosystem services in order to create green, healthy cities and towns.

The research team is based at the Australian Research Centre for Urban Ecology (ARCUE), and staff members Dr Mark McDonnell and Dr Amy Hahs have recently co-edited (with Dr Jürgen Breuste) a book Ecology of Cities and Towns, published by Cambridge University Press.

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EASTERN SPINEBILL. CREDIT: ROHAN CLARKE, WILDLIFE IMAGES

Mites hitch lift in birds' beaks

Nectar-eating Australian birds make clever choices about which flowers to raid. And so do the flower mites which hitch a ride in their nasal passages, according to zoologists Jolene Scoble and Assoc. Prof. Michael Clarke at La Trobe University in Melbourne.

During winter, eastern spinebills are particularly dependent on nectar from the mountain correa, a shrub which flowers over several months. During this time, a single bush may display hundreds of flowers at different stages of development.

Jolene and Michael showed the birds did not feed at random. Rather, they selected flowers at the peak of their nectar production. What's more, they avoided flowers which displayed a split or tear showing they had previously been visited by other nectar feeders, such as silvereyes. Just what flower features acted as a cue to attract the spinebills is the subject of future studies.

The spinebills were not deterred from feeding by the presence of another nectar robber—flower mites. In fact, Michael says, the mites travel from flower to flower by crawling into the nasal passages of the bird. "By choosing when to climb on or off the bill, the mite is also choosing where to feed."

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HELICOPTERS ARE USED BY BEN HOFFMANN AND DHIMURRU RANGER STAFF TO ACCESS REMOTE INFESTATIONS OF YELLOW CRAZY ANTS. CREDIT: CSIRO DARWIN

Research combats invasive ants on Indigenous lands in northern Australia

Invasive ants are among the greatest environmental, social and economic threats to Australia, potentially costing the nation more than $1 billion annually. However, knowledge of the basic biology of these pest species remains rudimentary, and many management operations have been unsuccessful.

CSIRO ecologist Dr Ben Hoffmann has been working on invasive ants on Indigenous lands, in collaboration with Indigenous ranger groups, for 13 years. His innovative research and science-based approach to management has resulted in substantially improved management protocols, leading to eradication of invasive ants from areas of high biodiversity and cultural values, including World Heritage-listed Kakadu National Park, the Tiwi Islands and north-east Arnhem Land in the Northern Territory.

Ben's research on ant biology and invasion ecology has been crucial to achieving effective control. It has also led to a better understanding of how species become invasive, the impacts of invasive ants on ecosystems, as well as ecosystem recovery following eradication.

The research and management protocols Ben has developed have been incorporated into invasive ant management plans and programs throughout the world. An African big-headed ant eradication conducted with the Malak-Malak Aboriginal rangers at Daly River also recently won a Northern Territory Landcare Award.

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Bushfires

LEARNING FROM BLACK SATURDAY. CREDIT: BUSHFIRE CRC

Black Saturday has raised questions and issues that will be the subject of scientific debate, in Australia and internationally, for years to come.

7 FEBRUARY 2009 NEAR KINGLAKE VICTORIA. CREDIT: BUSHFIRE CRC

Understanding Black Saturday

The devastating bushfires in Victoria, Australia on 7 February 2009 resulted in the loss of 173 lives and caused major property and asset damage. The fires are considered to be Australia's worst peacetime disaster.

The questions and issues that quickly emerged will be the subject of major debate, in Australia and internationally, for years to come.

The Bushfire Cooperative Research Centre reacted with a fast and comprehensive research response. Almost every day over the two and half months after Black Saturday, the Bushfire CRC placed teams of up to 50 researchers from across Australia, New Zealand and the United States in the field. This amounted to more than 2,000 staff days of extensive data collection and analysis, working in the aftermath of the disaster alongside fire fighters, police officers, community workers and residents across the fire-affected areas.

In the end the task force analysed more than 1,300 affected homes, interviewed more than 600 residents and took more than 21,000 photographs.

The mass of collected data is unprecedented in fire science. It is now a solid foundation for better decisions on fire and land management and on community safety, in Australia and around the world.

