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SAM

THE UNIVERSITY OF SYDNEY

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Where will postgraduate study lead you?

Postgraduate Studies Expo
Wednesday 16 May, 4–7pm

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THE UNIVERSITY OF SYDNEY

IDEAS FOR A CHANGING WORLD

Belinda Hutchinson AM (BEc '76),
Chancellor

Dr Michael Spence AC
(BA '85 LLB '87),
Vice-Chancellor and Principal

It was wonderful to see the 2018 cohort of new students arrive on campus so full of nervous energy, ideas and potential. This group of students is particularly significant because they are the first to participate in our new undergraduate curriculum and will undertake practical industry experience as a core part of their studies.

It is gratifying that so many businesses and organisations, often connected through our alumni network, have been eager to partner with us in this endeavour. Like you, we are excited to see what our newest students will experience during their time here, and what they might go on to achieve as Sydney alumni.

One way the University expresses its enormous pride in our alumni is through the annual Alumni Awards, which take place this year in May. You may have heard of some past winners: artist and activist Ben Quilty (BVA '96); influential architect and philanthropist Penelope Seidler (BArch '64); and mathematics teacher, YouTube star and recently named Local Hero of the Year, Eddie Woo (BEd(Second)(Math) (Hons) '08).

Of course, these awards cannot give a full picture of the incredible work done by our many alumni as they enhance their professions and communities around the world. As the new students of 2018 start their journey, our alumni everywhere are demonstrating that great things are possible.

To find an area where great things are happening, look no further than our academics and alumni working in medicine and health. These are rapidly evolving disciplines and our approach to them is evolving as well with the creation of our new Faculty of Medicine and Health.

This new faculty will bring together education and research activities in dentistry, medicine, nursing and midwifery, and pharmacy. Health sciences will follow. This will make it easier for our academics to work across disciplines and health sectors, and better prepare our students for a future built on a team-based workforce.

Another exciting priority this year is developing our Parramatta/Westmead campus. By 2050, more than half of Sydney's population will live in western Sydney. Our campus there will be another resource providing an outstanding student experience while University people work to solve some of the greatest problems the world faces.

It will be a considerable investment but progress is best made by committing wholeheartedly to the future.

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Inside cover: Geology students on excursion to Prospect, 1895; Photo supplied by the University of Sydney Archives G3_224_0169

Inside back cover: Geology students' field trip to Bombo Quarry, NSW South Coast, 2016

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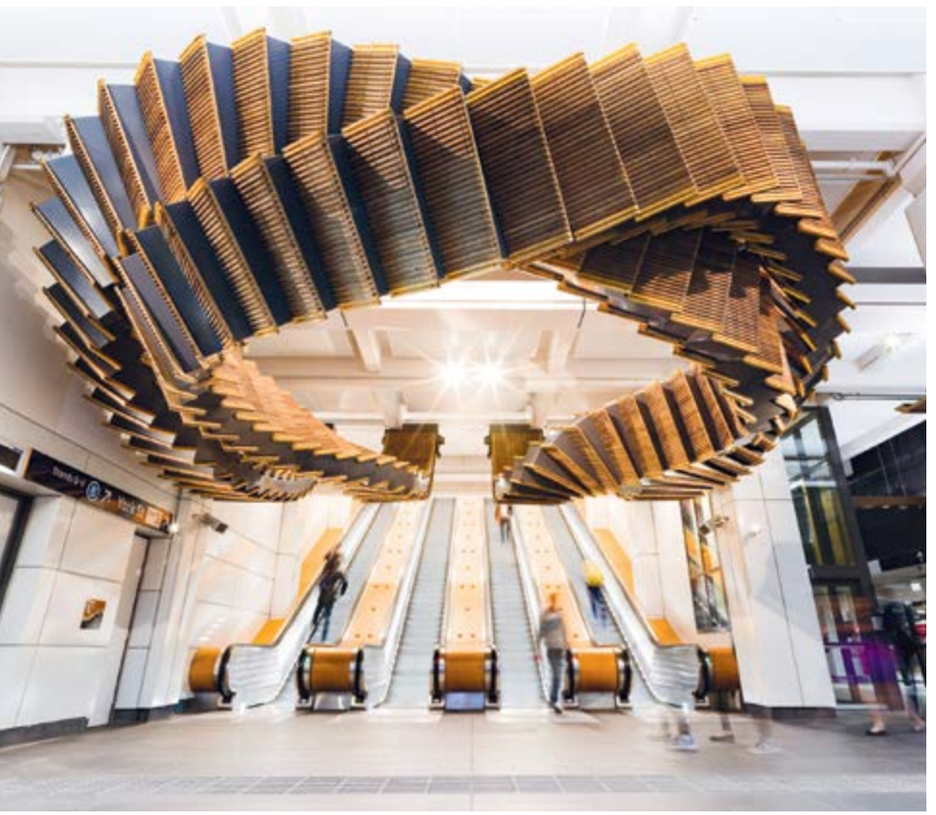


The Interloop art installation floating above the new escalators at Wynyard station.
Photo by Josh Raymond

▲ ART

Stairway to Wynyard

They might have gone to landfill but for the brilliant imagination of Chris Fox (BVArts '98). Instead, the old, wooden escalators at Sydney's Wynyard station are now a piece of daring and beautiful public art called *Interloop*.

Design and engineering took six months, with 12 weeks to fabricate the 5 tonne sculpture, which needed more than a kilometre of welding. The 48-hour installation was intense, but Fox, a lecturer in art processes and architecture at the University, was ready for the challenge.

The original stairs were installed in 1931, the same year the Harbour Bridge opened. They served Sydney well but were also a hazard for high heels and guide dogs. Their only risk now is making spellbound commuters late for work.

CULTURE

A Carillon milestone

This year is the 90th anniversary of the inauguration of the University Carillon.

After the First World War took the lives of 197 University people, the community wanted to commemorate the tragic events. Suggestions included a tower, a memorial gate and a swimming pool. Finally, it was decided to install a carillon in the clock tower of the Quadrangle.

The 54 bells were cast in England and shipped to Australia, with tens of thousands of people gathering for the inauguration ceremony on Anzac Day 1928.

The Carillon is now an important part of the character and culture of the University, as it honours past sacrifices.

