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CAVE SCIENCE

MEDICAL SCIENCE
'Tamed' bacteria may save the day for antibiotics

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COVER PHOTO: PAUL JONES

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Teaching and learning without boundaries

A digital eruption is hitting higher education. The expectations of learners have been transformed irrevocably. Vast quantities of free educational resources are available online, and learners of all ages are becoming more and more sophisticated at using them. If and when they arrive on campus, they expect an experience that students could never have imagined even 10 years ago – an experience that fully embraces technology and is truly mobile.

Whenever a new technology arrives, some people are afraid it will mean the wholesale destruction of all that has gone before. During the 15 years I worked at the BBC, I saw that fear: that the internet would mean the end of traditional radio stations, the end of traditional television stations. Of course it didn't. But it has fundamentally altered them, and in the same way the internet will transform campus-based education – but it won't destroy it.

Some aspects of university education can never be delivered purely by online means: student life inculcates a whole range of skills of which the things you learn in class are only a small part. But the internet may well sweep away the things that can be better delivered online.

If – and it's a big if – universities are prepared to make the often difficult and radical changes the digital age requires, they will be rewarded with unparalleled opportunities to transform what they have been doing throughout their history. Teaching and learning will become more effective as teachers adopt new techniques and technologies, and learners are put more in control of what they learn, and when, how and where they learn it.

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Monash – Delivering Impact

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It is now possible to reach a vastly greater number of people than would have been able to learn at a university in the past. One of the things we are most excited about at FutureLearn is the ability to unlock the talent and creativity previously held within university walls and open it up to people all over the world.

We should embrace opportunities, not fear change. I would question anyone's ability to predict exactly where universities will be in 10 or 20 years' time, but I am confident that while a future university will still be recognisably a university, it will live and breathe in manifold new ways that stretch far beyond its physical limitations.

Simon Nelson
CHIEF EXECUTIVE OFFICER
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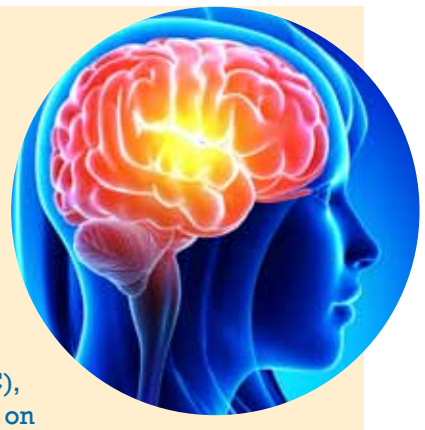
news



An outbreak of excellence

People with diseases that affect the immune system or brain are among those who stand to benefit in the future from research efforts at three new national Centres of Excellence. With a total of A$73.9 million in funding from the Australian Research Council (ARC), the centres – all led by Monash University – will focus on imaging techniques, computational techniques and bio-nanotechnology.

Of chief interest at the Centre of Excellence in Advanced Molecular Imaging, led by Professor James Whisstock, will be the development of innovative imaging technologies to explore the immune system.

Nanomedicine is at the heart of the Centre of Excellence in Convergent Bio-Nano Science and Technology, under the direction of leading polymer chemist Professor Thomas Davis. Nanomedicine is a rapidly emerging field revolutionising treatment for a wide range of diseases.

Professor Gary Egan will lead the Centre of Excellence for Integrative Brain Function. It will combine techniques for analysing brain anatomy and physiology with advanced computational techniques to determine the principles of brain function.

Monash also received more than A$5 million for two research hubs, funded through the ARC's Industrial Transformation Research Program. They will focus on additive and advanced manufacturing and will be led by Professor Xinhua Wu and Professor Gil Garnier.

NEW MONASH VICE-CHANCELLOR

Professor Margaret Gardner, AO, has been appointed as the ninth Vice-Chancellor of Monash University and the first woman in the role. Professor Gardner takes up the position on 1 September 2014. She succeeds Professor Edward Byrne, who after more than five years of distinguished leadership is leaving to become President and Principal at King's College London.

Professor Gardner comes to Monash from RMIT University in Melbourne, where she has been Vice-Chancellor and President since 2005. During her career, she has held a range of senior academic positions and served in many advisory and leadership roles. Chancellor Dr Alan Finkel says Professor Gardner will be an outstanding asset for Monash.

"Professor Gardner's extensive academic career combined with her expertise in economics, industrial relations and organisational management will further advance Monash University's position as a world-leading research institution, and continue to develop the opportunities offered to our students," he says.

Professor Gardner says she is honoured to become a part of Monash University's "expansive vision". "Monash University is one of the world's top 100 universities," she says. "It has an international presence unique for Australia and rare anywhere in higher education."

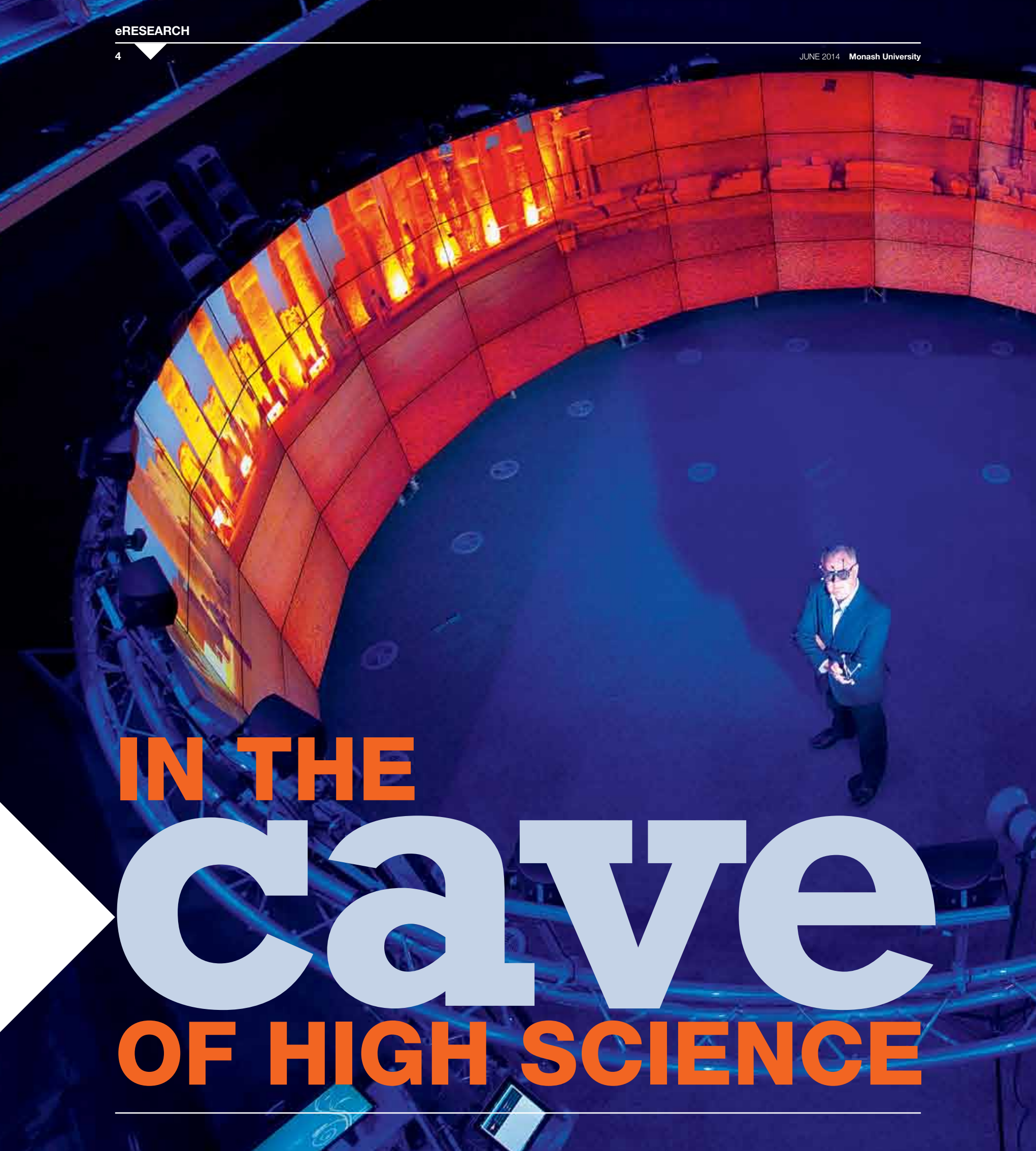
STROKE HOPE IN GENDER DIFFERENCE

A significant breakthrough in stroke research shows that the key to better recovery may be found in a "his-or-hers" approach that treats men and women differently. Males and females vary in their susceptibility to stroke. Up to the age of 75, men are more likely than women to have strokes; however, after 75 more women become stroke victims. Reasons for this difference have not been clear, although it has been thought to be tied to the hormone oestrogen.

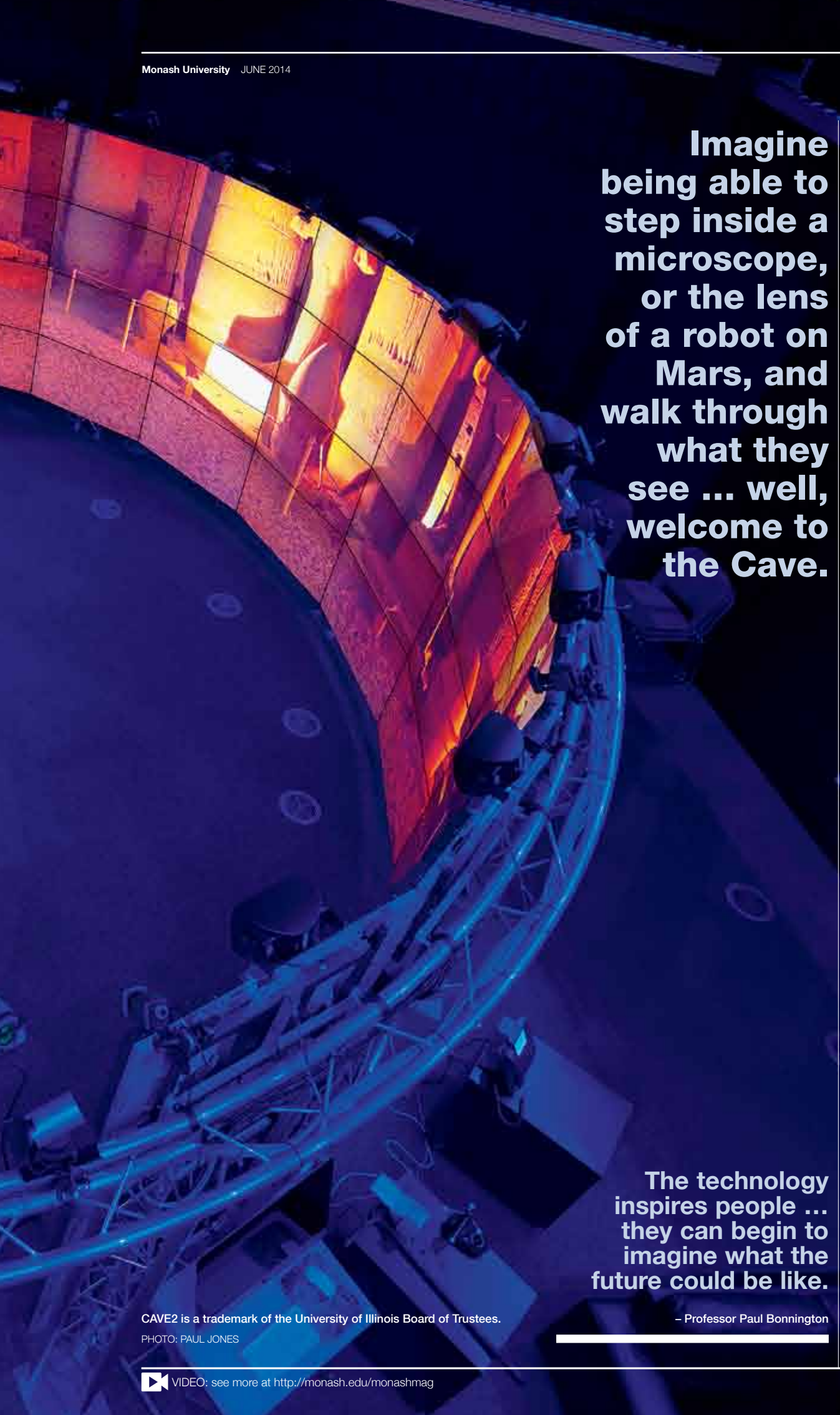
Now researchers at the Monash University School of Biological Sciences have found that if they target a recently discovered oestrogen receptor they can help alleviate the debilitating effects of strokes – but opposite approaches are needed for men and women.

Oestrogen receptors are proteins in cells that are activated by oestrogen. Associate Professor Chris Sobey says researchers have long known about two receptors, but a third has recently been found. His team showed that activating this "new" receptor with a drug would help women who had strokes. But for men, it helped to block it.

The results have been published in the prestigious *Stroke* journal. It is the first time that a drug with the potential to reduce, and even stop, the effect of a stroke in a gender-specific manner has been found.



IN THE cave OF HIGH SCIENCE



Imagine being able to step inside a microscope, or the lens of a robot on Mars, and walk through what they see ... well, welcome to the Cave.

The technology inspires people ... they can begin to imagine what the future could be like.

– Professor Paul Bonnington

CAVE2 is a trademark of the University of Illinois Board of Trustees.

PHOTO: PAUL JONES

WORDS Melissa Marino

Professor Paul Bonnington is surrounded by red dust and pebbles, underfoot and ahead, as he walks through a small valley wending its way through barren, undulating hills and rocky escarpments.

"Welcome to Mars," he says, as he guides us through the desertscape of our planetary neighbour.

It is so real, so enveloping a sensation, that you are tempted to try to souvenir a pebble.

With a few laptop keystrokes we are back on Earth, although the sensory overload does not diminish; in fact, it intensifies. We are now "walking" inside someone's brain. All around us, like psychedelic spaghetti, are large colour-coded tubes – the electrical circuitry connecting the brain's left and right hemispheres. As Professor Bonnington explores this space, bright red, green and purple tubes pass by on a seemingly endless trajectory.

As cinematic as they might seem, the brain circuitry and the Mars panorama are real enough: creations of one of the world's most advanced visualisation facilities, which gives researchers extraordinary new spatial awareness of their subjects – from the microscopic to the galactic.

Time and space

This ability to transcend time and space is facilitated by the compilation of 3-D images projected through 80 high-definition LCD screens encircling Professor Bonnington, who during this demonstration has been standing inside Monash University's virtual reality environment CAVE2™ – the latest version of this new visual representation technology developed by the University of Illinois in Chicago.

Mounted around a curved room, the screens produce images which, when viewed through special 3-D glasses, surround and immerse the viewer, providing an extraordinary wealth of detail captured by the imaging technology used to obtain the original pictures.

Wearing a pair of control "tracked" glasses, the viewer can not only see the images, but also manipulate them, walking through and around the subject to observe it from all angles.

This unique "immersed" perspective opens up new possibilities for insight and discoveries across a range of sciences, says Professor Bonnington, director of the Monash eResearch Centre (MeRC), who has overseen the development of CAVE2 at Monash University's campus at Clayton in Melbourne.

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VIDEO: see more at http://monash.edu/monashmag

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For example, the brain's white matter viewed close up in CAVE2 can provide biomedical researchers with new insights into disease – especially when they are able to compare diseased and healthy samples.

Senior research fellow and CAVE2 platform manager Dr David Barnes explains: "If you looked at this on a desktop display it would basically look like a bundle of wool. You don't appreciate the space and gaps between the circuitry and its 3-D structure, but CAVE2 lets researchers see the actual structural differences."

Similarly, while the Mars images originally taken by the rover Curiosity are readily available on NASA's website, it is not until they are screened in CAVE2 that the planet's features are seen at scale. "You can deduce a lot more from this perspective," Dr Barnes says.

And this is just the start. Dr Barnes says CAVE2 can benefit research and industry across a spread of studies, including archaeology, engineering, the biological sciences, history, architecture and construction.

Fragile historical ruins, for example, can be studied in detail, without disturbance. In complex engineering projects, design and infrastructure can be modelled precisely and examined in detail, potentially avoiding costly revisions later in a project.