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TIWI RANGER LEON PURUNTATAMERI LIGHTING EXPERIMENTAL FIRES AS PART OF THE TIWI CARBON STUDY. CREDIT: CSIRO DARWIN

Managing tropical fires for greenhouse gas abatement

The economic potential of carbon is the focus of a new fire project on the Tiwi Islands, 80 km north of Darwin in the Northern Territory and home to 2,000 Aboriginal Australians. Nearly half of the Tiwi Islands are burnt every year, resulting in significant greenhouse gas emissions. Reducing the extent of fire may provide substantial financial benefits under the emerging carbon economy.

Tiwi leaders have identified the urgency of developing an independent economy in order to address decades of social disadvantage. The Tiwi Land Council Rangers, the Tiwi College and CSIRO are working together to explore livelihood opportunities for managing fire to reduce greenhouse gas emissions, while maintaining the special biodiversity values of the Tiwi Islands.

The research team, led by CSIRO ecologist Dr Alan Andersen, is studying the effects of different fire management options on carbon sequestration, greenhouse gas emissions and biodiversity.

CSIRO's modelling indicates that there could be substantial increases in carbon stocks and reductions in emissions of greenhouse gases from reducing fire frequency, which could also have important biodiversity benefits.

The Tiwi Carbon Study features a series of long-term monitoring plots that are subject to different fire management options.

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Yeast—the next wine frontier

Australia's scientific approach to grape growing and winemaking means that you can be confident in what you're buying when you drink Australian wines. And that's helped Australian wine become the market leader in the UK and second behind Italy in the US market.

Now researchers at the Australian Wine Research Institute are tracking down the compounds that give wine its complexity. In 2007 they identified the compound responsible for the 'black pepper' aroma in Shiraz, and more recently they found the cause of the 'minty eucalypt' aroma of some Australian reds.

The next big challenge is to unravel the role of yeast. There are over one hundred different yeasts used in the industry but winemakers tend to stick with their trusted favourites.

"In 2008 we cracked the genetic code of a wine yeast," says yeast geneticist Dr Paul Chambers. "Now we're using that information to inform the development of new, improved wine yeast."

"We've already developed new yeast strains that give very pronounced fruit characters in many different grape varieties. Our aim is to generate yeasts that will give winemakers new creative opportunities, and also yeasts that could help winemakers work with drought-stressed grapes," says Paul.

The yeast studies are also contributing to blue sky research, as a pilot for the development of systems biology, through Bioplatforms Australia.

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science stories

RESEARCHERS ARE WORKING WITH PRAWNS IN THE SEARCH FOR A SHELLFISH ALLERGY VACCINE. CREDIT: RMIT

Vaccine hope for shellfish allergies

A new oral vaccine against shellfish allergies is being developed by researchers at RMIT University.

Assoc. Prof. Andreas Lopata and his team in RMIT's School of Applied Sciences are working to help find a different method for vaccination against the potentially deadly allergy.

"We want to create a vaccine that people can eat or swallow, rather than inject." he said.

Seafood allergies affect millions around the world, with up to 50 per cent of Asian children reacting badly to shellfish and other seafood.

These allergies can grow worse as children grow older, and a child with allergic parents has a 30–40 per cent chance of inheriting the condition. It is estimated about one per cent of Australians are allergic to seafood.

The RMIT research team is also using sophisticated high-pressure machinery to test whether allergens can be removed from shellfish, such as prawns.

"We are looking at five types of prawn from outside Australia that are sold to our markets, as well as prawns produced in Australia for the local market and for export," Andreas says.

"About 70 per cent of Australia's seafood is imported and this means more species and different processing procedures. It's not the quality of the seafood, it's the allergic reaction in some sensitised consumers which is the problem."

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RESEARCHERS ARE LOOKING AT THE GENETIC AND ENVIRONMENTAL FACTORS THAT INFLUENCE THE TASTE OF STRAWBERRIES. CREDIT: RMIT

Strawberries that pack a flavour punch

Why does the same species of strawberry taste different in different countries? How is it that Californian strawberries are loved by locals but fail to impress Down Under?

RMIT University researchers, Assoc. Prof. Eddie Pang and Prof. Phil Marriott, are looking for answers to those questions to help Australian strawberry growers identify which breeds grow best in which region.

The problem lies between the desire of strawberry lovers for the better tasting Australian breeds, which crop for only three months, and the financial needs of farmers, who would clearly prefer the nine-month season of the hardy varieties such as the Californian Selva.