Find out about free tours and recitals at sydney.edu.au/carillon

SUSTAINABILITY

What makes us perhaps the healthiest humans in history? No, not turmeric lattes. It starts with a helpful climate, arable land, clean water and breathable air – all of which are under threat.

To help protect these resources, the University has appointed the world's first Professor of Planetary Health, Dr Tony Capon, who brings deep experience in public health research, education and policy to the challenge. He'll be the lynchpin of the new Planetary Health Platform.

The aim is to create broad opportunities for ideas to ensure future generations are as healthy as us. "I'm looking forward to working with colleagues from many disciplines," Capon says.

The War Memorial Carillon bells are installed at the University; photo supplied by the University of Sydney Archives G3_224_0066_2


INCREDIBLE STAR COLLISION
WRITTEN BY: GEORGE DODD
ILLUSTRATED BY: DIEGO PATIÑO
PLANET EARTH, 130 MILLION YEARS LATER...

Think back to 17 August 2017. That was the first day electromagnetic radiation and gravitational waves from the same event were detected here on Earth. Our tiny planet and everything on it, was stretched up by the gravitational wave peaks and squeezed by the troughs.

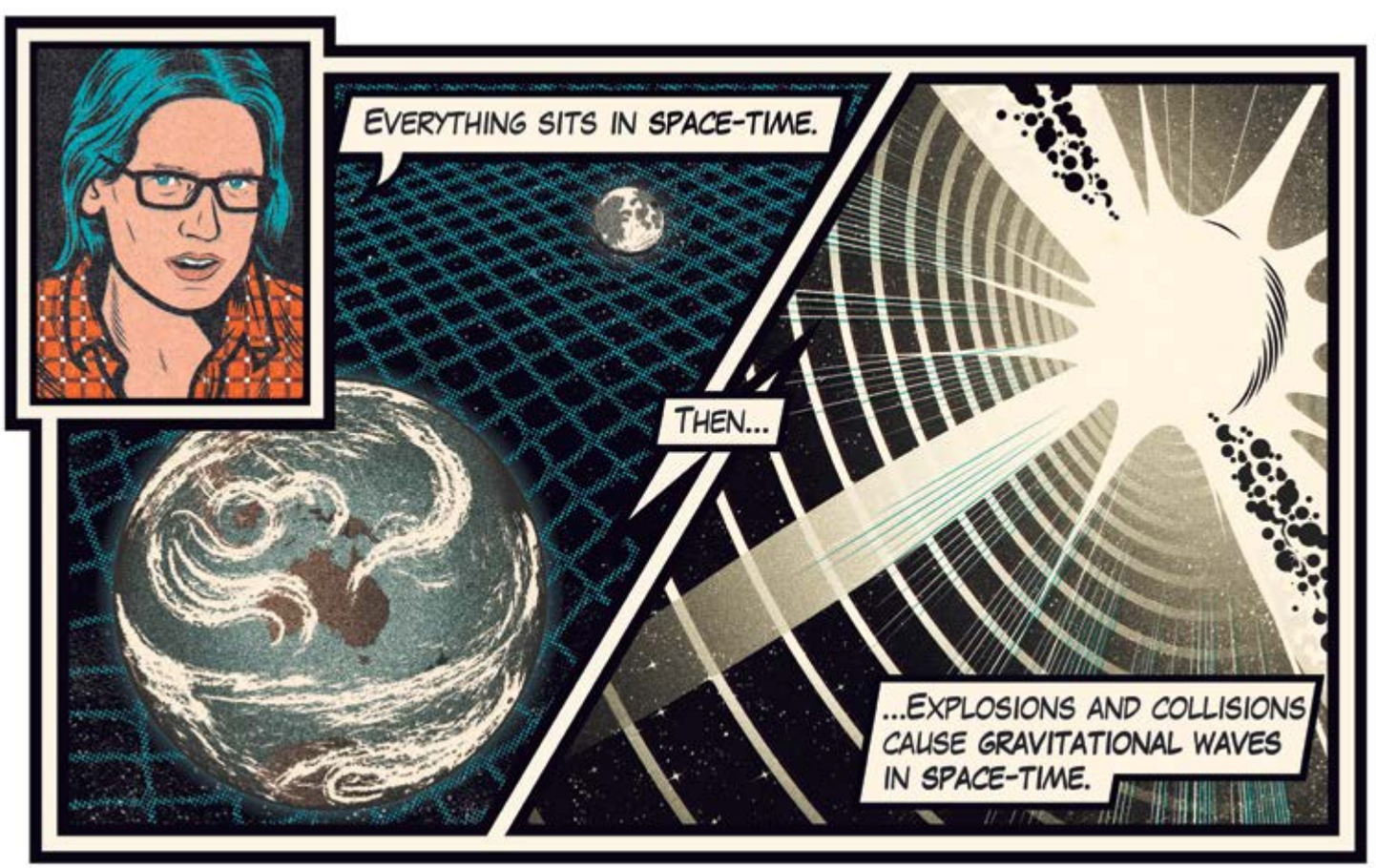
Did you feel it?

Probably not. In fact, you couldn't have. The waves had travelled such a long way, their power was beyond minuscule. We only know they arrived at all because of two highly complex structures in the United States called the Laser Interferometer Gravitational-Wave Observatory (LIGO).

LIGO was designed specifically to sense gravitational waves by measuring movement on the scale of one 10,000th the width of a proton – which is even smaller than an atom. By detecting that vanishingly small movement caused by gravitational waves, LIGO started a new chapter in scientific history.

The waves might have passed through us unnoticed, but their detection was an earthquake to the scientific community. Almost 100 years earlier, the Father of Relativity, Albert Einstein, had predicted the existence of gravitational waves. Now, finally, they had been detected, adding more evidence for his theory.

The waves started their light-speed journey 130 million years ago, at a time on Earth when plants were first experimenting with flowers and the earliest mammals were trying to avoid being eaten by dinosaurs. The waves were generated when two neutron stars that had been locked in each other's gravitational fields finally went into a death spiral and collided.



▲ Imagine a rubber sheet, strung taut. Throw a basketball onto the sheet and it dips where the ball lands. Throw a tennis ball nearby and it gets caught in the dip, moving towards the basketball. That's how gravity works between all objects in the Universe. The rubber sheet, very broadly, represents what's called space-time. When two massive objects, like neutron stars, explode or collide, they cause gravitational waves in the space-time fabric.