"We have had more than 1500 visitors from research and industry," Dr Barnes says. "People walk away feeling inspired to imagine new uses for CAVE2 in their own fields."

21st-century microscope

Professor Bonnington likens CAVE2 to a viewfinder on a 21st-century microscope. The microscope, at the centre of scientific discovery for hundreds of years, has three key components: at the bottom, a light source to illuminate a sample; in the middle, the focusing dials; and at the top, an eyepiece for viewing.

"Five years ago we set out saying, 'scientific discovery is still going to depend on this concept, but we need a modern equivalent'," he says.

So in Professor Bonnington's 21st-century incarnation of the microscope, the light source or imaging technology providing the sample includes instruments such as the Australian Synchrotron, a magnetic resonance imaging scanner or datasets such as a DNA sequence.

The 'middle' focusing and filtering components of the traditional microscope are replaced by computational tools through which the data sample is focused, transformed and filtered to extract features. These are packaged as a purpose-built interactive supercomputer installed in a national facility called MASSIVE, which has been developed by the eResearch Centre.

Taking the large amount of data from the bottom instrument layer of the "microscope" and placing it into MASSIVE is a software technology called MyTardis. Developed on-site, MyTardis is a data transport, management and storage facility.

Finally, the modern-day viewfinder is a powerful viewing lens – CAVE2 itself – which can reveal features, details and a perspective never before possible with the naked eye.

Up close and personal

Professor Bonnington says CAVE2 will help advance landmark research, including building further on the Human Genome Project. Mapping the human genome has been a great advancement in the study of genetics, but it was, he says, simply stage one.

"It was really just prep for where the research is going, and that is to understand not just the building blocks, but how they function," he says. This understanding will come through the Human Proteome Project, which is mapping proteins expressed by genes not only to shed light on protein function, but also to advance the treatment of disease.

The extent to which a protein's function is understood is often determined not by its chemical make-up, but by its shape and how this shape can change. There is no better place to analyse protein shape than in CAVE2 where, for example, electron microscopy data converted and modelled through MASSIVE can be studied up close in a super-sized format in three dimensions.

Similarly, CAVE2 could be used to fast-track drug design. "When you know the structure of a target molecule you could come in here with a bunch of drug candidates and literally carry them over to the molecule and see if they fit," Dr Barnes says.

He says the human brain is still the best pattern-recognition tool that exists. This is a key reason why viewing data in high-resolution, virtual-reality detail in CAVE2 is such an extraordinary opportunity for discovery.

City of Chicago policymakers certainly know about the potential of CAVE2 through its capacity to give large datasets a visual representation.

In 2013, they loaded crime-rate data from the city into the original CAVE2 in the Electronic Visualization Laboratory at the University of Illinois. This map overlay of crime patterns in a single large view guided the development of a new and more effective policing strategy.

Illinois's Electronic Visualization Laboratory experts helped install the CAVE2 technology in Melbourne, where it has been operating since November 2013. Professor Bonnington says the potential for application and collaboration with research and industry – and as a teaching tool – is boundless.

"The technology itself inspires people," he says. "They see technology used in a way they have never seen before, and they can begin to imagine what the future could be like." ■

PHOTO: ARUP

Arup infrastructure simulation.

Professor Paul Bonnington using "tracked" 3-D glasses and control that help to surround and immerse the viewer in CAVE2™.

PHOTO: PAUL JONES

PHOTO: ARUP

Arup walk-through building schematic.

Ground zero for "cutting-edge" engineering

Global engineering and design firm Arup has played a leading role in redeveloping the Second Avenue Subway precinct at Fulton Street, the site of the former World Trade Center towers in New York.

Using a gaming engine, Arup engineers modelled people moving through the space to identify bottlenecks and optimise crowd flows. But recently, bringing that information into CAVE2™ gave the project a whole new dimension, says Arup Australia's buildings practice leader, Peter Bowtell.

"You can actually understand how people move through space – you see them moving around you in their avatar form, and you get a greater understanding of 'what is the constraint; what is driving the particular behaviour?' and how you can improve the physical operations of a building when people are there," he says. "It is all about being able to visualise big datasets in a meaningful way."

The modelling was done as part of a Monash University/ Arup Industry Team Initiative, combining the talent of a team of university students with Arup projects to demonstrate the potential of CAVE2 in large-scale development projects.

Mr Bowtell, whose company is at the forefront of global innovation, says it has proved its worth. "You often are concerned with being at the 'bleeding edge' [new unproven technologies] rather than at the 'cutting edge' [proven state-of-the-art]. The work we have done with Monash is showing how we can apply or implement new technologies," he says.

Most notably, he says, the 3-D format of CAVE2 immerses clients and practitioners within a space, allowing people not only to see features from within a 320-degree view, but also to walk through and around a virtual finished building and inside its internal structures.

This offers clients and stakeholders a clear understanding of the design concept by showing what the finished product will look like, feel like and even sound like. It is possible, say Arup engineers, to apply a variety of flooring, finishes or other design elements to a virtual building in the cave, and hear how different choices affect noise levels in the building.

But more than just a "wow factor", CAVE2 offers practical benefits to the architectural, design, engineering and construction industries by identifying any potential "construction conflicts" in, for example, internal plumbing or electricity conduits. This could eliminate costly revisions later. Mr Bowtell says it is a trend catching on, with "virtual construction" driving anticipated savings of 15 to 20 per cent in the US and the UK.

"You can see new ways in which CAVE2 could really be incredibly valuable for proving building and project concepts before and during their production cycle," he says.

"There is always a bridge needed between academia and the application of research into real projects, and we can say that we now have the knowledge and understanding to be confident in using this technology," Mr Bowtell says. "We see this very much as the start of a journey rather than an end point."

ILLUSTRATION: JUSTIN GARNSWORTHY

PROTEINS THAT TAME BACTERIA

THE TERRIBLE CONSEQUENCES FOR PATIENTS OF ANTIBIOTIC-RESISTANT BACTERIA HAVE CAUSED WORLDWIDE ALARM AND INSPIRED SCIENTISTS TO TRY A RADICAL NEW STRATEGY – LETTING THE BACTERIA LIVE BUT SWITCHING OFF THEIR ABILITY TO CAUSE DISEASE.

WORDS **Dr Gio Braidotti**

Drugs that kill cells as a way to heal people have an insidious side. They inadvertently allow rare and unusual individual cells – mutants – to survive the drug treatment.

The result of this "selective pressure" is the evolution of drug resistance that can render useless many important drugs. But it is the resistance to antibiotics – the pharmaceuticals used to kill disease-causing bacteria – that is the most alarming threat to public health.

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The Centers for Disease Control and Prevention in the US recently reported that at least two million Americans each year are affected by serious antibiotic-resistant infections. About 23,000 die and many more deaths occur later from complications caused by infections.

The number of antibiotics now available for use by doctors has been reduced by nearly 25 per cent. And because bacteria can become resistant to multiple antibiotics, doctors around the world have been forced to fall back on old or toxic antibiotics in a desperate bid to save lives.

It leaves people with harrowing choices. For example, a leg wound that subsequently becomes infected can force a patient to decide between amputating the leg or taking an antibiotic so toxic that it will put them on dialysis for the rest of their life.

Antibiotic resistance also undermines important medical advances that require the control of bacterial infections. These include cancer chemotherapy, complex surgery, organ and bone marrow transplants, dialysis and treatment for diseases such as rheumatoid arthritis.

Live and let live

Compounding this increasingly dire situation is the fact that pharmaceutical companies have essentially abandoned antibiotic research and development because the drugs are compromised before the cost of development has been recouped.

All this has led researchers to reconsider the approach. If killing the bacteria is at the root of the resistance problem, the question becomes: "Why not let the bacteria live and find a way instead to make them harmless?"

Scientists in Australia and the US have discovered something about bacteria that makes such a radical strategy a real possibility.

Central to the discovery is the structure of two bacterial proteins – BamA and TamA.

BamA is present on bacteria's outer cell membrane and is essential for their survival. This is important for the "good" microbes that humans need for digestion and healthy immune systems.

TamA is like BamA's evil twin, found only in bacteria that tend to cause disease. When TamA is deactivated, the bacteria continue to live but lose much of their ability to cause disease.

Consequently, TamA makes a near-ideal target for developers of a new class of drugs that avoid killing bacteria indiscriminately and instead diminish the ability of the dangerous ones to make people sick.

TamA was discovered in the laboratory of Professor Trevor Lithgow at the Monash University School of Biomedical Sciences in Melbourne, a direct consequence of research targeted at the worsening antibiotic crisis.

"There really is a major global disaster in the offing," Professor Lithgow says. "If we are to overcome the loss of antibiotics and deal with resistant bacteria then we need new strategies.

"However, the first hurdle in trying to develop small molecules to act as drugs is to get those drugs into the inside of the bacterium. So we decided to start with targets on the surface of bacteria."

Over a seven-year period he and his team focused on learning more about bacteria's outermost "surface". The team comprised 13 researchers at Monash and collaborators including protein-structure specialist Dr Susan Buchanan from the National Institutes of Health (NIH) in Bethesda, Maryland, in the US.

"My interests lie in acquiring a better understanding of bacteria and how their outer cell surface works," Professor Lithgow says. "That is what will allow people to try new, left-field ideas to develop new therapies."

Secret tunnels

This outer surface has two main forms across bacterial species – as a cell membrane or a cell wall. The differences affect the uptake of a dye in what is called the Gram staining procedure, which leads to bacteria being categorised as either Gram-negative or positive.

Bacteria with an outer cell membrane are denoted Gram-negative. They are much more resistant to antibiotics and include many disease-causing species. It is this class that Professor Lithgow focused on, although his findings are broadly applicable to all bacteria.

When Professor Lithgow started, it was generally known that deactivating BamA caused the outer cell membrane to be destroyed and the bacteria rapidly died. This finding had set off a worldwide hunt for clues as to what BamA does that is so vital to bacterial survival.

When TamA was deactivated we found the bacteria could keep growing just fine, but disease-causing bacteria lost their ability to cause sickness.

– Professor Trevor Lithgow

In 2013, Dr Buchanan and her team found the most important clue. They deciphered BamA's 3-D structure, a major achievement given that currently only one per cent of proteins that associate with a cell membrane have had their 3-D structures mapped. Dr Buchanan's 3-D structure of BamA was published in *Nature* magazine in September 2013.

Dr Buchanan specialises in imaging the structure of "membrane-bound" proteins. She trained with Nobel Prize-winning chemist Professor Johann Deisenhofer, recognised for determining the first such protein structure.

Dr Buchanan explains that in structural biology, the protein of interest must first be purified and then induced to form

A leg wound that subsequently becomes infected can force a patient to decide between amputating the leg or taking an antibiotic so toxic that it will put them on dialysis.

well-ordered crystals. These are then bombarded with high-energy X-rays at a synchrotron causing them to scatter (or "diffract") in ways that reveal the arrangement of atoms in the crystal.

Viewed on a computer screen, BamA appears to form a dome within the outer surface of the cell membrane. Under the dome is an aqueous cavern with a side aperture that leads into the membrane and an appendage resembling a crane that reaches inside the bacteria.

"Our structure suggests that other proteins can use BamA to pass from inside the bacteria to the outer cell membrane," Dr Buchanan says.

"Besides providing physical passage into the membrane, BamA assists that insertion by biochemically altering the membrane, compressing it so that it destabilises and allows new molecules in."

Protein gateway

Back in Melbourne, Professor Lithgow now had an explanation for why bacteria cannot survive without BamA: it is a gateway through which all other proteins take up their positions in the outer membrane.

However, there was a complication. When he compared BamA from different bacterial species, he found some also contained a truncated BamA-like protein – TamA – that initially confused his analysis.

When the structure of BamA was solved, however, this annoying complication resolved into a golden opportunity.

Professor Lithgow realised that like BamA, TamA too is structured to allow other proteins to move from inside the bacteria into the outer cell membrane.

But TamA goes a step further. It processes molecules needed to infect and cause disease – molecules such as adhesins. These are long, sticky molecules that help bacteria to lock down, avoid the host's immune system, and infect and damage tissue.

"When TamA was deactivated we found the bacteria could keep growing just fine, but disease-causing bacteria lost their ability to cause sickness," Professor Lithgow says.

"At first, the results seemed too good to be true. But we now have enough evidence that in TamA we have a protein that associates with disease-causing functions in bacteria."

As such, TamA makes an ideal target for drug development because the drugs would be able to weaken disease-causing bacteria – including antibiotic-resistant bacteria – without also affecting "good" bacteria and also without selecting for drug resistance as dramatically as antibiotics that kill bacteria.

TamA tamed

Dr Buchanan describes Professor Lithgow's characterisation of TamA as simply beautiful. The opportunities it and BamA provide to develop drugs and vaccines are especially welcome at the NIH, which recently set up a consortium to accelerate progress to deal with the antibiotic-resistance crisis.

However, Professor Lithgow warns that drug development is neither straightforward nor quick, and requires substantial investment in research.

He is working on interim measures with the Commonwealth Scientific and Industrial Research Organisation and Monash biomedical engineers.

These include searching for compounds that target TamA for use in medical devices such as catheters, wound dressings or implants to dissuade dangerous bacteria from getting a foothold in wounded or critically ill patients.

At all times, efforts continue towards filling knowledge gaps. Professor Lithgow is keen to use a new, advanced imaging technology – super-resolution microscopy – to visualise the outer membrane of bacteria along with the BamA, TamA and adhesins proteins.

"Currently we have good reagents to see BamA and they are not randomly distributed on the surface of bacteria," he says. "They are sitting together in precincts that are sites for the assembly of important molecular structures on the cell's surface.

"What we want to know is what TamA is doing and what happens at these assembly sites when adhesins are expressed by disease-causing bacteria. We can then look for other non-essential factors that are specific to disease-causing bacteria to also target for drug development." ■

The re-emergence of infectious diseases

Bacterial resistance to antibiotics has meant the return of deadly diseases that for the best part of a century have been rare or a minor inconvenience.

Sepsis
Klebsiella pneumoniae **has started causing infections inside the healthcare system (for example, hospitals) since acquiring antibiotic resistance. This includes bloodstream infections, wound or surgical-site infections and meningitis, particularly among extremely sick patients who require devices such as ventilators and catheters. The bacteria are found normally in the human intestine where they do not cause disease.**

Pneumonia
Streptococcus pneumoniae **is a leading cause of illness among young children worldwide and is the most frequent cause of pneumonia, bacteremia, sinusitis and middle-ear infections – and has become worse with antibiotic resistance.**

Tuberculosis
Mycobacterium tuberculosis **has become resistant to multiple drugs. The bacteria usually attack the lungs, but infections can also attack any part of the body including the kidneys, spine and brain. If not treated properly, tuberculosis can be fatal and it was once the leading cause of death in the US.**

Campylobacteriosis
Campylobacter **infections are a notifiable disease in Australia. Food Standards Australia New Zealand reports a rate of 102.3 cases per 100,000 people. In the US, where *Campylobacter* is not notifiable, the infection rate is put at 13.6 cases per 100,000 people. Many of these infections are food-borne and result in diarrhoea, cramping, abdominal pain and fever. *Campylobacter* infections can result in long-term consequences, such as arthritis or a type of temporary paralysis called Guillain-Barré syndrome.**

Golden staph
Staphylococcus aureus **mostly causes skin infections, but in medical facilities, antibiotic-resistant *S. aureus* causes life-threatening bloodstream infections, pneumonia and surgical-site infections.**

Gonorrhoea
Neisseria gonorrhoeae **is a sexually transmitted disease that can cause pelvic inflammatory disease and infertility in women if left untreated.**

Recently, resistance was also detected against antibacterial agent triclosan, which is widely used in soap, cleaning supplies and mouth washes. A study on bacteria in streams and river sediments in the Chicago metropolitan region, in the US, found an increased presence of triclosan resistance and a change in the composition of bacterial communities.

TOO YOUNG TO BE *forgotten*

THOUSANDS OF YOUNG PEOPLE WITH DISABILITIES FIND THEMSELVES LANGUISHING IN NURSING HOMES FOR THE ELDERLY. RESEARCHERS HOPE TO CHANGE THIS TRAGIC OVERSIGHT IN HEALTH CARE.