"If you actually taste Californian varieties in California, they taste better there than they do here," Eddie says. "We bring these varieties over and they are clones, exactly the same genetic material, and we don't seem to be able to get the same flavour."

The researchers are testing a hypothesis that it is the interaction between the genes and the environment that determines flavour.

By isolating the compounds and measuring the contribution of each compound to the smell and taste of the strawberry, they hope to figure out the specific environmental factors that influence the flavour of different species of strawberries.

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Fresh Science stories www.freshscience.org.au

Every year an elite group of early-career scientists are selected from across Australia to present their peer-reviewed discoveries to the public. After a boot camp in science communication, they talk with school students, teachers, science and government leaders and with the media.

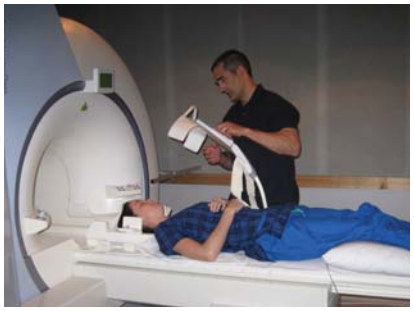
Here's a snapshot of some of the 2009 crop of Fresh Scientists. You can read more about their discoveries at www.freshscience.org.au

freshscience

LOOKING INTO THE BOREHOLE. CREDIT: GEOSCIENCE AUSTRALIA

Life beneath the sheets: 9000 years in the dark

Researchers at Geoscience Australia have unravelled the development of a unique seafloor community thriving in complete darkness below the giant ice sheets of Antarctica. The community beneath the Amery Ice Shelf in Antarctica is 100 km from open water and hidden from view by ice half a kilometre thick. This ecosystem has developed very slowly over the past 9,000 years, since the end of the last glaciation. Today it is home to animals such as sponges and bryozoans fed by plankton carried in on the current. Dr Alix Post studied shell fossils within core samples where she unexpectedly found evidence of these isolated ecosystems.



MRI SCAN SHOWING FAT INFILTRATION INTO NECK MUSCLE. CREDIT: JAMES ELLIOT, UNIVERSITY OF QUEENSLAND

Whiplash: who won't get better?

Most people recover from whiplash injuries within the first few months. However, some people have long term pain—lasting months or years. Until now there has been no way of diagnosing these more severe cases. New research suggests that fat deposits in the neck muscles are the key. "We've found that people with long term injury have large amounts of fat infiltration in their neck muscles," says Dr James Elliott from the University of Queensland (and former US professional baseball player). "Something is causing that difference, and it isn't their body weight," he says.

A POWERFUL OWL STUDIED BY FIONA HOGAN. CREDIT: FIONA HOGAN, DEAKIN UNIVERSITY

Owl CSI—feathers and DNA reveal night secrets

Dr Fiona Hogan is DNA fingerprinting Australian owls with the help of feathers and a keen public. Her work is transforming our understanding of the night life of owls, normally notoriously secretive. From a single feather, this Deakin University researcher can determine the species, sex, and identity of individual birds. She has already found a pair of powerful owls who have mated together for at least ten consecutive years, and that those breeding in urban areas are typically more closely related than those which breed in the bush.

SOPHIE BESTLEY CATCHING TUNA. CREDIT: THOR CARTER, CSIRO

Dinner for tuna

Southern bluefin tuna can't even have a quiet snack without CSIRO researchers knowing. They've developed a way of tracking when the tuna feed and also where, at what depth, and the temperature of the surrounding water. Dr Sophie Bestley and her colleagues at CSIRO's Wealth from Oceans National Research Flagship surgically implant miniaturised electronic 'data-storage' tags into juvenile fishes off the coast of southern Australia.

CREDIT: CSIRO FOOD FUTURES FLAGSHIP

How lobsters create their colours

A team of Queensland researchers have discovered the genetics that underlies the one molecule that lobsters, prawns and other crustaceans use to make the complex coloured patterns appreciated by biologists and connoisseurs of seafood. The work of Dr Nick Wade and colleagues will help with conservation and aquaculture and may even lead to a new food colourant. The colour of seafood is directly linked to its acceptability as food. Highly coloured lobsters and prawns attract a premium price. And for the crustaceans themselves, it's a matter of survival.

Other Fresh Science stories:

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