At that moment, several things happened that were nothing less than mind-boggling: more energy was released than by our Sun in its nearly 10-billion-year lifetime; atoms slammed together in a way that produced enough gold to make an entire planet; and an object was created of such density that a single teaspoon of it would weigh about a billion tonnes.

Considering how long astronomers had waited for this discovery, the timing wasn't great for astronomer, Associate Professor Tara Murphy (BSc (Adv) '00 CertEdStud '12). As one of the most important events in the history of science unfolded, she was at a conference in Washington, 15,000 kilometres away from her team and the equipment she needed to participate.

As she eagerly made her way home, she took every chance to phone her colleagues, postdoctoral researcher, Dr Christene Lynch and CSIRO astronomer, Dr Keith Bannister (PhD '12), and plan how to grapple with the breakthrough event. "It was extremely intense," she says, still buzzing with the memory. "We worked around the clock, and didn't sleep for the first couple of days."

The key task was to scan the heavens looking for the origin point of the waves which would allow a lot more information to be collected. For example, by examining the visible light from the collision, astronomers were able to confirm the creation of heavy metals, including that planet-sized amount of gold.

The search was all-consuming for Murphy, who remembers having a fascination with science from an early age. Her parents hadn't finished high school, but they encouraged her to pursue the interest. Finding herself at the University of Sydney was transformative and she still gets emotional talking about it. "I read about science my whole life but never actually discussed it with anyone except my teachers. Then I got to uni and it was like – oh wow. This is my world."

About 100 international teams, including Murphy's, were looking for the new object in space that was formed by the collision of the neutron stars. It would be generating radiation like gamma-rays and X-rays and, of course, gravitational waves. As radio astronomers, Murphy's team was looking specifically for radio waves.

The search generated some tension within the international astronomy community. Allowing that work done in disciplines like medicine, chemistry and physics can have commercial applications, researchers are often secretive about what they do. Astronomy hasn't been like that.

▲ Formed when a star explodes and the core collapses in on itself, neutron stars are about 20km in diameter but contain the mass of about 500,000 Earths. Neutron star gravity is about one billion times stronger than Earth gravity, crushing the protons and electrons in its own atoms together so they form neutrons – hence 'neutron star'. That same gravity would destroy the Earth if a neutron star were to enter our planetary neighbourhood.

"We have a strong history of international collaboration, where many telescopes have an open skies policy," Murphy says with some pride. "We share our data."

Things were different this time. LIGO was put together by a team from largely non-astronomy areas of physics. When it began operating, LIGO offered to tell any astronomer of a detection, provided they signed a memorandum of understanding and agreed to keep the news secret. LIGO didn't want scientific review by media.

Some astronomers, including Murphy's team, signed the agreement. Some didn't. Murphy eventually found herself in the difficult position of not being able to tell even close colleagues about this literally astronomical event. Though, as she points out, many people who didn't sign still figured parts of it out.

"So there's this really boring galaxy and suddenly hundreds of astronomers are pointing their telescopes at it," she says. "There are only so many reasons why that would happen."

Murphy also couldn't tell anyone her team was the first to find that needle in a hundred haystacks – the origin point of the gravitational waves from galaxy NGC 4993 in the Hydra constellation. She downplays the achievement. "There is a huge component of luck," she says. "This is an area of research we've been working on for years. We were very prepared."

Another consideration for Murphy, has been how our new understanding of gravitational waves might impact on one of astronomy's Holy Grails – what happened just after the Big Bang. We can't extract data from the visible light that still travels towards us from that event, because the fog of the early Universe is opaque. But unlike light, gravitational waves should be able to travel to us relatively unencumbered.

"So if ..." Murphy pauses, "big if – if, in the far future, the detectors were sensitive enough, we would be able to detect primordial gravitational waves from the Big Bang itself."

For a quiet moment, she contemplates the possibility. ●

REACHING FOR THE SKY

Some of our most talented researchers, including Associate Professor Murphy, are Sydney Research Accelerator (SOAR) fellows. The program enhances leadership profiles and research careers through funding, personalised research support and structured mentoring. Find out more and watch a SOAR video at sydney.edu.au/soar

▲ The two, 4km-long arms of LIGO shelter a laser beam. When the gravitational waves passed through the Earth, they stretched the arms of LIGO a tiny fraction of the width of a proton. This meant the laser took very slightly longer to reach the end of the arm. This also happened at a second LIGO facility 3000km away, confirming the reading wasn't a local vibration. With confirmation, notifications went out to participating astronomers.

FRONTIERS OF SCIENCE

No men in tights or women with X-ray vision here. For the groundbreaking Australian comic strip, *Frontiers of Science*, the superheroes were real scientists. It also inspired the comic-book approach of our gravitational waves story.

In its heyday, the comic strip *Frontiers of Science* was syndicated in more than 600 newspapers around the world. Not bad for an idea that started in 1960s Sydney with a conversation over lunch between a professor and a filmmaker.

The professor was Stuart Butler, one of Australia's best minds in theoretical physics, who worked in the School of Physics, and had a passion for making science more approachable for non-scientists. The filmmaker was Bob Raymond, one of the original team on ABC TV's *Four Corners,* who went on to have a successful filmmaking career.

The two talked about how to make science accessible without trivialising it. They hit on the comic strip format and the ball started rolling almost immediately.

Butler was the science adviser and Raymond wrote the comic strips, sometimes on the bonnet of his car in remote filmmaking locations.

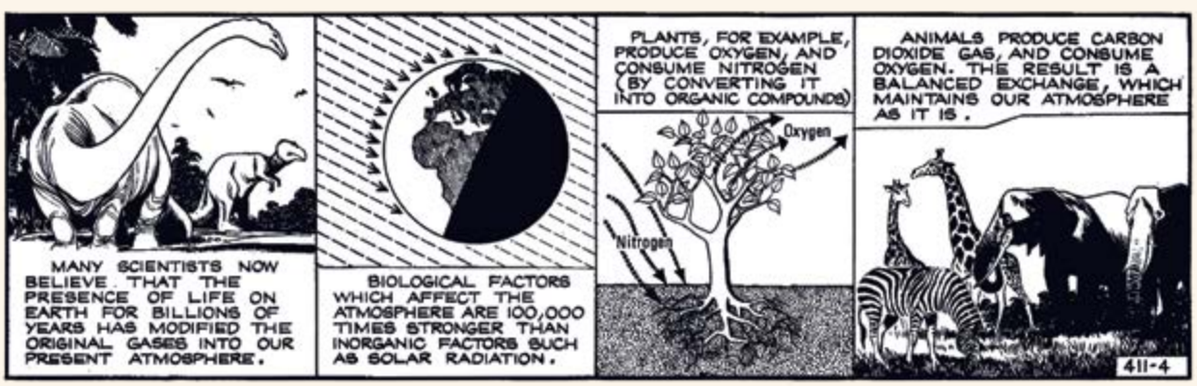
The first comic strips, in 1961, were drawn by artist by Andrea Bresciani, with David Emerson taking over in 1970. Over the years, 939 weekly strips were produced, only ending in 1982 with the passing of Professor Butler.