WORDS Melissa Marino

Vicki Wilkinson never expected to live in a nursing home. At least, not yet. The mother of two enjoyed an active life until medical complications from an accident left her confined to a wheelchair without torso control or the ability even to hold up her head. With the complex care required, a nursing home was the only option.

At 48, Ms Wilkinson is decades younger than the other 62 residents, with whom she has little in common. "I don't want to play bingo or do craft," she says. "Sometimes I stay up late just so I can turn the music up and be me."

Her emotional state is also affected by rigid institutional routine and the passive compliance expected of residents. Ms Wilkinson relies on staff for even the most basic tasks – dressing, reaching for a book or turning on the light. Independence is discouraged. Bath and meal times are inflexible. "It dehumanises us," she says. "Nursing homes are not for the faint-hearted."

More appropriate housing could improve life for people such as Vicki Wilkinson, for whom a nursing home is often the only option.

PHOTO: FRED KROH

Ms Wilkinson lives in Victoria, Australia, but her story would be all too familiar across most of the developed world where care is institutionalised and where, simultaneously, there is insufficient housing for young people requiring daily care after brain or spinal cord injury, or because of degenerative neurological conditions such as multiple sclerosis.

"Not enough accessible and affordable housing and support for people with disability is a worldwide issue," says Monash University's Libby Callaway, who is building a research-backed case for more housing and support to meet the needs of young people.

In the US, government health program data shows that one in seven residents in nursing homes is under 65, and therefore of working age. Research also shows that one-third of longer-stay residents with multiple sclerosis are 50 years or younger on admission – and the situation appears to be getting worse. Global data is scarce, but US figures show that since 2003 the population of younger residents in nursing homes there has increased by 22 per cent. As in the US and Australia, Canadian research has identified nursing homes as an "inappropriate living environment" for people with acquired brain injury, but the research on which to model alternative arrangements is lacking.

In the UK, recent research by the spinal injury charity Aspire says that one in five people with spinal injuries will end up in nursing homes for older people because there is nowhere else for them to go.

Friendless lives

The Australian Institute of Health and Welfare figures show that every year in Australia more than 200 people younger than 50 face admission to nursing homes for care, because there are no alternatives.

Ms Callaway and her colleagues have been working for several years towards determining more clearly the needs of young people with acquired and late-onset neurological disabilities. This is through her role as research manager at the Summer Foundation, which specifically addresses the issue of young people in nursing homes, and through Monash University's Department of Occupational Therapy.

Ms Callaway's rehabilitation work with collaborator Dr Di Winkler, the Summer Foundation CEO, shows that people with acquired brain injury can improve in the long term with the right models of support and housing. Therefore, she says, there needs to be a range of age-appropriate, affordable options that allow people to develop community links and independence as part of a more fulfilling post-injury life.

A nursing home, where the average age of residents is 84, is not the place for this to happen, she says. Staff ratios are not high enough to provide, for example, opportunities for young people to venture out. A lack of privacy discourages visitors, causing further isolation.

Ms Callaway says 53 per cent of young people in aged care receive a visit from a friend less than once a year and one-third never have the opportunity to participate in community-based activities. She advocates a new integrated housing model.

In October 2013, the Summer Foundation launched its example of next-generation housing for people with disability. The demonstration project has six apartments for people with high support needs peppered throughout a larger housing development close to a train station and shops. The objective is to maximise social inclusion. Residents can use an iPad or smartphone to control lighting, heating, cooling, blinds and doors or to contact support staff. This provides greater independence and privacy while still connecting to 24-hour on-call support.

Outcomes for residents will be evaluated over two years and compared with traditional group homes. The project is funded through the Institute for Safety, Compensation and Recovery Research, a joint venture between Monash, the state of Victoria's Transport Accident Commission and WorkSafe Victoria.

A similar housing model is in development through another project secured by Ms Callaway and her colleagues. This will be in partnership with community housing providers Mission Australia Housing and Yooralla and will use an Australian Government grant from its three-year Supported Accommodation Innovation Fund, established in 2011.

Built adjacent to a Monash campus in south-east Melbourne, the project will house six people in individual units, providing privacy, autonomy, community connection and optional support from the university's allied health undergraduates.

Human rights

The ideal housing model, Ms Callaway says, varies for different circumstances. Indeed, some residents of aged-care facilities report being satisfied, as do many in traditional shared arrangements. But she says the range is limited and choice – if the family home is not an option – is almost non-existent.

She regards this lack of choice as a human rights issue, particularly given that Australia is a signatory to the United Nations Convention on Rights for People with Disabilities. Australian Disability Discrimination Commissioner Graeme Innes says the convention sets out the rights of people with a disability to live in the community with choices equal to others. "We need to turn that right into a reality," he says.

53% of young people in aged care receive a visit from a friend less than once a year.

– Libby Callaway

Young people in Australian nursing homes have a range of disability types

Acquired brain injury
58%
Multiple sclerosis
13%
Huntington's disease
9%

In Australia, most young people in nursing homes acquired their disability as adults. Almost half (48%) have partners. More than a quarter (27%) have school-aged children.

SOURCE: SUMMER FOUNDATION LTD AND PWC

He says a significant step towards this was the introduction in Australia in 2013 of the National Disability Insurance Scheme (NDIS), which will provide funding for equipment and support to help people with disabilities to live in the community. Research by Ms Callaway, Dr Winkler and PricewaterhouseCoopers was used to inform the NDIS. The researchers set out in stark terms the resources required for young people to be able to leave nursing homes and enter the community.

They found the average cost of support services for one person would be A$145,000 per year. When combined with the capital costs of housing, the estimated extra cost to the system of relocating up to 310 young people across the three NDIS launch sites was A$35 million.

This demonstrates the enormous scale of the issue on both a social and an economic level.

Building independence

In working on improved, long-term housing models, Ms Callaway, Dr Winkler and Summer Foundation colleagues have been able to draw on the outcomes of a previous scheme in Australia, a five-year Younger People in Residential Aged Care program, which ended in 2011. It allowed about 250 people to be moved from nursing homes and a further 244 to be diverted from entering them in the first place.

The researchers assessed outcomes for people supported through the initiative. They found moving from nursing homes into smaller-scale, home-like settings with more individualised support and staff substantially improved quality of life.

"We found people had more opportunity to get out of bed, get out of the house, and they had more choice around decisions such as when to go to bed, what to wear or what to eat."

Ms Callaway says that along with policy and institutional barriers, community attitudes also need to change. "We need to help the broader community understand that a person with a disability is just like anyone else and has dreams and hopes for their future. To achieve those things they need an age-appropriate model of housing and support so they can live in the community and pursue their goals," she says.

Ms Wilkinson's hopes and dreams are both grand and simple. "I'd like to travel, get married again and walk around the lake with somebody and enjoy the sunshine," she says. "I don't belong in a nursing home." ■

At time of going to print, Vicki Wilkinson had moved out of the nursing home and was re-establishing her place in the community.

Trials AND errors

Prosecuting war criminals raises complex legal and moral issues that must run the political gauntlet.

WORDS **Alexandra Roginski**

The first time Gideon Boas met Slobodan Milosevic was in the dictator's holding cell in The Hague. As a senior legal officer for the United Nations' International Criminal Tribunal for the former Yugoslavia, the young Australian lawyer had a message to deliver from the court to the former Serbian head of state.

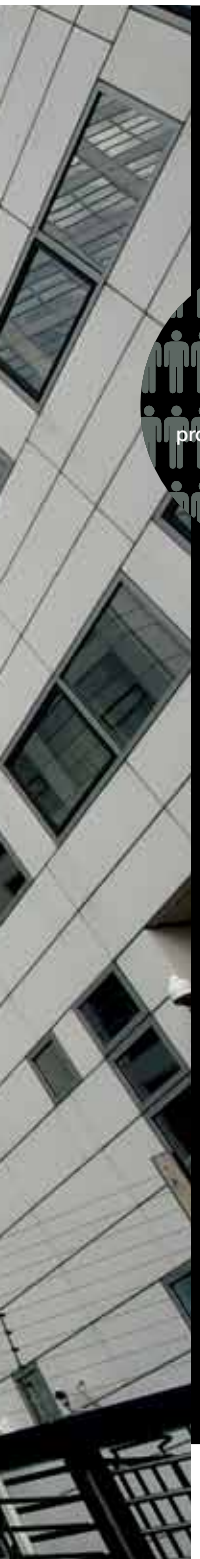
"I went into the room and there was a desk and a chair. He offered me the chair, sat on the desk and was polite and charming, an enormously charismatic man. It was quite disturbing being in his presence because one could forget momentarily what he was alleged to have done," says Boas, now an associate professor at Australia's Monash University, reflecting on how horrific crimes can be instigated through the power of personal persuasion.

Associate Professor Boas's nine years in The Hague, many of them spent working on the Milosevic trial, today inform his broader research into international criminal justice. "I'm interested in these things from a legal angle, which is my baseline training, but also from political, social and cultural perspectives. I'm interested in what we prosecute and why, and how that is influenced by a variety of factors."

His work encapsulates not only major international forums, such as the International Criminal Court (ICC) and UN criminal tribunals, but also the prosecution of atrocities in an alleged war criminal's new country of residence. This challenges that country's willingness and capacity to confront these otherwise remote crimes, opening up a range of complex moral and legal issues that are the focus of some of Associate Professor Boas's current research.

PHOTO: WWW.123RF.COM

For example, he argues that discussions need to be revived as to how Australia should address the presence of war criminals – said to be as many as 2000, from various conflicts – living in the community. He says failed attempts to prosecute former Nazi war criminals in the 1980s and 1990s, and the low political capital that this generated, mean governments have become reluctant to engage in debate about how these matters could be tackled. The issue has also been overshadowed by the focus on counterterrorism efforts since the 9/11 attacks in the US.



International Criminal Tribunal for the Former Yugoslavia (ICTY)

- 161 people indicted by the tribunal (23 in custody at the UN ICTY Detention Centre)
- 20 proceedings ongoing (16 before the appeals chamber, 4 at trial)

SOURCE: WWW.ICTY.ORG

Decisions over the number of charges happen in all jurisdictions. But obviously there's a vastness of criminality when you're prosecuting presidents and generals.

– Associate Professor Gideon Boas

The International Criminal Court in The Hague, the Netherlands, where war crimes are sent to trial.

A national choice

The Australian position on war crimes was not always so timid.

Between 1945 and 1951, more than 800 Japanese were tried in Darwin and other locations in the Pacific region for war crimes, a history that Associate Professor Boas has been exploring as part of an Australian Research Council Linkage Project with the University of Melbourne and the Australian War Memorial.

These trials have subsequently been criticised, with claims that the defendants were not given adequate time to prepare and that some prosecutorial and judicial staff were not lawyers. But Associate Professor Boas points out that these prosecutions preceded the modern human rights regime, and that not all resulted in conviction or long sentences, indicating some level of impartiality.

There were no further prosecutions until the 1980s, when three trials of alleged Nazi collaborators from the Ukrainian community in South Australia failed to secure convictions.

The protracted nature of the trials, their expense and the fact that they did not result in convictions all affected public opinion on the importance and even relevance of prosecuting war crimes in Australia, particularly for events that occurred in other countries and a long time ago.

Since then, although the Australian Government has been proactive in assisting with extraditions and cooperates with the UN's international criminal tribunals and the ICC, there have been no further national prosecutions.

Associate Professor Boas says that, by comparison, countries such as Canada and the UK have continued to spend money on developing special war crimes units. In 2009, the UK passed retrospective legislation allowing war crimes committed before 2001 to be prosecuted. But the Australian Government has so far refused to close similar loopholes in its own legislative framework.

In particular immigrant communities where many people are victims of war crimes, there are varying perspectives on whether sleeping dogs should be allowed to lie, Associate Professor Boas says.

Such debates are valid in a national discussion about how a country should deal with war criminals.

"But at the moment, the government's position is that we don't even want to have that debate because it's complex and expensive and there's no political capital in such a conversation," he says.

"My research is trying to uncover why this is the case and to make suggestions about what can be done." ■

International justice by numbers

To forensically trace a war crime up the chain of command to the head of state is a herculean task, requiring years of hearings and examinations. That challenge becomes even more daunting when there are multiple charges or, in the case of Slobodan Milosevic's trial in the International Criminal Tribunal for the Former Yugoslavia, about 7500 of them.

"One of the things I learnt about how you run massive war crimes trials like this is that the prosecution has to exercise discretion," says Associate Professor Gideon Boas, who was senior legal officer to the trial chamber for the Milosevic trial. He explains that the Milosevic indictment for alleged crimes in Kosovo was joined with indictments relating to Croatia and Bosnia to encapsulate eight years across all three conflicts in the former Yugoslavia.

"Decisions over the number of charges happen in all jurisdictions. But obviously there's a vastness of criminality when you're prosecuting presidents and generals."

Selecting one event over another is an emotionally difficult thing to do, Associate Professor Boas says, but prosecutors need to show courage if the trial is to avoid being derailed by the sheer volume of charges.

"The trial felt endless. We were struggling to even deliberate a format by which the judges could determine, point by point, element by element, crimes and facts. I was up even the night before Milosevic died thinking this was impossible." (These challenges were further complicated because Milosevic chose to self-represent and also manipulated his cardiovascular medication to become ill at crucial points in the trial.)

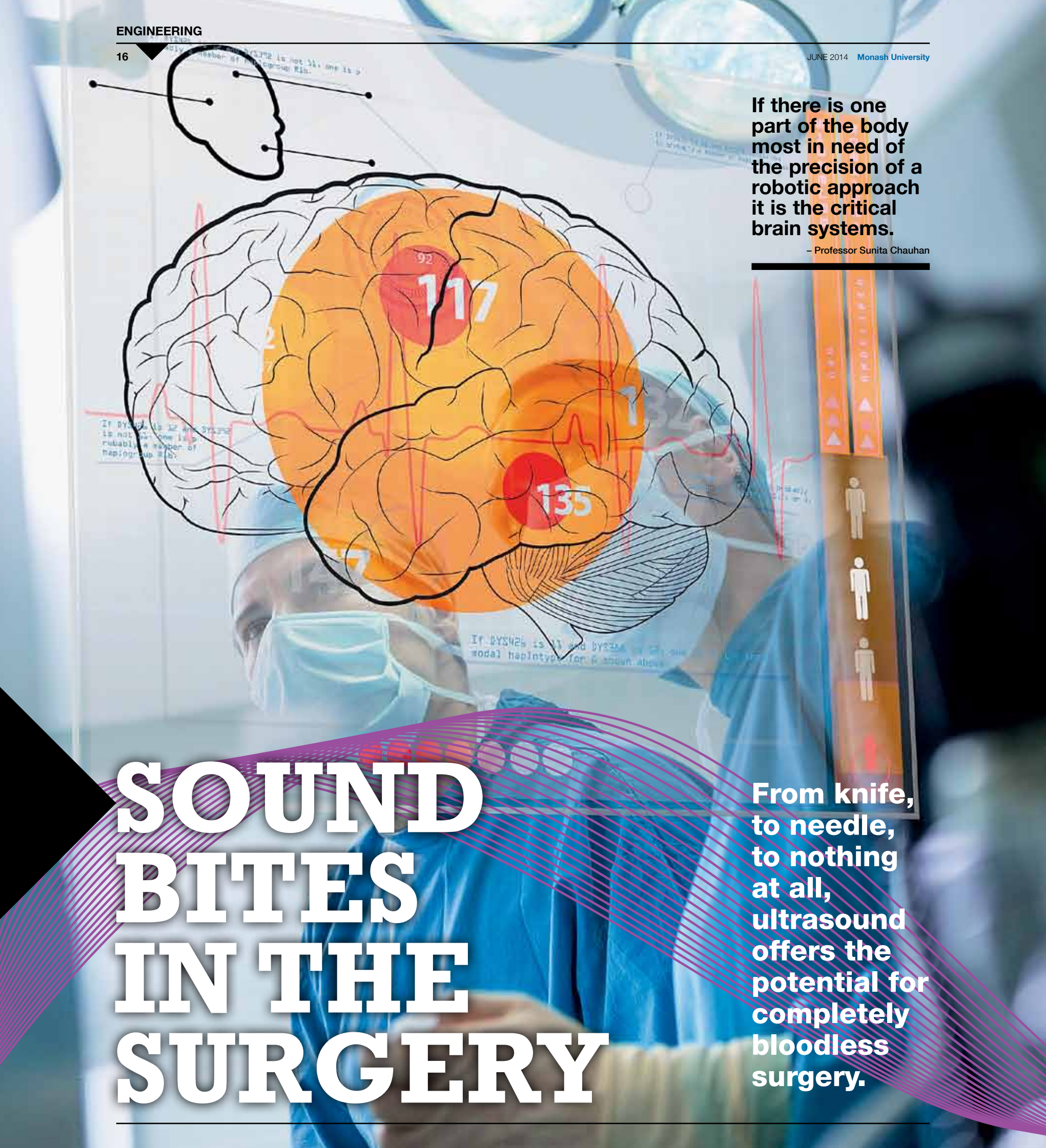
The international criminal justice system appears to have taken note of these issues since then. The International Criminal Court's first conviction, of Thomas Lubanga Dyilo from the Democratic Republic of Congo in 2012, hinged on charges limited to conscripting and enlisting child soldiers.

Although a prosecutor's selectiveness of charges stirs criticism about what this means for victim's rights, Associate Professor Boas says the focus needs to be on the bigger picture of what war crimes trials are seeking to achieve.

"Are we really there to prosecute for every single victim, or are we doing something more broadly political in nature?" Securing conviction as quickly as possible results in a much broader message about reconciliation, he says. "It's about more than the individual victim and accused. It's also about removing dangerous people and enabling states to rebuild; it's about rebuilding shattered communities; it's about what contributions can be made to peace and reconciliation."

Where some war crimes are tried

- **International Criminal Court: based in The Hague, the Netherlands, and operational since 2002, the court is a permanent tribunal for war crimes, crimes against humanity and genocide. There are currently 122 states party to the court.**
- **International Criminal Tribunal for the Former Yugoslavia: established by the United Nations Security Council, the tribunal has indicted 161 persons since 1993. Along with the International Criminal Tribunal for Rwanda, it is to be wound up at the end of 2014.**
- **National level: many countries, including the UK, the US and Australia, have domestic legislation that enshrines jurisdiction for prosecuting war crimes committed on foreign soil.**



If there is one part of the body most in need of the precision of a robotic approach it is the critical brain systems.

– Professor Sunita Chauhan

SOUND BITES IN THE SURGERY

From knife, to needle, to nothing at all, ultrasound offers the potential for completely bloodless surgery.

WORDS **Catherine Norwood**

The patient, ready to have a malignant breast tumour removed, lies face down on a special operating table with a controlled integrated container of water. The water is the medium through which the surgery will be conducted.

Through an opening in the operating table, the affected breast, inside a latex shield, is suspended in the water. An instrument array comprising multiple robotically operated ultrasound transducers fires up under the guidance of the surgeon.

Using previously determined coordinates, the array precisely targets the cancer deep within the breast tissue. Within seconds the soundwaves travel through the water, unimpaired by air (which disperses sound) and converge, converting their energy to heat that sears away the cancerous tissue. The ultrasound transducers repeatedly refocus and refire, as directed, until all of the identified cancer tissue has been burned away.

These ultrasound waves are tightly focused so that no surrounding tissue is damaged. There are no cuts, no wounds to heal, no blood loss and no extended hospital stay.

This scenario, while not yet an actual clinical practice, is a realistic glimpse into the future of surgery being designed by Monash University systems engineer Professor Sunita Chauhan, a specialist in medical robotics.

Brain surgery

The type of high-intensity focused ultrasound (HIFU) unit described is still experimental, although a prototype has been developed and patents filed. As spectacular as it already sounds, it is only part of a suite of robotic surgery technologies being researched to finesse procedures and alleviate the trauma of conventional surgery.

Professor Chauhan has a particular interest in developing neurosurgery that does not involve cutting into the brain, or even opening the skull.

"If there is one part of the body most in need of the precision of a robotic approach it is the critical brain systems," she says. "Operating in this area presents the highest degree of difficulty for the surgeon in avoiding any damage to critical structures."

HIFU robotic neurosurgery was the subject of Professor Chauhan's PhD at the Imperial College London in 1999. She has been working to make that research a reality ever since. Beginning with Focused Ultrasound Robots, nicknamed FUSBOTs, she has been working on trans-abdominal organs, such as the liver and kidneys, to demonstrate the technology works and is a serious advance in surgical practices.

HIFU continues the momentum of minimally invasive surgery that has significantly improved patient outcomes in recent decades. Laparoscopic, or keyhole, surgery uses smaller incisions than traditional surgery and remotely guided equipment. There is reduced blood loss, less pain, fewer complications, a shorter hospital stay and faster recovery than with traditional surgery.

The benefits of robotic systems that provide even greater precision and instrument control have already been demonstrated. One study in Cambridge, UK, showed hospital stays for radical prostatectomies were reduced from an average of 4.9 days for traditional open surgery to 2.8 days following laparoscopic procedures. This was further reduced to 1.3 days with a combination of robotically assisted surgery and post-operative care.

No scalpels

HIFU techniques create the possibility of surgery without a scalpel, reducing the potential for complications inherent in any procedure that cuts into the body.

However, most HIFU treatments are still considered experimental.

"It is usually offered to patients who have no alternatives," Professor Chauhan says. "Some people do not want to have surgery and others are poor candidates for various reasons – their health, or their age. Some people might require multiple surgeries and you can't operate on the same place over and over again because of the scar tissue. Or they might be offered this technique when other treatments, such as radiotherapy, have failed."

She says that, while ultrasound is already used for diagnostic imaging and therapeutic purposes, the potential of HIFU in clinical medicine as a surgical technique is only just beginning to be realised. In procedures such as lithotripsy, ultrasound is used as an alternative to laser or electromagnetic waves to break up gallstones or kidney stones. The fragments are subsequently excreted naturally, avoiding the need for open surgery.

HIFU, which uses precisely targeted soundwaves oscillating at up to 4000 kilohertz, has gradually gained acceptance in procedures to remove benign tumours in the uterus (uterine fibroids), and for tumours associated with prostate cancer. There are already several commercial devices approved for these procedures by the US Food and Drug Administration.

Professor Chauhan says the FUSBOTs she has developed for breast and prostate cancer have now been extended to the treatment of other organs, including the liver and kidneys.

Sound potential

As director of Monash University's mechatronics program, Professor Sunita Chauhan is actively investigating other potential uses for ultrasound and remotely operated robotic systems in a range of medical and industrial applications. These include:

- **as a supplement to radio-frequency stimulation in the treatment for neurological conditions such as epilepsy;**
- **as a treatment for osteoporosis and arthritis, nerve stimulation and bone healing around joints; and**
- **to remotely test the soundness of mechanical parts, particularly in aircraft.**

But one of the challenges in operating in the trans-abdominal region has been addressing the involuntary movement of these organs in response to respiration and heartbeat.

"Although we have very high-accuracy, high-precision systems delivering the ultrasound, it is difficult to maintain that level of precision when you are targeting something that moves inside," she says. "And this movement can be very unpredictable. In the same person the two kidneys will have completely different patterns of movement, particularly if one is diseased."

Professor Chauhan led a clinical study at the Singapore General Hospital to help understand and quantify the 3-D movement of the kidneys. The trials involved 100 participants – both renal patients and healthy volunteers. The results have helped to identify the ways in which the organs move under both healthy and diseased conditions.

Mannequin patient

In modelling organ movement, Professor Chauhan has been inspired by "Harvey" – the cardiopulmonary mannequin that has become the worldwide medical student training model – to develop her own robotic, smart mannequin patient able to simulate organ movements.

It will help non-invasive robotic systems such as ultrasound, radiosurgery and laser surgery to "learn" about the potential movements of different organs and factor this into their operating systems. Models of the lungs, liver, brain and heart have already been completed; kidneys are next on the list.

"Our smart mannequin project will help to train the surgeons and robotic systems for better treatment outcomes, and will also save the lives of thousands of animals that would otherwise be used for testing."

For Professor Chauhan, much of this work leads back to her initial priority of treating brain tumours. The most common sufferers of brain tumours are children and the elderly – two groups who are also high-risk candidates for conventional neurosurgery.

Parts of the brain are also extremely high risk for surgery in terms of the potential for damage to cognitive and motor functions; these areas can, however, be precisely targeted with robotically assisted HIFU.

Fundamental research is continuing into the mechanisms of ultrasound transmission through multi-layered brain structures, and imaging techniques to ensure the most accurate and safest targeting of lesions in the brain.

"But we've still a long way to go," Professor Chauhan says. "We are still working to prove our techniques in non-critical surgeries, before we advance to the brain – our ultimate goal." ■

AUSTRALIA-INDONESIA BUILD RESEARCH BRIDGE

Some of the Asia-Pacific region's most pressing issues – energy, food security, infrastructure, and sustainable health and education – are to be tackled by a new research collaboration that will team up scientists from Australia and Indonesia.

The recently formed Australia–Indonesia Centre at Monash University's Caulfield campus in Melbourne plans to draw on the resources of the region's two largest economies to take on some of the most intractable obstacles to economic and social stability. It will also explore ways for Australia and Indonesia to take a joint approach to increasing their global economic performance. In gross domestic product terms, Australia and Indonesia are the world's 12th and 16th largest economies respectively.

Professor Paul Ramadge, a Vice-Chancellor's professorial fellow at Monash University and former editor-in-chief of *The Age* newspaper in Melbourne, has been instrumental in establishing the centre. He is inviting the public, governments, academia and industry to recast the two countries' relationship and exploit opportunities to collaborate on regional and global challenges.

INNOVATION SPACE

To achieve this, the centre plans to create networks of collaborating Australian and Indonesian researchers. The Australian Government has contributed A$15 million to fund the centre over its first four years. Monash has also contributed A$5 million, with the centre currently building a team to develop research networks, industry partnerships and government links. Already opting in from Australia are three other universities – the University of Melbourne, the University of Sydney and the Australian National University. Australia's peak scientific and research agency, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), is also participating.

Professor Ramadge says the first objective is to map participants' research and development capabilities, identify shared national challenges between Australia and Indonesia, and then facilitate collaborative research.

"The centre's role is to identify pathways that haven't been taken before and through which we can make a difference," Professor Ramadge says.

ILLUSTRATION: JUSTIN GARNSWORTHY

ADVANCES IN FIGHT AGAINST RABIES

Rabies kills about 60,000 people worldwide each year, but there are hopes of lowering that toll now that scientists have found a new strategy for the development of safe, highly effective live vaccines.

Rabies, in humans or animals, is caused by 15 known species of lyssaviruses and transmitted by bats or dogs through bites or scratches. Unless it is treated before symptoms develop, it is invariably fatal.

Taking a significant step towards protection from the disease, an international team of scientists led by Dr Greg Moseley and Professor David Jans from the Monash School of Biomedical Sciences has developed a mutated virus that cannot evade the body's immune responses. Rather than proving lethal, it no longer even causes disease. The team reported its findings, which Dr Moseley said brought new live vaccines closer, in the *Journal of Infectious Diseases*.

CUTTING THE OBESITY–DIABETES LINK

Obesity and type 2 diabetes have long been connected but now scientists have discovered a protein that may break this unfortunate chain of events.

Being obese puts people at risk of developing a fatty liver disease that is similar to a condition seen in alcoholics. Nearly two-thirds of obese adults and half of obese children have this liver disease, which is a precursor to type 2 diabetes. Professor Matthew Watt and researchers at the Monash University School of Biomedical Sciences have discovered that fatty liver disease causes a particular protein to be secreted, which then causes diabetes to develop.

They first isolated a group of proteins secreted by a fatty liver that led to insulin resistance in skeletal muscle, a characteristic of early-stage diabetes.

One of the proteins in this group had a hitherto-unknown role in the cascade of physiological consequences of a fatty diet.

Working with researchers in the Netherlands, Professor Watt tested the blood of patients with fatty liver disease and found raised levels of this protein that were related to the level of insulin resistance.

He believes that developing a drug to block the protein in question could be a way to help prevent some of the deadly consequences of obesity.

35% of adults worldwide aged 20 and over are overweight and about 12% are clinically obese – figures that have doubled since 1980.

SOURCE: WORLD HEALTH ORGANIZATION

Live vaccines can easily be grown in large quantities and delivered as a single oral dose. Existing "killed" rabies vaccines must be injected several times over an extended period, making them problematic for use, particularly in resource-poor countries. Most human rabies deaths occur in Asia and Africa. Plans are now underway to develop a vaccine based on the mutated virus.

PHOTO: iSTOCK.COM

Flat price takes fizz out of drinking

Make alcohol more expensive and people will drink less of it – but an effective approach to problem drinking involves careful consideration of just how to apply that price rise.

Dr Anurag Sharma from the Centre for Health Economics at Monash University says it is important to deter heavy drinkers as much as possible without also penalising moderate consumers.

His team assessed the relative merits of a minimum unit price (MUP) and a uniform volumetric tax. The MUP would set a price for a specified volume of pure alcohol or alcoholic beverage under which drinks could not be sold. Volumetric taxation would be calculated on the amount of pure alcohol in a drink.

The result? The volumetric tax would increase beer and wine prices, but lower the cost of spirits and cider, so drinkers could simply change their tipple. The more effective strategy would be applying a A$1 minimum price for a standard drink.

This would make cask and fortified wine dearer and so have a big impact on heavy drinkers, but leave occasional drinkers pretty much unaffected.

The researchers noted that any pricing control should be complemented by other strategies, such as public education programs, for the most effective reduction of problem drinking. Alcohol consumption is one of the top-three risk factors for disease globally and carries high social and economic costs.

MALE PILL IN 10 YEARS

A drug that causes complete – but temporary – male infertility could be on the market as a male contraceptive pill within 10 years. Researchers Dr Sab Ventura and Dr Carl White of the Monash Institute of Pharmaceutical Sciences are working towards a drug that blocks two proteins on the smooth muscle cells that trigger the transport of sperm. This drug would stop sperm being ejaculated during sex, but as hormones are not involved, sexual behaviour and function would not be affected. The sperm would still be produced normally, meaning there would be no long-term implications for the wellbeing of offspring conceived once the drug was no longer being taken.

To date, strategies developed by researchers seeking a male pill have generally involved hormones or the production of dysfunctional sperm, and therefore tend to interfere with sexual activity or damage fertility irreversibly.

Dr Ventura says a drug targeting one of the proteins was already available, but his team would have to find a chemical and develop a drug to block the second one. They hope their research will mean that an effective, safe and readily reversible male contraceptive pill will be available within a decade. The findings of their study have been published in *Proceedings of the National Academy of Sciences of the United States of America*.

First hug of life

When a mammal embryo is only eight cells large, its roundish cells appear to embrace in a first "hug" that seems critical to healthy development – and may have implications for human in-vitro fertilisation (IVF) treatments.

Scientists from the EMBL Australia research team at Monash University's Australian Regenerative Medicine Institute used high-tech imaging equipment to observe this process for the first time.

In research published in *Nature Cell Biology*, Dr Nicolas Plachta, Dr Juan Carlos Fierro-González and Dr Melanie White noted arm-like structures called filopodia appearing on some cells during the eight-cell stage. They watched them grab neighbouring cells, pulling them closer and elongating the cell membranes. After they let go, the cells returned to a round shape and continued their normal process of dividing and multiplying.

When the cells did not compact like this, the embryo tended not to survive.

Dr Plachta says knowledge of this "completely unanticipated mechanism" could be applied to human IVF treatments, helping doctors choose the best embryos to implant. He and his team are designing non-invasive imaging approaches to see if human embryos used in IVF form normal filopodia and undergo normal compaction. They will work in partnership with the Monash Faculty of Engineering to improve implantation success.

PHOTO: 123RF.COM

We have opened a door and found a vast room with no walls or ceiling. It is potentially limitless.

– Professor Dan Li

PHOTO: BRAD COLLIS

OUR NEW black gold

A major technical obstacle has been jumped in science's quest to deliver revolutionary graphene technologies to industry and medicine.

WORDS **Brad Collis**

Dark grey, a little greasy to the touch, graphite is neither pretty nor particularly useful. Most deposits around the world sit largely untouched, although it is used in a variety of ways in the steel industry, in batteries and lubricants, and of course as "lead" in pencils.

But a few years ago, this poorest of ores revealed a secret. At the molecular level it is a unique two-dimensional molecule: an electrically conductive lattice-like layer just one carbon atom thick. In this state it is called graphene, and an intensifying global research effort into this attribute is putting graphite at the brink of becoming one of the most valued ores ever mined.