Some of the original artwork and published strips are now held in the Rare Books section of the Fisher Library. You can see the comic strips and find out more at frontiers.library.usyd.edu.au

SIFTING THE MOON – PART 1 Published 26/6/1967

What happened next? Most scientists don't wear suits to work anymore. The crew of Apollo 11 landed on the moon in 1969. No-one sank into the dust, but the space suits were quite a bit bulkier.

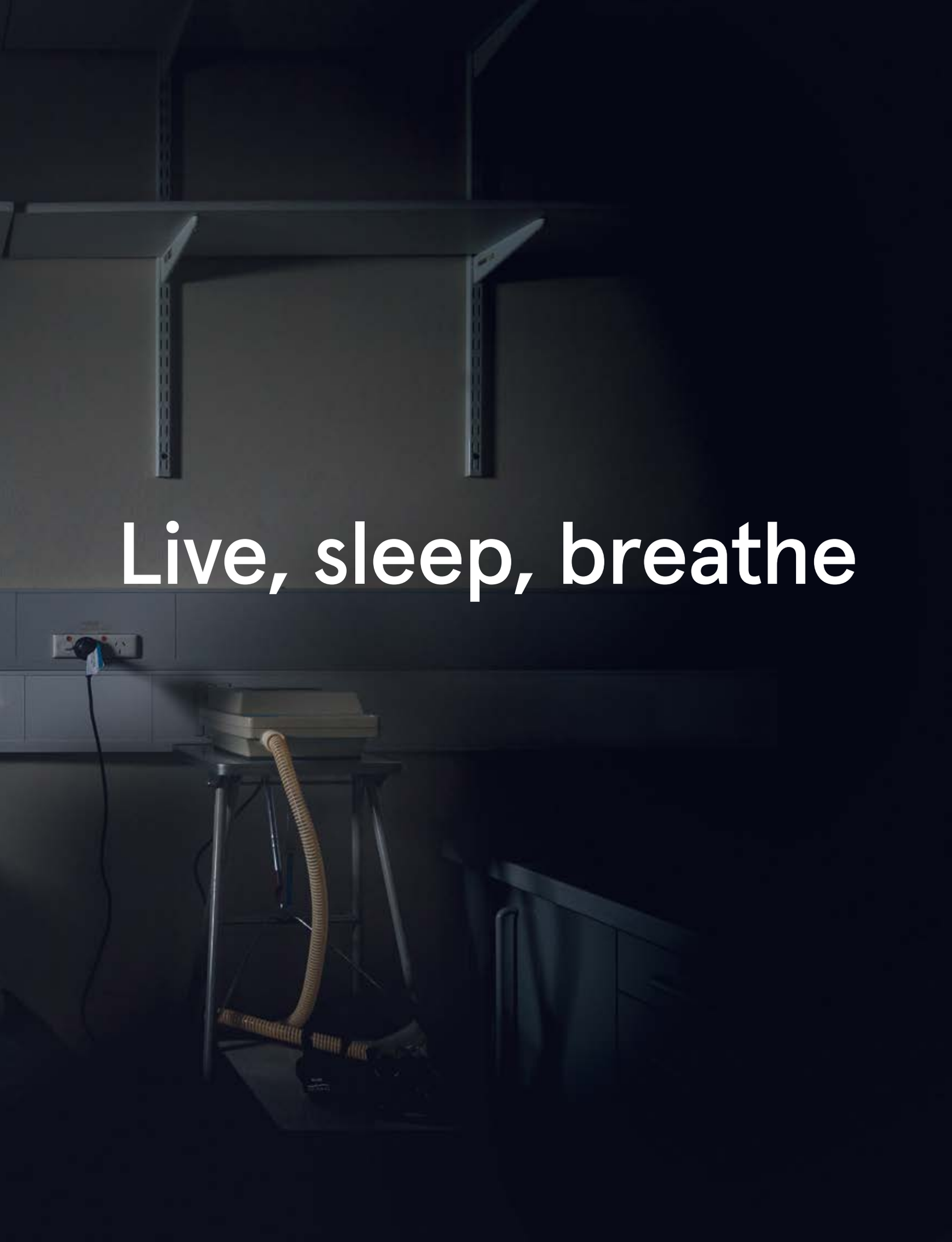
THE PUZZLE OF THE PLANETS – PART 4 Published 24/7/1969



What happened next? In the early 1960s, the concentration of CO_2 in the atmosphere was about 315 parts per million by volume. In 2014, it was 401. The forces affecting the atmosphere are no longer in balance, and climate change is one of the greatest challenges we face.

More than 12 million people with sleep apnoea use the CPAP machine invented by Professor Colin Sullivan. It has transformed and saved lives, and opened up a whole new area of research and clinical medicine.

Written by George Dodd
Photography by Stefanie Zingsheim


Live, sleep, breathe

It's now considered one of the most significant medical advances of the 20th century, but at the time of its creation, no-one could have imagined the impact the continuous positive airway pressure (CPAP) machine would have. Not even its inventor, Professor Colin Sullivan (BSc (Med) '67 MBBS '70 PhD (Med) '77).

"Most people were thinking in terms of a surgical solution to sleep apnoea," Sullivan says, sitting in the very rooms of the University of Sydney's Blackburn Building where he investigated the condition and painstakingly built the first CPAP device. "The machine was an experiment, but the experiment turned into the treatment."