It has usually cautious physicists and chemists itching with excitement, mesmerised by the possibilities starting to take shape – from flexible electronics embedded into clothing, to biomedicine (imagine synthetic nerve cells), vastly superior forms of energy storage (tiny but immensely powerful batteries) and an array of new materials that could make many of today's common metals and polymers redundant.

"We have opened a door and found a vast room with no walls or ceiling. It is potentially limitless," says one of the early graphene research pioneers, Professor Dan Li at Monash University's Department of Materials Engineering.

Professor Li began searching for a functional platform for new graphene-based technologies in 2006, barely two years after a single layer of graphene was first separated from graphite. This was done by two curious University of Manchester physicists, Professor Andre Geim and Professor Konstantin Novoselov, who simply used sticky tape to peel off micro flakes. It started as a bit of fun, but turned serious when they realised that by repeatedly peeling off further layers from the original flake they were able to get down to the thinnest possible layer, just one carbon atom thick.

CONTINUED PAGE 22

Power burst

Supercapacitors have short-term energy storage, compared with rechargeable batteries, but can deliver intense energy bursts, 10 to 1000 times more powerful than a battery. They are regarded as integral to the development of more advanced electric vehicles.

Mining revival

About 75 per cent of the world's graphite is currently produced by China; however, the anticipated step-up in demand as graphene technologies emerge is seeing renewed interest in graphite mining in countries such as Australia and the US.

A graphite mine was recently reopened near Port Lincoln in South Australia, and US mining interests are reported to be preparing graphite operations following the US Department of State declaring graphite a critical raw material for future technologies.

World production of natural graphite is currently about 1.1 million tonnes. Predictions are for a six-fold increase in the years ahead.

Super graphene

As a 2-D molecule, layers of graphene can take any form or flex to adhere to any surface. Graphene is transparent, conducts current more effectively than copper, is harder than diamond and stronger than steel.

Being carbon, it is stable in corrosive environments and its resistance to heat makes it attractive for use in applications such as energy storage and aviation componentry.

Graphene is already emerging as the key to the next generation of battery technologies as well as hybrid and electric vehicles, more efficient solar and wind power generators, and fuel cells.

FROM PAGE 21

For many scientists this discovery is up there with penicillin for the opportunity that has been opened for graphene technologies to impact on just about every aspect of human activity and endeavour. Certainly few were surprised when the pair were awarded the 2010 Nobel Prize in Physics.

Functionality challenge

However, while scientists can see extraordinary potential for graphene's properties – from its electrical conductivity to the creation of new materials, including bio materials, that would be lighter, stronger and less energy-demanding than anything currently in use – the stumbling block has been to get graphene into a useable form.

Being only one atom thick, the two-dimensional graphene layers pack tightly like the pages of a book. For it to be functional, ions or other molecules need to be able to engage with the flat molecular surface area between each layer.

So a challenge has been to find ways to take the graphene sheets apart and reassemble them into functional macro forms in which the full potential of the individual sheets can be accessed.

This is where Professor Li's research is opening the next tantalising chapter in the graphene story. He has invented a cost-effective and scalable way to split graphite into microscopic graphene sheets and dissolve them in water. From this he has developed two new graphene technology platforms – the starting points for developing commercial applications. One is a graphene gel that works as a supercapacitor electrode, and the second is a 3-D porous graphene foam.

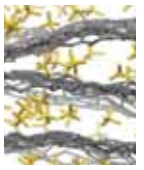
The graphene gel provides the same functionality as porous carbon – a material currently sourced from coconut husks for use in supercapacitors and other energy-conversion and storage technologies – but with vastly enhanced performance.

Professor Li's research has already produced two papers in the journal *Science* plus six pending patents. These are for processes developed for suspending graphene in a water solution at room temperature (a major breakthrough because graphene is otherwise water-repellent) for the development of the gel and for the even more functional 3-D foam.

First stable platforms

These are remarkable achievements that provide some of the first stable platforms from which new graphene-based technologies can now be developed.

Professor Li has already taken the first steps towards a commercial application by developing a high-performance graphene-based energy-storage device. Since its unveiling in *Science* last August the device has been touted as a breakthrough in the field of supercapacitors.



In a supercapacitor the separated sheets of graphene (in the form of a chemically engineered gel) provide a high ion-accessible surface area, but are still far more densely packed than conventional porous carbon. This gives the graphene supercapacitor a much higher "energy density", meaning much more power from a much smaller device.

Current supercapacitors use activated porous carbon impregnated with a liquid electrolyte to carry the electrical charge. The drawback is a low energy density (energy storage-to-volume ratio) of just five to eight watt-hours per litre. But by replacing the porous carbon with a multi-layered graphene gel film, Professor Li's team has created a compact supercapacitor with an energy density of 60 watt-hours per litre. Supercapacitors have an expanding range of applications as their capabilities increase, from powering computer memory backup to powering electric vehicles.

The gel film is made by dissolving graphene in a water-based solution to create a graphene "ink", which is then filtered (not dissimilar to traditional paper-making).

To make a graphene electrode from this gel, Professor Li's team used liquid electrolytes to control the spacing between the graphene sheets. In this way the liquid electrolyte plays a dual role: maintaining a space between the graphene sheets and conducting electricity.

In a parallel development, Professor Li's team has also been able to give graphene a more functional 3-D form by engineering it into an elastic graphene foam. This is made by a process Professor Li calls "freeze casting". As the solution's ice crystals form, they exert enough pressure to distort the flat structure

of the graphene sheets and, significantly, the effect is irreversible. The graphene sheets stay separated after the liquid thaws into a foam that has a similar cellular structure to cork.

The graphene blocks produced by this revolutionary process are extremely light, able to support more than 50,000 times their own weight, are efficient conductors of electricity and are highly elastic. “We’ve been able to preserve the extraordinary qualities of graphene in an elastic 3-D form. This paves the way for the anticipated uses that people have for graphene, from aerospace materials to tissue engineering,” Professor Li says.

“We have a platform from which to move us from the laboratory to commercial developments.”

New energy

One of the leading researchers internationally in the use of graphene for energy applications, Professor Richard Kaner from the University of California, Los Angeles (UCLA), says Professor Li’s high surface area developments open up exciting new energy applications.

“The beauty of Dan’s gel development is that it is scalable so could be used to build very large supercapacitors of high-energy density,” he says.

Professor Kaner, who is Distinguished Professor of Chemistry and Distinguished Professor of Materials Science and Engineering at UCLA, is also researching graphene energy applications, but has taken a different path. “My research is investigating light-scribed graphene. We hit graphite oxide with a powerful light source to convert it to a porous carbon network. Our approach suits the development of micro supercapacitors. Dan has opened up a more macro-scale platform.”

Professor Li likens his developments to having invented bricks, and now it is time to bring in architects and builders to create new technologies based on his platforms. “The opportunities now are limitless,” he says.

“These graphene molecules bring a whole new capability to nanotechnology and materials science, and this includes new-generation energy storage and harvesting devices, bio-compatible materials able to work in the human body, separation membranes for water purification, and strong and lightweight composite materials for aerospace.”

Professor Li attributes his success in tackling the graphene separation issue to his decision to take a chemistry (his primary academic background) rather than a physics approach. This, he says, is how he found a way to make the graphite dissolvable in water, which was the starting point for the graphene gel and foam.

“These are very exciting because they are bridges between concepts and actual new technologies.” ■

Professor Dan Li says his team has a platform to move from the laboratory to commercial developments.

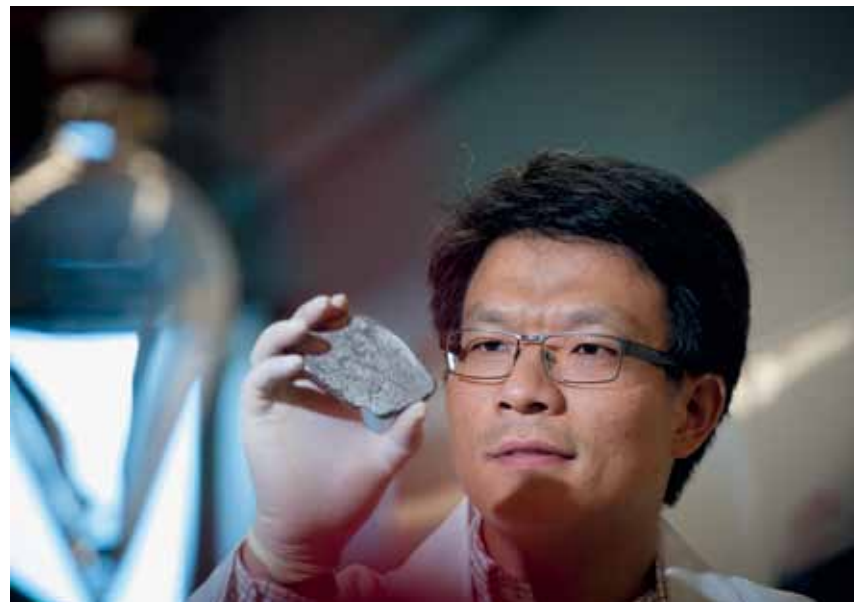


PHOTO: BRAD COLLIS

GLOBAL CLASSROOM

Universities are pursuing with increasing confidence and creativity the education opportunities presented by online technologies that can link teachers and students from around the world.

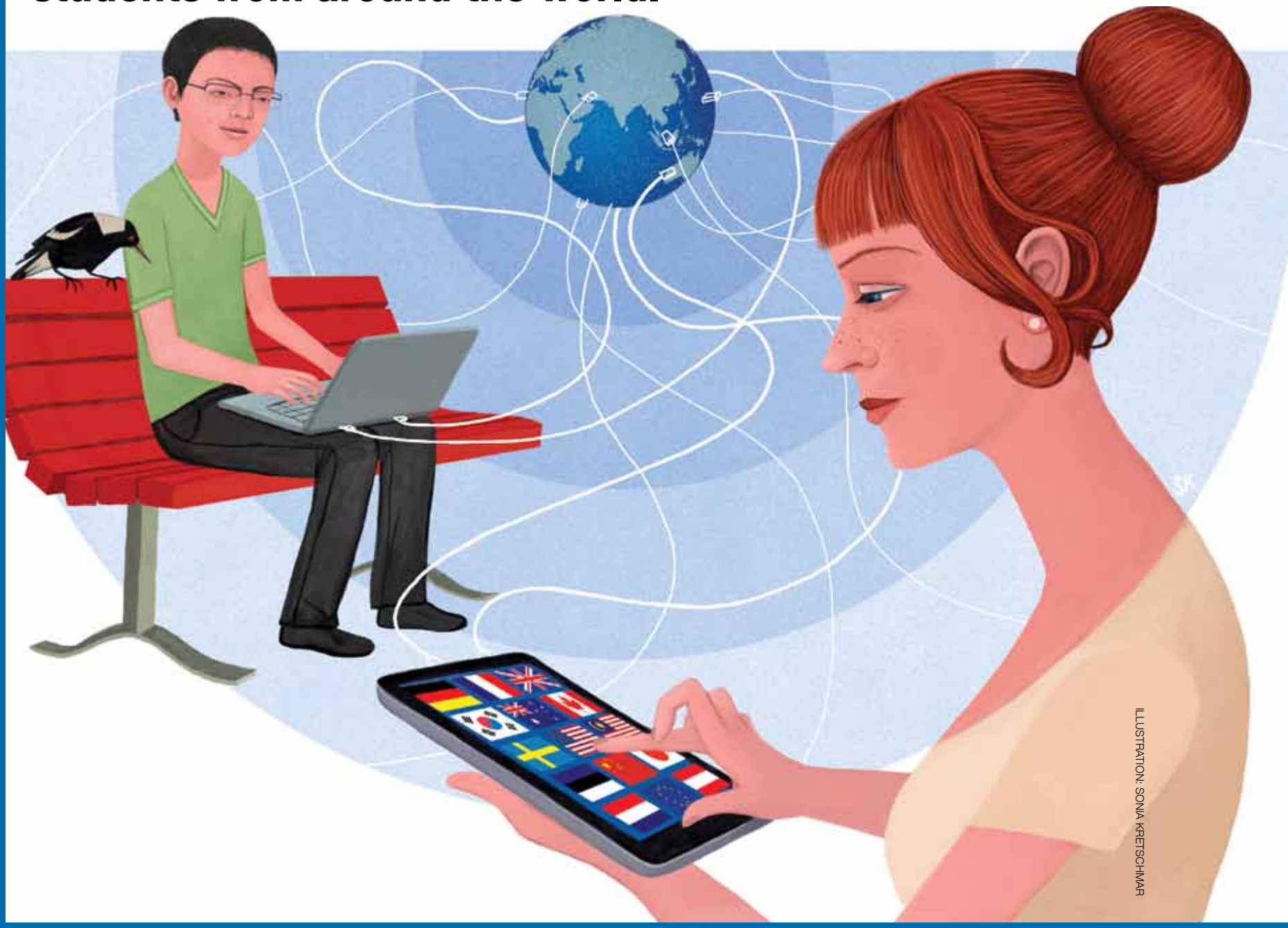


ILLUSTRATION: SONIA KRETSCHMAR

Down at the track, a high-performance, aerodynamically sophisticated racing car is put through its paces. In the heady atmosphere of a trading room, investment bankers make split-second decisions as they buy and sell, gain and lose. In a virtual laboratory, using virtual materials, pharmaceuticals of myriad forms are created and perfected. And in a tutorial room that looks much like any other, a student turns to chat to a classmate – who just happens to be on the other side of the world.

Welcome to university education, 21st-century style. Although lecture theatres are still a part of life in education institutions around the globe, technology and shifting expectations are progressively unsettling and undermining the generations-old model by which academics transmit knowledge to students.

The internet and mobile devices give extraordinary access to information from just about anywhere: students no longer need to be in the same place at the same time as their teachers. The same rapidly developing communications technology that is behind that change has also contributed to a world in which employers increasingly seek graduates who come ready primed with an international outlook and a cultural understanding that transcends the boundaries of their home country.

Universities everywhere are feeling the pressures, even as they take up the opportunities that new capabilities are making available.

"We are in a disrupted world of education," says Professor Darrell Evans, who as Vice-Provost (Learning and Teaching) is instrumental in taking Monash University into the future. "We must ask ourselves how we are going to tackle things differently. How are we still going to be a university in 20 years' time if we don't transform the way we understand education?"

An academic world still coming to terms with flipped classrooms and blended learning was further challenged by the advent in the past few years of massive open online courses (MOOCs). *The New York Times* dubbed 2012 "the year of the MOOC" and take-up has been phenomenal. MOOCs are mostly short courses; they are often provided by a leading professor at a top-drawer university, and they are both free and freely available to anyone. Harvard University, Stanford University and the Massachusetts Institute of Technology, along with many other elite American universities, have swept into the world of MOOCs, working through platforms such as edX, Coursera and Udacity.

The US leads the field, but in 2012 the UK's Open University founded a MOOC platform called FutureLearn, listing among its partners not only top UK universities but also cultural institutions such as the British Library and British Museum. Last year Monash became its only Australian partner, with two courses scheduled to start this year – one on computer programming for creative design and the other about the science behind medicines.

The measured approach taken by Monash contrasts with the enthusiasm with which others have embraced MOOCs, but is entirely in keeping with Professor Evans's view that keeping education in good shape calls for a flexible framework, not a cookie-cutter approach. His guiding principle is to search for the best of what is available.

"Technology is an enabler," he says. "It allows us to do things we never dreamed of, but it must still be fit for the purpose for which it is used. We are experimenting in the online course world with FutureLearn and other companies such as Pearson. It is a matter of understanding what the technology can bring to those initiatives and assessing it. What will be the impact on students? What can we learn from online assessment that we can then bring back into the campus learning experience? Is it better than something we currently do?"

The last question, broadly applied, is at the heart of the new approach to education he is introducing at Monash through the "Better Teaching, Better Learning" agenda.

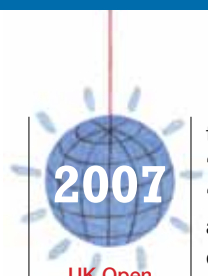
A challenging philosophy

"I want our teaching to be challenged in the same way our research is," Professor Evans says. "Researchers are always coming up with new ideas, testing them, making changes. No one would ever use 'I've done it this way for 10 years, it must be all right' as a philosophy for research."

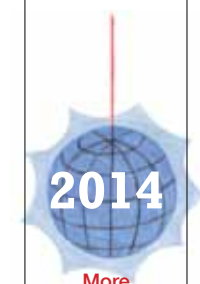
Modern communication technology most clearly threatens lecture-based teaching, but it is not simply a question of the pros and cons of moving online. Personal connection is important; curriculum design is important; learning spaces are important – and all, Professor Evans says, must work together.

Sometimes this may mean quite practical changes, such as those undertaken recently by the Monash School of Physics when it reconfigured a workshop to provide more areas for small-group learning, with appropriate equipment from tables to technology. In the shift from lecture-based to more interactive learning, the set-up encourages students to be fully involved as they grapple with the principles and problems inherent to this field.

Rooms were also made available for pre and post-class discussion and activity: Professor Evans admits to a qualm about their appeal but it was quickly laid to rest. "If you go in there, it's stunning," he says. "There are the students, without teachers around, immersed in discussion and debate, and working collaboratively."



UK Open University reports 16 million course downloads through iTunes U; 89% from outside the UK.



More than 250 colleges and universities offer more than 9000 free courses online.

SOURCE: OPEN UNIVERSITIES AUSTRALIA

Other programs take the university into a world that not so long ago would have been impossible outside science fiction. Thanks to Skype, an expert from anywhere in the world can readily appear in a classroom, but the real-virtual mix goes beyond that. When pharmacy students at Monash learn the complexities of tablet-making, they do so using software, gaming technology and a virtual laboratory rather than an industrial machine and real ingredients – and it is not only more effective, it is also a lot cheaper (see page 28).

Meanwhile, their counterparts in business and economics gain similarly effective training without leaving the classroom, which in their case is the STARLab trading room (see page 29). Here a "real" trading environment prevails as students get to practise the theories learned in management studies, banking and finance, and economics.

But for all its wow factor and ability to provide a new perspective, technology is not always going to be the answer, Professor Evans says. Sometimes, that time-honoured connection between teacher and students, aided only by a whiteboard and some coloured pens, is the best way to get the message across. Provided it stands up to the challenge of being questioned, he sees no reason to throw it away and would indeed actively promote it.

Engagement that is not just personal but seriously hands-on has also proved its worth. Teams of engineering students from hundreds of universities and colleges around the world, including Monash, get engaged in the building of race cars for Formula SAE, a competition that started in 1978 (see page 27). They do the hard practical laps of design, construction and testing, and in the process they must also reinforce the academic aspects of their study, learning to defend, support and explain what they are doing.

A new world of learning

One of the challenges for modern universities, says Professor Karen O'Brien, Vice-Principal (Education) at King's College London, is combining students' "virtual connectivity" to information and to each other with the face-to-face interactions and collaborations that are still important in classrooms and laboratories.

"As educators today, we must create radical new learning opportunities from the multiple ways in which our students interact and gain access to information and knowledge," she says.

CONTINUED PAGE 26

FROM PAGE 25

Another, says Professor Evans, is the need to interact and operate on a global scale. Like others around the world, Monash is a multi-campus university; it has hubs not only in Australia but also in Malaysia, India, South Africa, China and Italy, with strong connections to the University of Warwick in the UK, thanks to the Monash–Warwick Alliance.

Universities will increasingly seek to link learning between campuses, and to do so in a way that includes personal connection. "You can come away from a course with knowledge but you need the interaction to really excite the learning journey," Professor Evans says. "With distance learning, it's especially important for students to learn as communities – how do we do that?"

An early step towards answering this is the "international portal" that links a classroom at Monash University's Caulfield campus in Melbourne with one in Warwick, allowing students from both universities to do the same course, at the same time and in – virtually – the same room (story this page).

"It's across time zones. In Melbourne, we stay late – they get up early; everyone interacts. It's a first stage, but it shows what can be done when you are working with multiple campuses or of course if you have other kinds of links with overseas audiences."

With an enthusiasm for learning that has pushed his career from research in biology to a full focus on education, Professor Evans is keen to seek out scope for improvement anywhere he can find it.

"We can give people the opportunity to learn anywhere. There are people who like to learn on the bus or train, because they like the buzz but they still get immersed; others prefer to be at home. Technology should enable us to learn differently; to learn where we want to learn."

Overall, he says, it's a question of generating an approach that can adjust to the many different needs of different fields of study, while also remaining open to inevitably changing pressures and demands.

"We must stay responsive to change. Once you have a model, then you lose that flexible quality because it just becomes the way you do things. We want to keep things dynamic so that we can keep hitting the changes that are happening very quickly at the moment in education." ■

You can come away from a course with knowledge but you need the interaction to really excite the learning journey.

– Professor Darrell Evans

PORTAL OPENS WAY TO VIRTUAL CLASSROOMS

WORDS **Alice Russell**

The students gather for their class, arranging themselves in a large circle. A dynamic discussion develops. At times they break into groups, or post their findings on whiteboards. Just another uni tutorial? Not exactly. The students in the part of the circle that is beyond the large screen on the end wall are not just in another part of the room – they are 16,000 kilometres away.

INTERNATIONAL PORTAL

"You feel you could walk over and touch them; you forget they are not there in person," says Monash University lecturer Dr Sarah Pasfield-Neofitou, one of the co-teachers of Forms of Identity, the first course undertaken in this mingled real and virtual space termed the "international portal".

Here, where technology links Monash in Melbourne, Australia, and the University of Warwick in the UK, people on either side of the portal can see each other at close to life size, thanks to a screen that runs almost from floor to ceiling. Cameras and microphones are unobtrusively installed in such a way that anyone anywhere in one room can see and hear anyone in the other room. There is immediate engagement with everyone involved.

Classes proceed much as they would if everyone were in the same physical space, with some inevitable adjustment for running a course for people at two institutions who not only live in different time zones but also work to different academic calendars. To fit into the limited overlap between semesters, for example, courses are planned as high-intensity units that run for just two or three weeks.

Students appear to relish the experience.

"They are with the group across the portal in a short space of time, and that creates a real dynamic," says Monash University's Dr Sarah McDonald, who co-leads the international portal project with the University of Warwick's Dr Nick Monk.

Potential administrative tangles are eased by collegial connections underpinned by the Monash–Warwick Alliance, a partnership between the two universities whose goals include meeting the increasing demand for graduates with a global education.

"Some students who are unable to study abroad welcome the experience with lecturers and students from a different location," Dr McDonald says. "It gives them the opportunity to engage with a cohort they would not normally be exposed to."

It is not all about classes. The first International Conference of Undergraduate Research, founded by the Monash–Warwick Alliance, was held simultaneously at both universities in 2013. The next conference, scheduled for September this year, will expand to include partner universities in Malaysia, Singapore and South Africa as well as Australia and the UK.

Lecturers hope portal technology will ultimately link more campuses and universities as its potential is increasingly realised. The next course planned for the portal has the apt title of Global Connections, and the future may open up more scope for academics to teach in fields not offered at their home institution, for example, or for students to "attend" more classes in other institutions. Even at this early stage, students and researchers alike gain from exposure to more varied academic expertise than they could expect at just one institution.

Along with the very high-tech side, low-tech elements also contribute to efficient functioning. On each side of the portal there is a carpet with a large circle on it. Students in each room form a physical half-circle at "their" end that joins – virtually – in the middle.

"To us in the room, it feels as though the circle goes right round," Dr Pasfield-Neofitou says. ■

PHOTO: PAUL JONES

PHOTO: PAUL JONES

MONASH MOTORSPORT

FAST-TRACK LEARNING

WORDS Brad Collis

At the 2013 Formula 1® Rolex Australian Grand Prix two cars attracted an inordinate amount of attention from team engineers, given they were not part of the headline event. But the two Formula SAE race cars nonetheless embodied what F1 racing is all about – technology.

Both cars were built by engineering students: an electric prototype race car built at the Swinburne University of Technology, and a more conventional high-performance car built by Monash University engineering students.

The Monash students and their car represented Monash Motorsport, a student-inspired and driven initiative that over the 14 years since its inception has reached the top of the international Formula SAE competition.

Formula SAE was started in 1978 by the Society of Automotive Engineers to give the world's engineering students the chance to apply their knowledge by designing and fabricating a race car that embodies race track performance and engineering excellence.

Teams from more than 550 universities compete annually to build a car that demonstrates critical thinking and problem-solving. Monash Motorsport is currently ranked number two, behind the University of Stuttgart in Germany.

The car demonstrated at the 2013 F1 Grand Prix featured an innovative drag reduction system. "It's a pneumatic system that turns the flaps to a neutral low-drag position when travelling in a straight line, using less fuel and increasing car speed," team leader Edward Hamer explains.

Mr Hamer says the Monash team has focused heavily on aerodynamics and the application of computational fluid dynamics: "We were one of the first SAE teams to introduce this, although the idea has been around for a while. That's what it's like in motorsports; a lot of innovations float around until someone can work out how to build them into the complete package.

"Also with SAE you have to be able to explain and justify your decisions: not just make a fast car."

Monash Motorsport team leader Edward Hamer (right) and fellow engineering student Andrew de Morton with the race car that puts theory into practice.

Applied aerodynamics

Mr Hamer says this is what makes the motorsports program valuable to students. "To be a successful engineer you have to be able to build a legitimate argument to support your ideas.

"That is what is demanded of us in developing these cars. We have to apply what we know, take in critical feedback, learn to work as a team and articulate the academic reasoning behind everything we do."

About 50 students are currently involved in Monash Motorsport, representing mechanical, aerospace and electrical engineering, and mechatronic engineering.

The team reports to an academic supervisor, Dr Scott Wordley, who was one of the students who started the program in 2000.

Mr Hamer says the program embodies what students believe engineering should be. "It is creative and challenging and you are expected to be intelligent. People will push you, and that's good.

"And we have a clear goal: to become the most respected SAE team in the world. That shapes our decisions and how we conduct ourselves and we take it seriously because it gets everyone working collaboratively and moving forward." ■

PHOTO: 123RF.COM

PHARMATOPIA

CYBERSPACE PHARMACY

WORDS **Dr Gio Braidotti**

The use of 3-D virtual-world computer gaming technology is giving pharmacy students a realistic experience of the complex industrial processes involved in pharmaceuticals manufacturing.

Specially developed software provides a virtual laboratory in which they can test, via interactive animation, different formulations and receive detailed feedback on the correctness of their work. The software is called Pharmatopia and the simulated manufacturing process gives students a far deeper understanding – through practice in this virtual laboratory – of the numerous formulations that are needed for different types of tablets and capsules.

Previously students' experience of the manufacturing process took the form of crowding around expensive (and often outdated) industrial tableting machinery, gaining only a limited understanding of the different tablet properties that are possible from different ingredients.

Senior lecturer at Monash University's Faculty of Pharmacy and Pharmaceutical Sciences Dr Ian Larson says a pharmacist often needs to be able to explain to a patient what is in a medicine and why it is there, including the inactive ingredients needed to make the tablet. "Many tablets are only five to 10 per cent drug. The other ingredients are required to assist drug function," he explains.

"So we felt students were wasting too much time on skills – learning to use the machinery – that are no longer relevant.

"Instead we needed an activity that allowed any kind of tablet to be made and different formulations compared, so students acquire practical experience of how ingredients affect a tablet's properties, including drug delivery."

Dr Larson has been instrumental in developing this alternative teaching module now adopted by universities worldwide and by two leading pharmaceutical companies – GlaxoSmithKline (GSK) and the CSL Group. The tablet machines have been replaced by a 3-D virtual factory in which students can simulate the use of the most advanced industrial tableting technology.

PHOTO: PAUL JONES

Dr Ian Larson has been instrumental in developing alternative hands-on teaching modules.

"The first module – developed with pharmacy academics and practising pharmacists – was developed just for Monash students," Dr Larson says. "Evaluations soon showed Pharmatopia to be a better, more engaging learning activity than the traditional method."

Knowledge shared

When trials by other universities proved similarly successful, the Pharmatopia software was made available, at no cost, to any education institution.

As Pharmatopia's use spread, it also came to the attention of GSK in the UK. The company now uses Pharmatopia (under licence) to help its workforce better understand the tableting process and improve problem-solving when tablets fail quality-control tests.

"We now have an ongoing relationship with GSK to co-develop further online training activities," Dr Larson says.

This is in addition to modules Monash has developed in collaborations with other universities, including one with Victoria University in Melbourne to create two modules sponsored by the CSL Group.

Monash also recently helped the University of Namibia to make the simulation resources available to the newest pharmacy school in the world. "While it is fantastic to share resources with the developed world, maybe some of the biggest gains are to be had by working with universities in the developing world, which have the same need for expertise but far fewer resources," Dr Larson says.

Having witnessed the benefits and popularity of shared online teaching resources, the Monash academics now host a website, SABER, where pharmacy and pharmaceutical science educators from all over the world can collect and share teaching resources and network for new collaborations. ■

www.pharmatopia.monash.edu; www.saber.monash.edu

PHOTO: PAUL JONES

The STARLab, where business and finance students simulate working in a currency trading room.

STARLAB

REAL-WORLD PRESSURE TEST

WORDS **Brad Collis**

Associate Professor Kevin Tant sits in a control room, fingers speeding across keyboards as he simulates myriad economic and behavioural forces influencing the money market. He is at once a central bank adjusting monetary policy, a cluster of investment bankers entering and leaving a trade, and a score of other commercial forces typical of the influences that test professional traders every day.

This is the Simulated Teaching and Research Laboratory (STARLab) and Associate Professor Tant, from the Department of Banking and Finance at Monash University's Faculty of Business and Economics, is using it to challenge, in real time and with real-world scenarios, teams of students who are putting into practice all that they have learned as theory.

The objective of this innovative teaching program is to deliver graduates as close to job-ready as possible: to have them leave university with practical experience and exposure to the real-world pressures of careers in finance.

Associate Professor Tant initiated the program several years ago in response to some students being unclear about how various course units fitted together. "Because my background is banking and finance I decided to create a trading room – STARLab. It was conceived to provide real-world application for management studies, banking and finance, accounting and economics. We set it up as a capstone – an all-encompassing final-year unit," he explains.

"This required me developing a software package, 'Monash Trader', which replicates a real trading environment. This has continued to evolve in response to student and industry feedback and is now a web-based program."

Associate Professor Tant hopes to further develop the program over the next 12 months so that it can also involve Australian students trading in real time with students at Monash University's Malaysia campus.

"We've also expanded the subjects to include investment portfolio management, business finance, accounting, equity markets and even deeper risk-management strategies using options and other derivatives as well as climate change and emissions trading.

"STARLab is also a research facility because, at the end of the day, it's really a behavioural lab."

Employers need graduates to come on-stream as quickly as possible after they start work.

– Associate Professor Kevin Tant

Dealing with challenges

At its core, STARLab emulates a treasury dealing room and students operate in teams of three – a dealer, risk manager and accountant. They have to deal with challenges requiring rapid decisions that in the real world could be making or losing millions of dollars.

Another component of this practical, interactive learning environment is being responsible to a CEO.

"Employers need graduates to come on-stream as quickly as possible after they start work. So part of that preparation is me performing as a CEO in class, rather than an academic," Associate Professor Tant says.

"That means students learning to communicate and to write reports to a level that management can use.

"So we have moved away from the traditional lecturer–student engagement to a more interactive learning model."

The facility is also used by industry. The National Australia Bank (NAB) has used it to give staff who are responsible for calculating market risk an insight into the pressures that traders face. Chris Hoy, NAB's manager of market risk analytics, says risk managers have the advantage of being able to take a considered viewpoint of an established position.

"But what they can't see is what actually goes into creating that position in the first place. This is where STARLab has been of enormous benefit," he says. ■

Merchants of culture

EUROPEAN COLONISATION IS PORTRAYED MOSTLY AS AN ERA OF BRUTAL SUBJUGATION OF INDIGENOUS PEOPLES, BUT NEW STUDIES ARE SHOWING THE CULTURAL ENGAGEMENT MAY NOT ALWAYS HAVE BEEN SO CRUDELY ONE-SIDED.