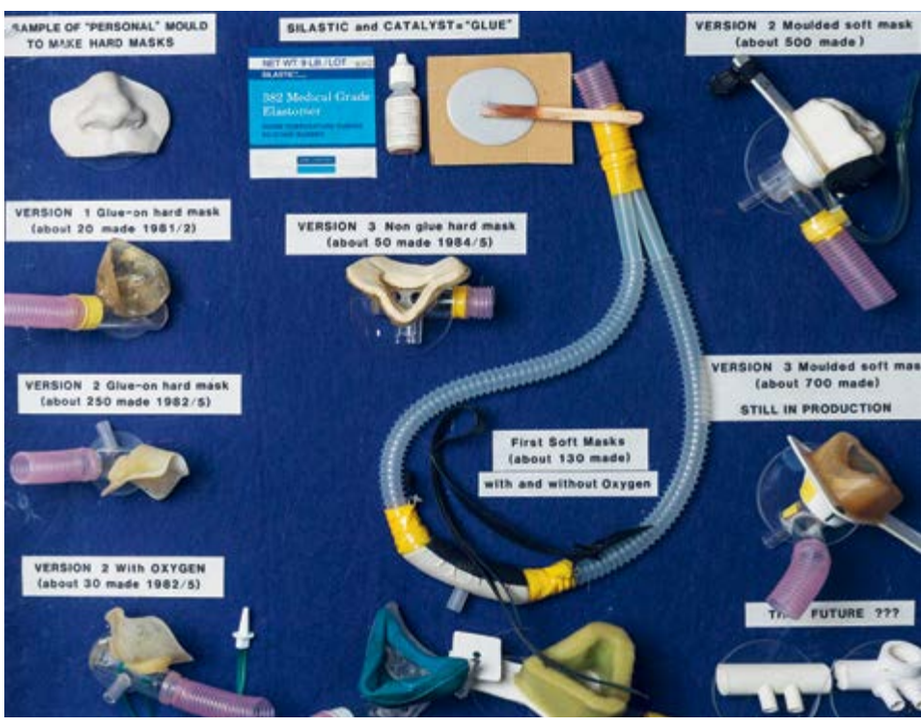
As Sullivan speaks, you can clearly sense his dedication, his compassion for his patients and how energised he is by his work. Ironically, in the early days, he didn't get much sleep either. He worked long hours, conducting sleep studies on his patients well into the night, followed by clinical work the next morning. Even now, there are too few hours in the day as he shares his time between not just research and clinical work, but also teaching. In fact, during his career, Sullivan has guided and encouraged more than 46 PhD students.

Work on CPAP started in the late 1970s when Sullivan was a University of Sydney researcher and a clinician at Royal Prince Alfred Hospital, mostly looking after people with respiratory failure, often caused by unrecognised sleep apnoea. Internationally, a handful of people were studying sleep, but no-one thought to look at how breathing behaves during sleeping hours. The doorway in for Sullivan was a colleague's contact with Sudden Infant Death Syndrome (SIDS).

"The notion with these babies was that something happened to their breathing when they were asleep," Sullivan says. "So we started researching the physiology of their breathing. At the time we had no idea that thousands of adults had breathing problems during sleep as well."

In fact, when Sullivan made the connection with adults, sleep apnoea was considered so rare that hospital authorities wouldn't provide much in the way of resources to study it. Sullivan had to borrow, improvise and invent the equipment he needed.

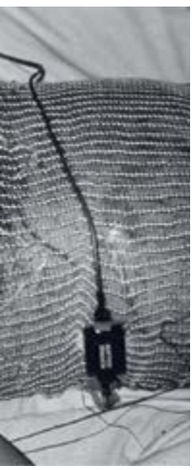
▼ Trialling new ideas meant the CPAP machine evolved quickly. Getting the mouth and nose covering right was a big challenge.



▼ The first CPAP trial in 1980. The CPAP machine has saved literally millions of people from apnoea-related heart disease, strokes, diabetes and accidents caused by sleep deprivation.

"In some areas of research, if you fail, you might just move on to something else. But if you're also a clinician, you still have a patient there. You have to keep working to solve the problem."

— Dr Colin Sullivan



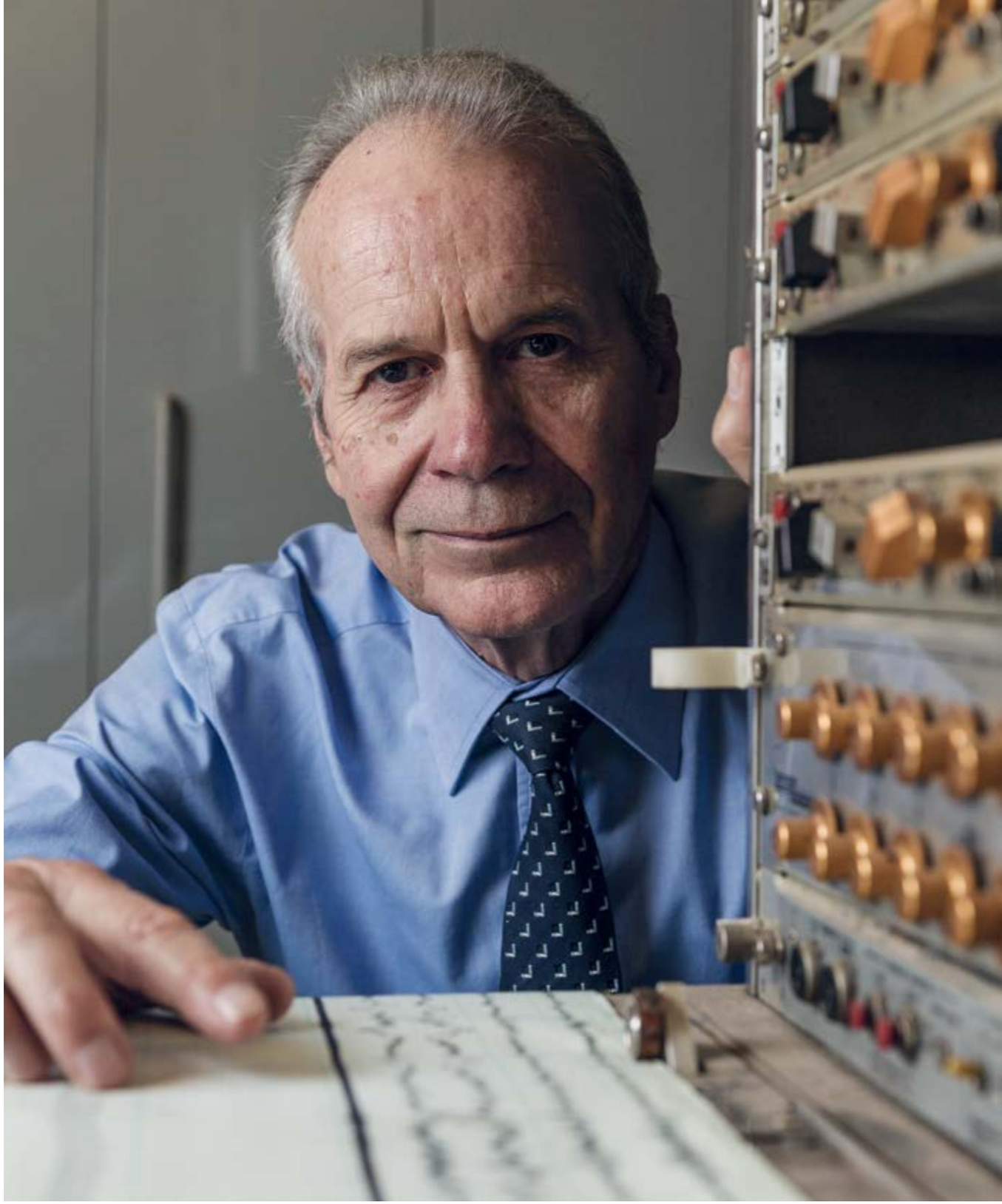


Image on page 10–11:
The rest is history. Professor Colin Sullivan in the room where he did his first sleep studies, leading to the invention of the CPAP machine.

▲ Polygraph machines are best known for spotting untruths. In the early days, Sullivan used this machine to measure blood pressure, pulse and respiration in sleeping patients.

▶ In pre-digital days, Sullivan's research generated vast lengths of paper with patients' readings. He still has much of it.

An early model. The first CPAP machines were big and so noisy, they had to be set up outside the bedroom. The latest models are small and virtually silent.

Of course, sleep apnoea was never rare. It was hiding in sleepy spouses and snoring grandparents. Family and friends would often make light of symptoms we now know are signs the body is under tremendous strain, enough to be debilitating or even deadly.

One of Sullivan's early patients was in the life-threatening stage of the condition, yet he refused the only treatment at the time: a tracheostomy, where a hole is made through the neck into the trachea so breathing can bypass the nose and mouth. "I said, 'Look, you really have to have this, or the apnoea will kill you'," Sullivan recalls, still with a sense of alarm.

For this patient, the cure was worse than the disease, especially since the only symptom he thought he had was sleepiness. His blood chemistry told a different story. The blood oxygen levels of a sleeping person in the grip of apnoea can drop by 50 percent. That's like being at the top of Everest, which would normally cause an awake person to pass out or even die.

Since the patient refused the operation, Sullivan decided to try an idea he'd had where the patient's airways would be gently pressurised, like a splint keeping airways open.

Sullivan came from a mechanically minded family. His mother was a milliner, his father was an electrician who worked on ships at Sydney's Cockatoo Island and his two older brothers became successful engineers. So it wasn't surprising that his idea for tackling apnoea was non-surgical.

"I asked my patient, 'Are you happy to do an experiment? I want to test this idea and it might help you.' He agreed to do it, and it worked," Sullivan says.

Sullivan found he was able to turn his patient's apnoea on and off with the machine, an effect which today makes it invaluable for researchers in the field of sleep disordered breathing (SDB); a field initiated by Sullivan's work. For that first patient, the results were dramatic. His oxygen levels normalised, his respiration and cardiac function improved, and for the first time in many years, he was getting enough sleep. This, of itself, changed his life.

Sleep studies involved measuring the patients' vital signs. This equipment was used to amplify the signs to reveal more information.

The workshop where Sullivan worked with Jim Bruderer. Sullivan himself had to be electrician, designer, metallurgist, even upholsterer, wielding the needle to fix the fabric of the bed used for sleep studies.

> "Most people were thinking in terms of a surgical solution to sleep apnoea. The machine was an experiment, but the experiment turned into the treatment."
>
> — Dr Colin Sullivan

That first success kick-started an energetic process of research and invention. Helping Sullivan were his first two PhD students, Faiq Issa (PhD(Med) '85) and Mike Berthon-Jones (MBBS '77 PhD(Med) '87), who set about measuring the significant improvements resulting from CPAP treatment. Later came people now considered world authorities on sleep: Dr Ron Grunstein (MBBS '80 MD '95), Dr Peter Cistulli (PhD(Med) '95), who published original research on oral appliances and is the University's first Professor of Sleep Medicine, and Professor Karen Waters (PhD(Med) '94), who researches sleep apnoea in children and also SIDS.

Another key member of the team was a retired Swiss-trained toolmaker, Jim Bruderer. He and Sullivan worked together in a CPAP machine workshop in the Blackburn Building, constantly producing improved CPAP masks as they were needed.

"People were always asking, 'Why don't you outsource that?' But doing everything right here, responding almost instantly to what we found we needed – you just can't have that immediacy if you're outsourcing," Sullivan says.

All this led to the opening of the world's first sleep apnoea clinic at Royal Prince Alfred Hospital, allowing patients to take their CPAP machines home. By 1985, a hundred people were on the program, but interest stayed mostly local. Further afield, clinicians were interested in the concept for research purposes, but doubted if patients would use what was then a loud and cumbersome machine, long term.

At a time when few people knew they had sleep apnoea, Sullivan sometimes had to use himself as a test subject.

The CPAP machine evolved quickly because the elements were manufactured where the research was done.

In the foyer of the Blackburn Building, one of the first places in the world where clinicians were also researchers.

It was also still widely thought that surgery would ultimately provide the answer.

That surgical answer is yet to come but by 1989, one thousand patients were using machines built in the Blackburn Building workshop. Both Sullivan and the University's Business Liaison Office could see the potential of the device, and indeed for an Australian medical device company. On this basis, an offer in 1985 was refused from the CEO of Respironics (now Phillips), the first company in the United States to market a system based on Sullivan's original 1981 publication in the leading British medical journal, *The Lancet*.

Not long after, Sullivan began working with Dr Peter Farrell (BE(Chem) '64), who was looking for investment opportunities in medical advances. This led to the first commercial production of the machine through a company called ResCare, which later became ResMed. A major advance emerged in 1990 from the ongoing work by Sullivan and Bruderer in the form of a new design element called the "bubble mask". This provided a new level of comfort and sealing, and gave a competitive advantage as the nascent ResCare entered the major US market.