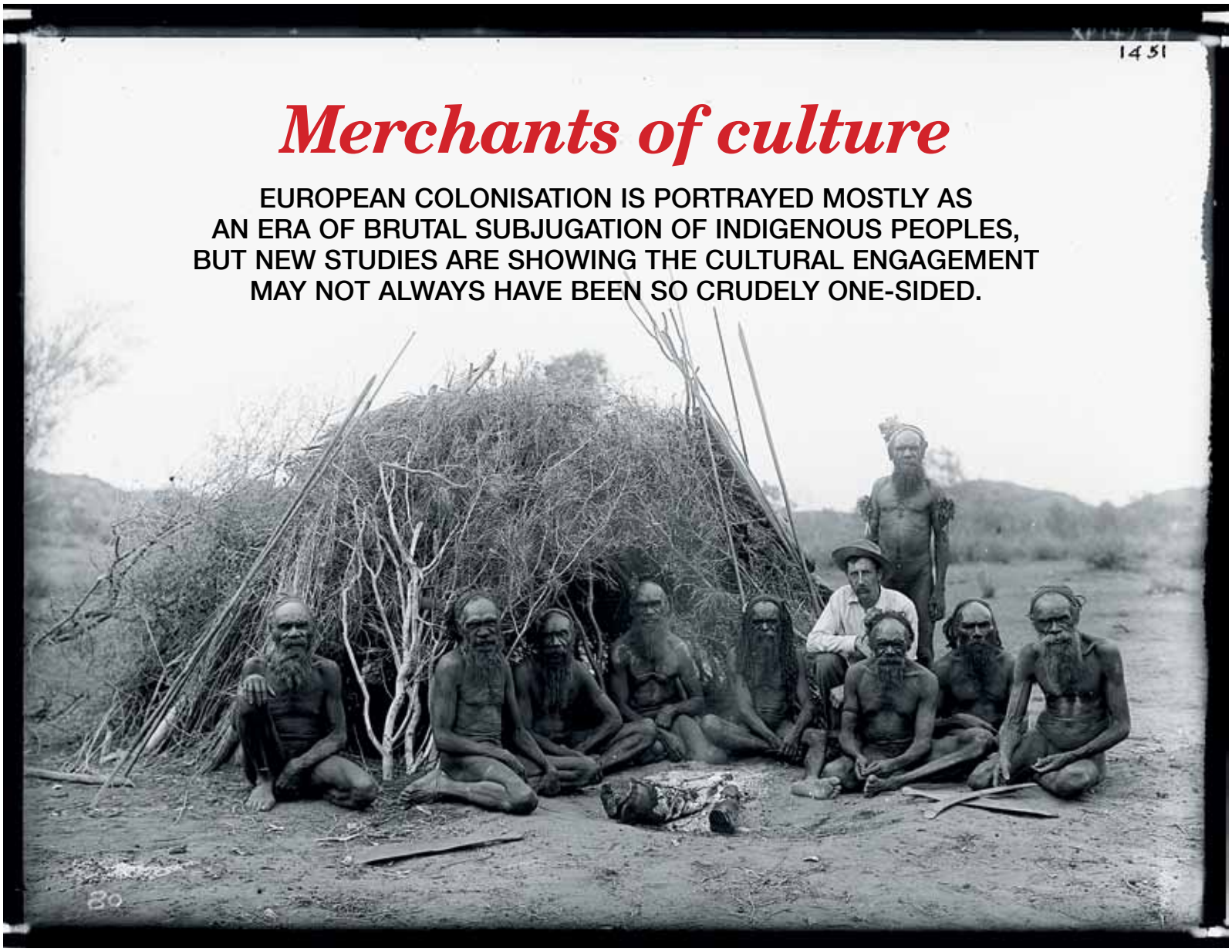


PHOTO: REPRODUCED COURTESY OF MUSEUM VICTORIA

Baldwin Spencer seated with the Arrernte elders, Alice Springs, Central Australia, 1896.

WORDS **Alexandra Roginski**

In 1914, as Europe was on the brink of war, an expedition of several hundred scholars from the UK's finest institutions sailed to Australia. Guests of the Australian Government, these members of the British Association for the Advancement of Science (BAAS), many of them anthropologists, undertook a whirlwind schedule of lectures, state events and field trips.

Their visit reflected a fascination by British scientists, the public and humanitarians in the indigenous people of the colonies; an interest dating back to the mid-19th century. Scholastic debates had begun to grapple with the origins and hierarchy of races. Whether turned to the native people of New Zealand, North America, South Africa or Australia, the nascent discipline of anthropology had begun asking who these people were, how they lived, and how European settlers should relate to them.

Today, the voluminous BAAS archives are at the heart of a research project exploring the history of this elite group of scientific minds and the global network they spun to glean information from the furthest corners of the British Empire.

"The BAAS was crucial to scientists engaged with anthropology. Soon after its inception in the 1830s, it became a powerful carrier of debates about human difference," explains Dr Leigh Boucher, a Macquarie University historian who is part of an Australian Research Council (ARC) funded project looking into the BAAS studies.

"While based in the UK, the network of members stretched around and beyond the British Empire. Together, these imperial interlocutors forged a global community of authors, correspondents and readers who often used their colonial experiences to claim authority," she says.

PHOTO: JAMES BRAUND

Professor Lynette Russell

By the time the BAAS experts arrived on Australian shores, similar expeditions had already visited Canada (in 1897 and 1909) and South Africa (in 1905).

For Monash University historian Professor Lynette Russell, leader of the ARC project, the BAAS expedition embodies the story of early anthropology. She says it also provides glimpses of Aboriginal empowerment in the face of forces that tried to subjugate them.

Professor Russell, who is the director of the Monash Indigenous Centre, describes a field trip to South Australia's Coorong region, encompassing the vast mouth of the Murray River, in which the BAAS scientists were chauffeured to a corroboree staged by the local Ngarrindjeri people.

The visit was organised by a business-savvy Aboriginal elder.

"There is one little cryptic comment made by someone at the corroboree," says Professor Russell. "This person describes the Aboriginal promoter of the corroboree as a man who would have found a comfortable career as an entrepreneur in London's West End."

Agents in history

Professor Russell explains that Australian Aboriginal people had been ranked near the bottom of the racial hierarchies of the 19th century, far lower than the native people of North America or New Zealand. Their acts of resistance and engagement were either dismissed or misunderstood by Europeans who were much more familiar, for example, with the organised guerrilla warfare of the Maori people or the native people of North America. By contrast, Australian Aborigines were seen as passively accepting European colonisation.

But events such as the Coorong corroboree present historical opportunities for a different reading. Here, the comment about the corroboree promoter suggests the local Aboriginal group cannily brokered a deal for the performance of the ceremony and dances, and probably for payment.

"The reality, we find, is far more complex than this idea of anthropologists studying disadvantaged, disconnected, disassociated Aboriginal people. My argument would be that Aboriginal people were never that disconnected or disestablished," Professor Russell says.

The terminology of anthropology suggests this was indeed the case. Aboriginal men and women who engaged with researchers are termed "informants", which inherently indicates that a choice was made to engage and offer information. This might have been due to cultural pride, an impulse to have one's stories recorded in the face of impending colonial change, financial gain or just plain curiosity in the engagement.

Golden age

The BAAS expedition to Australia appears to have been far more interested than other expeditions in people. At the front of the expedition handbook was a chapter on Australian Aborigines. For the Canadian expedition, a similar chapter was placed after chapters about Canada's natural environment.

The approach to South Africa was different again. "The South African handbook includes anthropology, but it is more concerned about how to govern these large numbers of people. It uses anthropology very specifically in terms of control," Professor Russell says.

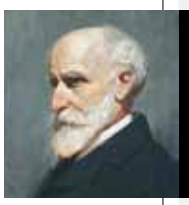
An explanation for Australia's ascendance in global anthropology dates back to the discovery of gold in the fledgling colony of Victoria in 1851. The influx of capital and fortune seekers could easily have launched Melbourne onto the usual trajectory towards becoming a big "flashy" city.

But instead, Professor Russell says, Melbourne became an intellectual scene of international standing. "There was a community of intellectuals through the Mechanics' Institutes, the Royal Society of Victoria, and various philosophical and other societies. Every night you could go to lectures, and many of them were about what was paternalistically phrased 'our Aborigines'."

In 1854, the National Museum of Victoria was established and initiated a long history of documenting the lives of Australia's first peoples. This was particularly so after the 1899 appointment, as museum director, of Sir Baldwin Spencer, an anthropology pioneer internationally. With his connections to London luminaries in this field, Spencer strongly influenced the anthropological angle of the BAAS expedition.

Professor Russell is fascinated by early anthropologists such as Spencer and his peers.

Above her desk hangs the painting *Portrait of A.W. Howitt* by prominent Australian artist Tom Roberts, which was commissioned by Spencer. Alfred William Howitt was an explorer, magistrate and natural scientist, whose 1904 tome on the Aborigines of south-east Australia is a cornerstone of early Australian ethnography.



Portrait of A.W. Howitt, 1900, Tom Roberts, Monash University Collection.

"Howitt engaged with Aboriginal people and wrote volumes of observation. These are of course patronising and paternalistic, as one would expect from a man of the 19th century. But in his personal correspondence there were also expressions of friendship, of admiration, and even – one might say – of affection and love," Professor Russell says.

Through Howitt, she was also captivated by the diaries of George Augustus Robinson, appointed the Protector of Aborigines in Victoria, and her interest has now evolved into a broader study of Victorian ethnographers, funded by the ARC. This study also includes the often-unrecognised wives, daughters and mothers who assisted in the work.

Later this year, Professor Russell will begin a visiting fellowship at the University of Oxford, using the BAAS archives there to better study the Australian expedition and how it differed from similar journeys to Canada and South Africa.

50 years of Indigenous engagement

Half a century ago, in 1964, Monash University took the then-radical step of establishing a centre dedicated to research and study about Australia's Indigenous people.

It was a move in keeping with the iconoclastic outlook of the young university, which had enrolled its first students only three years earlier.

The Monash Indigenous Centre (originally called the Centre for Research into Aboriginal Affairs) was the first such centre in Australia and remained the only one for nearly 20 years.

Under the initial direction of Dr Colin Tatz, it assumed a broad role combining not only research and teaching but also engagement with real-world issues. This philosophy continues under the current directorship of Professor Lynette Russell.

One of the centre's most significant programs, the Monash Orientation Scheme for Aborigines (MOSA), was launched in 1984, with Associate Professor Isaac Brown as inaugural director. The scheme's brief was to redress inequities in education for Aboriginal and Torres Strait Islander people. It was the first program of its kind in the country. The Yulendj Indigenous Engagement Unit now continues the work, recruiting and supporting Indigenous students through pathway programs, academic support and the promotion of excellence among Indigenous scholars.

In MOSA's first year, nine Indigenous students enrolled; now there are more than 170 studying in a range of disciplines.

In 2014, Monash University is celebrating 50 years of contributing to greater understanding of Aboriginal history, anthropology, culture, identity and literature, and of supporting Aboriginal and Torres Strait Islander people in accessing higher education.

www.monash.edu.au/about/indigenous/celebrating-50-years

PHOTO: REPRODUCED COURTESY OF MUSEUM VICTORIA

The anthropologist Baldwin Spencer in Alice Springs, 1901.

The project brings this remarkable expedition out of the shadows of World War I, which erupted as the BAAS scientists reached Adelaide, in South Australia.

In many ways, her work represents an inversion of the mass arrival of these scientists from the UK a century ago. Professor Russell is an Australian academic travelling to the UK to conduct fieldwork within an institution regarded as a repository of that country's knowledge of the world's indigenous peoples.

"I'm collecting the collectors," she observes wryly. ■

ILLUSTRATION: SONIA KRETSCHMAR

Mathematical minds rally to problem solve

Next time you are stuck in a traffic jam, calm yourself with the knowledge that somewhere in the realm of statistical mechanics lies an explanation for your plight.

WORDS **Alexandra Roginski**

Traffic jams – an exasperating fact of life in every major city in the world – challenge planners, engineers and motorists, and especially mathematicians for whom efficient vehicular movement is a source of endless fascination and possibility.

In Australia, it is one of the tasks being tackled by a new problem-solving centre called the Monash Academy for Cross & Interdisciplinary Mathematical Applications (MAXIMA), a member of which is Dr Tim Garoni, senior lecturer with the Monash University School of Mathematical Sciences.

"Traffic is a good example of statistical mechanics that deals with the patterns formed when you've got a large number of objects all interacting with each other," Dr Garoni says of the cars, buses, trucks, trams and trains he has turned into mathematical abstractions.

His task is to make sufficient sense of these patterns to give transport system managers a tool or model that lessens the chaos and frustration.

The project showcases MAXIMA's role of bridging the gap between theoretical formulations – which can be excellent for modelling complex but idealised geometries, relationships and interactions – and the real world, which tends to be unruly and unpredictable.

MAXIMA members use tools such as computational physics, statistical mechanics and combinatorics to better predict behaviour of physical systems in the real world. Once behaviour can be predicted, it can be controlled and optimised using other powerful tools from mathematics.

Since 2008, Dr Garoni has been working with VicRoads, the statutory body overseeing roads and traffic in the state of Victoria, to model transport scenarios that are difficult or impossible to test through field trials.

Collaborating with Dr Lele Zhang, also of Monash, and Associate Professor Jan de Gier from the University of Melbourne, Dr Garoni has applied mathematics to traffic-flow data to determine different priorities at traffic lights.

It has provided an interesting test case for theoretical maths and some of the real-life imponderables that get in the way.

In this case, Dr Garoni explains that a traffic-light system following a mathematical model that allows it to be totally adaptive and demand-driven could lose its predictability. Combine loss of predictability with human behaviour and the outcome could be even more frustration and chaos.

"In other words, if you were just designing networks from a mathematical perspective, an adaptive, demand-driven system is what you would have," Dr Garoni says. "But in reality, drivers like to know what is about to happen."

So traffic management remains a perpetual challenge – balancing theoretically sound mathematical solutions with what can be implemented in practice – but one that mathematicians are determined to eventually solve.

It reflects the real-world engagement intended for MAXIMA by its director, Professor Kate Smith-Miles. Ask her "to which problems can mathematics be applied?" and her answer is "to which problems *can't* it be applied?"

Professor Smith-Miles sees mathematics as the engine room for new science and

she is making MAXIMA a rallying point for mathematicians whose careers may have branched off into other fields such as engineering, information technology, econometrics, astronomy or epidemiology.

Professor Smith-Miles's mission is to encourage these dispersed mathematical minds out from their departmental niches to form a critical mass of skill, experience and thinking that can develop creative solutions to multidisciplinary problems.

"I think once you're trained as a mathematician you continue to view problems through a mathematical lens," she says.

MAXIMA intends to respond to industry needs, to support Monash's interdisciplinary projects, to train up-and-coming mathematicians in the "art" of collaboration, and to communicate to school-aged mathematicians the exciting potential of mathematics-based careers.

Broad research church

MAXIMA provides a research platform supported by about 50 mathematically trained academics from across Monash University's faculties and departments. This platform has also recently employed a small team of mathematicians with experience of interdisciplinary collaboration at other leading universities such as the University of Oxford, Pennsylvania State University, Harvard University and the Schlumberger-Doll Research Center (a Harvard industry partner).

"We've recruited mathematicians who've become experts in epidemiology and infectious disease modelling, in carbon sequestration, and the study of complex fluids," Professor Smith-Miles says.

"We have people who work on models of bone formation, and others who work on understanding the process of wound healing and how the rate of healing is affected by oxygen and bacteria levels."

One of MAXIMA's primary goals is to seek out collaborative projects that provide mathematical challenges. "We require a mathematical solution, but we don't know straightaway how to do it – it triggers the need to create new mathematics," Professor Smith-Miles says.

For researchers Professor Fima Klebaner, Associate Professor Kais Hamza and PhD student Rotem Aharon that means examining, using probability theory, the migration of cancer cells when subjected to radiation therapies.

Probability theory provides a way to analyse seemingly random behaviour to reveal deeper patterns. These patterns can provide insights into how a system that seems erratic and unpredictable – such as the movement of cancer cells when shocked by radiotherapy – actually changes over time.

Trained to collaborate

Professor Smith-Miles believes that the ability to collaborate with researchers from medical, engineering and other disciplines is a learned skill. MAXIMA's goal of training the next generation of interdisciplinary thinkers is illustrated by a research project on human immunity that has important implications for vaccine manufacture.

The project was instigated by PhD students Melanie Neeland from the Monash Department of Physiology and Qianqian Wu from the Monash School of Mathematical Sciences. It centres on events that occur within the body's immune systems that are central to the body's ability to recognise and fight infections and cancers.

Recognition of a threat results from interactions between two types of immune cells – dendritic cells and T cells. Dendritic cells in effect "gobble up" foreign material (such as bacteria or viruses resulting from infections or vaccines), munch that material down and then display some of the debris to other immune cells to alert them to the identity of the threat.

Dendritic cells primarily display their trophy (the 'antigen') to T cells, which are the immune cells capable of directing the entire immune system to train its biochemical weapons against that particular disease threat.

"So we are interested to know how many antigen-affected dendritic cells you need in the lymphatic system to trigger an immune response," says Professor Smith-Miles, who co-supervises the students with Associate Professor Tianhai Tian (MAXIMA) and Dr Michael de Veer (Monash Department of Physiology).

This question is important for vaccine development since vaccines work by providing the immune system with a harmless replica of a bacteria or virus in order to prime dendritic and T cells to fight should they come across the real thing. "Possibly, some vaccines are too strong; maybe they don't need as many antigen-affected dendritic cells to achieve an immune response. Or maybe the current vaccine strategies are not activating enough T cells to trigger an immune response."

In the process, both students are learning how to work across disciplines. For Ms Wu, it is a chance "to learn how to talk to a physiologist, to understand the language and the terminology, and convert that into a mathematical framework".

"A new generation of mathematicians trained to speak the language of other disciplines will help accelerate the impact they will have on society," Professor Smith-Miles says. The intellectual mobility that a mathematical background provides will mean there will be no shortage of research options for the new recruits.

This mobility is reflected by Professor Smith-Miles's own diverse career path, which has taken her from modelling neural networks to optimising the scheduling of robots inside pathology testing machines.

"As the MAXIMA director I'm the first port of call and people come to me with interesting problems that need a mathematical approach," she says.

In fact, it was after fielding requests for her mathematical insight from researchers working in fields as diverse as stem cells, bionic vision, psychology, physiology and regenerative medicine that the need for a facility such as MAXIMA became apparent. "There is a huge array of practical applications for beautiful mathematics and we enjoy tackling significant problems that impact society," she says. ■

One of MAXIMA's primary goals is to seek out collaborative projects that provide mathematical challenges.

Calculating brain "floppiness"

Brain injury might generally be considered the exclusive province of trauma surgeons or sports doctors, but at Monash University it is also the concern of mathematicians.

In a new approach to understanding shockwaves that resonate through the brain after a knock to the head, researchers from the Monash Department of Physiology are working with MAXIMA mathematicians to model these concussive repercussions.

The idea originated in a research project pursued by undergraduate science student Jessica Crawshaw and supervised by MAXIMA's Professor Kate Smith-Miles and Dr Jerome Droniou, and Associate Professor Ramesh Rajan from the Monash Department of Physiology.

"At the moment what we have is a whole bunch of descriptions about the changes that occur as a result of a blow to the head – for example, during a car accident or a sporting field accident," Associate Professor Rajan says.

"However, our data told us that in the first instance – just after the head hits a solid object – a pressure wave is created and it can cause damage as it travels through the brain."

The MAXIMA mathematicians are working to provide the brain physiologists with accurate predictions of how pressure waves move given the particular properties of the brain's structures – its fluid-filled spaces versus the areas filled with dense cells. In turn, those models are being tested for their ability to predict where damage in the brain is most likely to occur.

"If we can understand the sort of pressure generated at each point in the brain as a result of the pressure wave then we are in a much better position to predict the kinds of medical interventions best suited to individual brain trauma patients," Associate Professor Rajan says.

"So the collaboration with the mathematicians is about taking knowledge about the occurrence of pressure waves and translating that into predictive tools that have important clinical applications."

This fusion of mathematics and physiology is now seen as a first step for a whole new approach to studying brain injury.

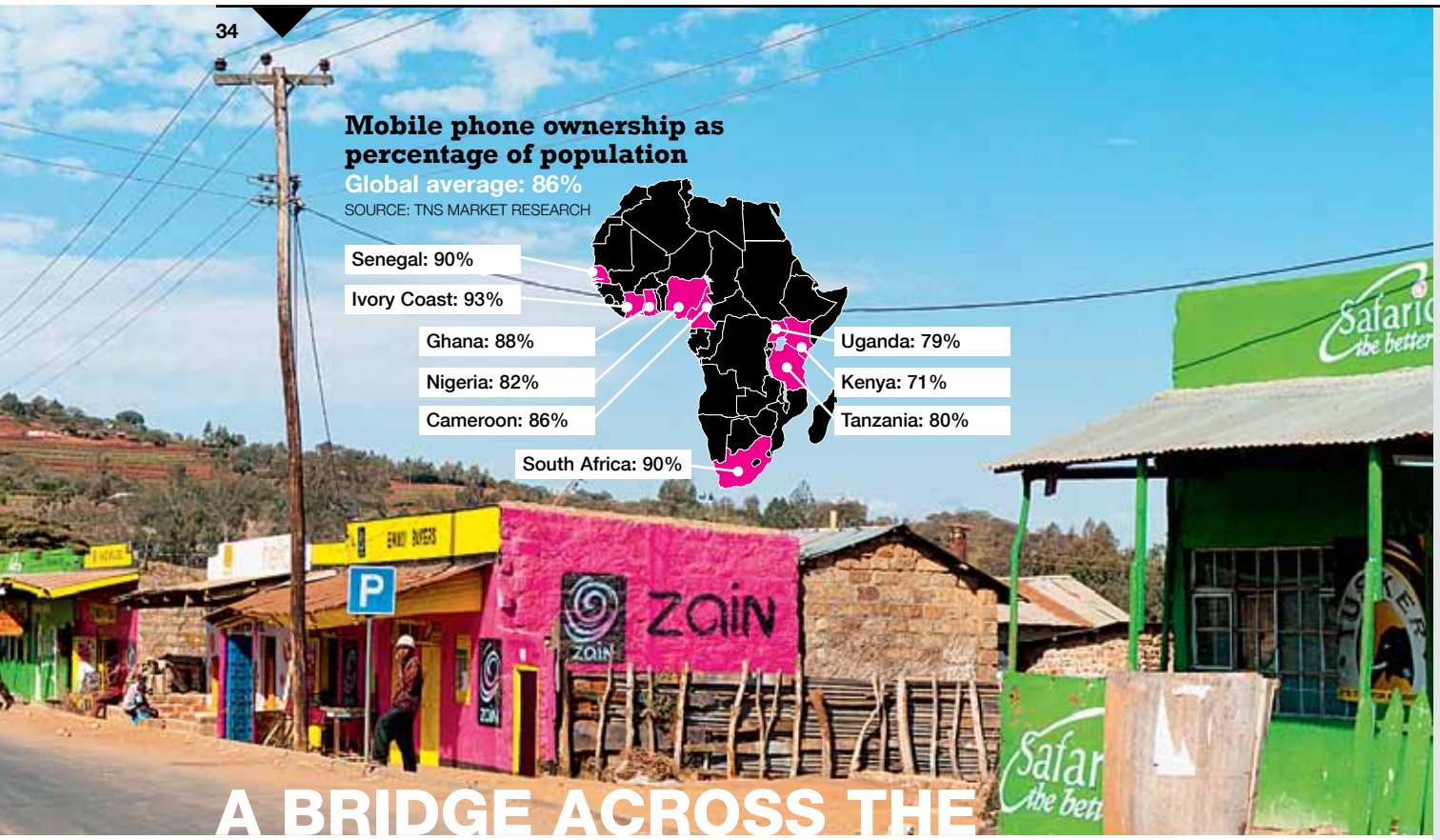


PHOTO: iSTOCKPHOTO.COM

A BRIDGE ACROSS THE TECHNOLOGY DIVIDE

WORDS **Rebecca Jennings**

A postman on a donkey delivering a text message to a village in rural Africa. Bangladeshi village women using social media to communicate their needs to a humanitarian organisation. An Indigenous child in remote Australia logging on to a computer built to handle the rigours of a hot, dusty landscape. Can technology change the circumstances faced by five billion people around the world who live in poverty with poor health, worse education and no access to the knowledge that could change their lives?

The developing world is not exactly in a digital stone age – mobile phones are used even in remote African communities – but the question, according to Monash University's Dr Jacques Steyn, is how to usefully mesh "corporatised" technology into developing countries? How to tackle digital illiteracy? How to deliver health, hygiene, education and farming knowledge to empower social and economic change?

These are challenges he faces every day as head of the School of Information Technology at Monash South Africa, where research focuses on information and communication technologies for developing countries, a field known more formally as development informatics (DI).

"Technology helps us to communicate over geographical distances and across time boundaries. It makes knowledge exchange possible, which offers opportunities for self-empowerment," Dr Steyn says. "Just knowing that basic hygiene helps to avoid sickness improves quality of life. But knowledge like this, which we take for granted in our developed lives, is often absent among the poor."

Technicians are still grappling with the social, geographical and logistical barriers to introducing technologies into the remote regions of Africa. Modern information and communication technologies (ICTs) such as computers with internet access require digital skills and expensive network infrastructure.

Dr Steyn's recognition that most DI projects fail prompted him in 2006 to establish the International Development Informatics Association, a platform for sharing experiences and research ideas.

"There has been an amazing uptake of mobile phones among the world's poor," Dr Steyn says. "The dominant use is for communication with family and friends. In itself, this constitutes a considerable success even if there is no clear economic benefit: it has made people's lives easier. But we are still far from using ICT for empowerment through knowledge."

The practical and sustainable transfer of technological hardware and skills comes down to acceptance that DI is actually a socio-technical discipline: the human component is a critical consideration.

Monash researchers are therefore testing and assessing systems designed specifically for the developing world and for remote Indigenous communities. They are also involved in training engineers to bring a more socio-technical perspective to projects such as the Digital Doorway, and to promote a communication model that combines a traditional postal service with mobile technologies.

You can't eat a computer

DI projects come with a moral question: do developing communities *want* this ability to connect?

Dr Larry Stillman, senior research fellow in the Centre for Organisational and Social Informatics in the Faculty of Information Technology at Monash in Australia, explains: "When we think of technology, we think of computers, phones, programs designed for an affluent middle class.

"But we're talking about poor AIDS-afflicted communities without health, education, clean water – and you can't

People who cannot read can still learn how to use icons on the phone; people who can't write can communicate textually using voice recognition programs. These are tools that empower a person.

– Dr Larry Stillman

Digital solutions

ePOST

To overcome geographical barriers, Monash University researchers have simulated a communication model to be used in a village with traditional social networks but no global connection (via internet). Using mobile devices, multimedia messages can be "posted" to the village's ePost office. They are then collected by an ePostman (passing the village on a donkey, camel or llama). When this ePostman travels past a global network, the messages are distributed. Even villages sharing a single phone could participate.

DIGITAL DOORWAY

Open-access computer kiosks designed for multiple users have been developed by South Africa's Meraka Institute (of the South African Department of Science and Technology). Monash University is training engineers and testing the kiosks. There are now more than 200 Digital Doorways throughout South Africa and Uganda and in three remote Indigenous communities in Australia.

eat a computer. When we take these technologies into developing countries, there is a danger of overlaying our Western expectations onto their usefulness as well as how they will actually be used. These moral concepts are important considerations."

Dr Stillman refers to a traditional village of about 200 residents in rural Limpopo, South Africa, where he examined the relevance of ICTs to village life, working with the Meraka Institute, a government-funded research organisation. Dr Stillman says the Meraka Institute has now installed a robust, multi-user computer – a Digital Doorway – in the community meeting house, and the community is engaged in recording how it affects their lives.

His research about the complex issues involved have also taken him to KwaZulu-Natal in South Africa, working with Oxfam Australia and a local organisation that empowers HIV-positive people to become community facilitators, and to Bangladesh to design a low-cost, community-focused information system, again working with Oxfam and local agencies.

Generational change

A community may accept technology, but then be hampered by the high illiteracy among adults in the developing world. Monash ICT researchers are addressing this by focusing on the next generation, as children tend to be able to teach themselves how to use a computer or learn from their peers.

The researchers are also looking for features within the technology that enable digital competency, Dr Stillman says. "People who cannot read can still learn how to use icons on the phone; people who can't write can communicate textually using voice recognition programs. These are tools that empower a person in a developing country, or groups of people together, helping each other. One may talk, the other may type – this is the African idea of *ubuntu* [human kindness].

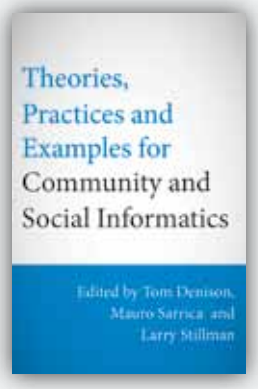
"And a mobile phone is simple technology that can be charged from a car battery, shared by a family or even a village, and used with minimal training."

Dr Steyn hopes that the differences these technologies are making in a few communities will create a ripple effect.

"The way forward is a slow one and requires patience. But if a rural community has better knowledge about how to manage their produce, about healthier living, about women's rights or floods, we have helped them make the world a better place for themselves." ■

Monash South Africa, www.monash.ac.za;
International Development Informatics Association, www.developmentinformatics.org

in print



Theories, Practices and Examples for Community and Social Informatics

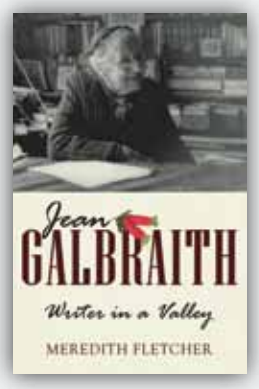
Edited by Tom Denison, Mauro Sarrica and Larry Stillman

Community informatics, which focuses on the design and implementation of information and communications technologies for and within localised communities, is an emerging discipline area.

In recent years, Monash University has developed considerable expertise in this field; two of the book's editors, Dr Tom Denison and Dr Larry Stillman, are researchers in the Monash Centre for Organisational and Social Informatics in the Faculty of Information Technology.

This collection combines theoretical exploration with detailed case studies as it examines how social order is mediated through these technologies, and considers their general effects on community and cohesion, class and power, and personal and social psychology.

www.publishing.monash.edu/books



Jean Galbraith: Writer in a Valley

Meredith Fletcher

Writer in a Valley is the compelling story of Jean Galbraith (1906–99), one of Australia's most influential botanists and writers on nature, plants and gardens.

As a garden writer, she was notable for spreading knowledge of Australian flora and encouraging the cultivation of native plants in home gardens. As a botanist, she wrote accessible field guides to Australian wildflowers that made a vital contribution to the conservation of native plants.

Galbraith conveyed the wonders of nature to generations of children through her child-centred stories of adventures in the natural world. Her nature writing evoked the spirit of places she knew well and introduced readers to the beauty of the Australian bush.

www.publishing.monash.edu/books

Breaking the Silence: Survivors Speak about 1965-66 Violence in Indonesia

Edited by Putu Oka Sukanta
(translated by Jennifer Lindsay)

Former political prisoner Putu Oka Sukanta is the editor of this collection of accounts from people around the archipelago who experienced the 1965 violence in Indonesia.

Fifteen witnesses from Medan, Palu, Kendari, Yogyakarta, Jakarta, Bali, Kupang and Sabu Island share their stories of how they navigated this horrifying period of Indonesian history and how they have lived with this past.

The lives of ordinary people – teachers, artists, women's rights activists, police – were turned upside down when attacks began on those considered to be supporters of the Communist Party of Indonesia. These accounts, including one from a perpetrator who is now tormented by guilt, and survivors who still feel isolated and rejected by society, show how the violence continues to influence Indonesian society.

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A global initiative for the UN has chosen Monash to play a lead role in developing *sustainable solutions* for our future.

We think that's *brilliant*.

In 2012, the UN Sustainable Development Solutions Network (SDSN) was launched by the UN Secretary-General to help find solutions for some of the world's most pressing environmental, social and economic problems. Monash has been chosen as the Australia/Pacific Regional Centre for the SDSN and will mobilise researchers, industry and community organisations to develop ways to end extreme poverty and protect the environment. It's a brilliant responsibility that will help pave the way for a bright future.

MONASH University

Where brilliant *begins*