Starting with just nine employees in 1989, ResMed now employs well over 6000 people, operates in 100 countries and is considered one of the most successful commercialisations of a medical advance ever achieved.

Sullivan has had a long association with the University of Sydney, which began with him being taken to an open day when he was a teenager. For the first time, he became aware of the science of physiology, which deals with the mechanics of the human body. Sullivan had found his path. He excelled at his studies and went on to demonstrate drive, initiative and creative thinking in everything he did.

Another vital ingredient of his work, and something he believes in passionately, is the University of Sydney's bridge between medical research and clinical treatment. When the Blackburn Building opened in the 1930s thanks to a grant from the Rockefeller Foundation in the United States, that bridge was literal, with a footbridge allowing researchers to walk from what was then the Rockefeller New Medical School Building, to Royal Prince Alfred Hospital.

At the time, it was a radical idea for researchers to have clinical patients. Today it's best practice and for good reason. "In some areas of research, if you fail, you might just move on to something else," Sullivan says. "But if you're also a clinician, you still have a patient there. You have to keep working to solve the problem."

Indeed throughout his career, Sullivan has been a gifted problem solver for himself and others. As previously mentioned, his work opened up the field of sleep disordered breathing, with implications for conditions such as dementia, the surprisingly common childhood apnoea, and the many causes of respiratory failure. Perhaps most dramatically, a person with polio or muscular dystrophy no longer has to stay locked in an iron lung. The modern, super-compact CPAP machine, gives them a freedom that was previously impossible.

Sullivan's current research is on obstructed breathing during pregnancy, which pushes up maternal blood pressure, reduces the amount of oxygen reaching the foetus and can compromise foetal growth.

So, well beyond the benefits of treating sleep apnoea, the significance of Sullivan's work has been profound.

"I received a letter from someone in the United States yesterday, saying thank you. I feel quite ..." he hesitates, struggling to find the right word as he's caught between the huge impact of his invention and his natural humility. "I mean, it's wonderful to be part of this. I feel this is wonderful." ●

◀ Taken in the early 1980s, this photo shows a meeting of almost all the sleep researchers in the world at the time. Today, there are more sleep researchers at the University of Sydney, alone.

With her podcast, *Lit Up*, Angela Ledgerwood created a platform for authors to talk about their books, lives and writing process. Along the way, she also found her true calling.

For the love of books

Written by Lauren Sams (BA(Hons) ’07)
Photography by Natan Dvir

The first job Angela Ledgerwood (BA ’04 BCom ’04) had in the United States was, fittingly, on the set of a film called *The Jane Austen Book Club*.

“I’d just moved to LA and literally knew one person,” she tells SAM over the phone from her home in New York City. “I had no idea how to get a job in the States and my friend got me a gig as a wardrobe intern.” The job was far from glamorous. “I wasn’t allowed to hand any of the actors anything,” Ledgerwood recalls. “So I spent most of my time driving around, going to various Targets to get Spanx for the actresses.”

While a career in film wasn’t on the cards for Ledgerwood (“I got bored very quickly!”), the fact that the movie was about a book club was apt. Ledgerwood is now the host of the popular literary podcast, *Lit Up* (**thelitupshow.com**). Since 2015, she has interviewed a different writer every week: Salman Rushdie, Roxane Gay, Ann Patchett, Jay McInerney, and many more.

In a world awash with podcasts, it seems almost foolhardy to launch a new one. But while watching *The First Tuesday Book Club*, Ledgerwood suddenly saw a gap in the book market, and knew she could fill it.

“I was covering books at [United States] *Cosmopolitan* at the time,” she says, “and the remit there was basically, ‘Choose a few books coming out this month that the reader will like’. There wasn’t any critiquing or judgement.” Ledgerwood, who describes herself as the kind of bookish child who preferred to sit indoors and read while her mates played in the sun, jumped at the chance to create a platform for authors to speak about their books at length.

“I’ve learned that the interview is not about me; it’s about the other person, and that has been so freeing.”

— Angela Ledgerwood

“As well as the books pages at *Cosmo*, I was interviewing a lot of amazing women – [actor] Julia Louis-Dreyfus, [Facebook Chief Operating Officer] Sheryl Sandberg, Senator Elizabeth Warren. I would speak to them for 40 minutes or so, knowing only a few paragraphs would make the magazine. I really wanted a way to have proper, long conversations with authors and notable people I loved and admired.” And so, *Lit Up* was born.

Two years on, Ledgerwood has interviewed authors from acclaimed essayist Sloane Crosley to controversial Norwegian memoirist Karl Ove Knausgaard. Her guests are many and varied – there are fiction and non-fiction authors, Americans and international writers, men and women, debut authors and industry veterans.

The show is funny and illuminating, a testament to Ledgerwood’s ability to put her subjects at ease immediately. “I’m most interested in where people’s art or creativity intersects with their life and their experiences, maybe even more so than the writing process,” she says. “I want to get to the illuminating parts of the authors’ lives that have shaped the issues they’re interested in or drawn to.” Often, she says, this comes back to childhood and family.

Her own childhood was largely spent reading and watching old movies. "There was a joke in my family that I liked hanging out with Bill Collins (BA ’56 DipEd ’57 MEd ’65), who introduced the Sunday afternoon movies, more than other kids!”

Top: Beyond her podcast, Ledgerwood also writes *Esquire* magazine’s monthly online books coverage.

Middle: Ledgerwood (left) interviewing the host of *The Daily Show*, Trevor Noah. She has also interviewed Salman Rushdie and Arianna Huffington, among many others.

Bottom: Though she lives in Brooklyn, Ledgerwood records her podcast at a studio near Manhattan’s SoHo district.

It may have seemed obvious that she would pursue a career in the arts, but when it came time to choose her university degree, she faltered. “I chose commerce because I thought I needed to be serious. I did arts, too, which I loved, but I had little interest in my commerce subjects.”

Ledgerwood, who resided at Women’s College for two years, recalls being hauled into the office by then-principal and CEO, Quentin Bryce (DLaws (*Honoris Causa*) ’09), when it became obvious she was barely going to pass accounting. “She told me to get it together, basically,” says Ledgerwood, laughing. “I told her I hated accounting and she said that wasn’t really important. I’d chosen it – I had to give it my best. It was a great lesson.”

After uni, which included a year on exchange at Cornell University in the United States, Ledgerwood made her way back for that fateful job on *The Jane Austen Book Club*. From there, she drifted a little. Internships at small magazines, a job at an online recruitment portal, and a master’s degree in fine arts followed before Ledgerwood found her feet at *Interview* magazine, then *Cosmopolitan*, where she was working when she conceived *Lit Up*.

As she started the job at *Cosmopolitan*, she was close to broke. “My mum always said, ‘come home’ but I felt like I couldn’t until I’d done something I was really proud of. I just had to keep going.”

With the podcast, she says, she has created something she’s incredibly proud of. Does she get nervous interviewing big-name authors, particularly ones whose work she admires? “Sometimes,” she says. “I’ve admired Siri Hustvedt’s work for a long time and I was really nervous about interviewing her. But I’ve learned that the interview is not about me; it’s about the other person, and that has been so freeing. I approach interviews with the idea that it’s my job to make this person be the best version of themselves for an hour – to let their work and their personality come through.”

After two years interviewing literary luminaries, Ledgerwood still has plenty of potential authors on her wish list. “Zadie Smith would be amazing,” she says. “And JK Rowling. I have so many questions for her.”

There’s one interview she’d like to do over again – with fellow Aussie Richard Flanagan. That conversation made her cry. “We recorded right after he won the 2014 Man Booker Prize for *The Narrow Road to the Deep North*. I was a mess. That book hit a nerve with me; I loved it fiercely.”

Putting the incident down to a mix of homesickness and a deep love of the book, Ledgerwood felt so bad about crying during the recording that she never uploaded it. “We still have it,” she says. “We might run it one day. My producer told me the crying was the best bit!”

ON MY DESK: GOETZ RICHTER

Associate Professor Goetz Richter (BA ’97 PhD ’07) is equal parts musician and philosopher. Growing up in Germany, he moved to Australia in the 1980s, drawn to its growing reputation for fine music. Now coordinator of violin studies and Associate Professor for Strings at the Conservatorium of Music, he himself is a violinist; he previously held a 15-year tenure as Associate Concertmaster with the Sydney Symphony Orchestra. He says the best part of his work is unlocking the independent imagination and intuition of his students.

Photography by Stefanie Zingsheim

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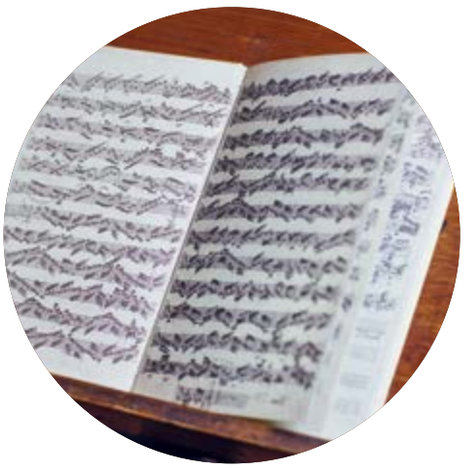
◀ CHILDREN’S DRAWINGS ON THE WALL

While my sons were growing up, I was working as a teacher, performing, and studying towards my PhD, so I couldn’t spend as much time with them as I wanted. I’ve always had their pictures and art up on my walls to know they’re with me. They’re in their 20s now, but I still like having their art around.

▼ PHILOSOPHY BOOKS

I was taught by violinist and concert master, Gerhart Hetzel. He was incredibly curious and tolerant and a keen philosopher. He stimulated my interest in philosophy as well as music and encouraged me to immigrate here, as he knew that Australia was a place with a future in music.



▲ BACH BOOK

This book shows scans of Bach's handwritten compositions. When we see printed versions of music, we forget they are an interpretation of characterful meaning. But with handwritten music like this, you can see the character, impulse, feeling and the musical direction in the notes.

▼ VIOLIN

This was my first full-sized violin, a beautiful instrument bought for me by my father 43 years ago. It was made in Venice in 1796. My dad is an amateur cellist. He often invited other musicians to play at our home. I would sit and watch them and I made my own violin from things I found around the house.

▼ ULA FALA NECKLACE

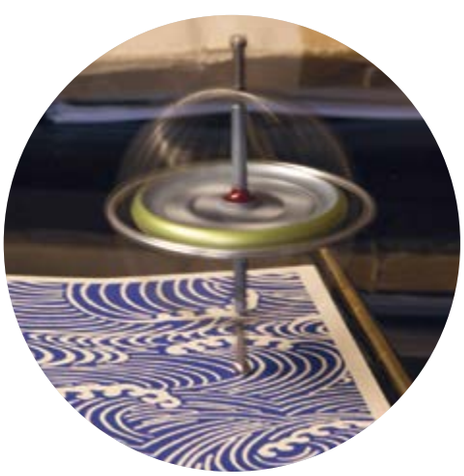
This is from a farewell ceremony at the National Orchestra of Samoa. Beatrice Carey (BMus(Perf) '11), who helped develop the orchestra, asked if the uni could donate some spare instruments. I wanted to do more, so I flew over to teach and perform with them.

▲ INDUSTRIAL EARMUFFS

One of the fundamentals of playing music is to anticipate what we will do, not to focus on what we've just done. I get students to practise while wearing earmuffs. They can't hear themselves well so they're not preoccupied with their mistakes.

▼ GYROSCOPE

If the gyroscope doesn't move, it falls over. Similarly, when we try too hard, we experience frustration and hesitation – which stops us. I use this gyroscope with students to encourage intuition, imagination and to show that we need a feeling for momentum.



The modern city is like a giant, highly complex machine. Steven Bai says it's time the machine had an upgrade, and he's already working on it.

POWERS OF PERSUASION

Written by Lauren Sams (BA(Hons) '07)
Photographs supplied

Not many of us have a literal lightbulb moment when we realise our calling in life, but Steven Bai (BDesComp '15) does. "When I was a kid in China," says Bai, "I used to run around the town we lived in with my father, playing around with firecrackers. It made me so happy – seeing the sparks, watching the sky become bright. And I knew that's what I wanted to do: make our environment a happier place."

Bai doesn't often have the chance to play with fireworks these days, while he works between Sydney, Beijing and New York. But true to his word, his work is about making the world a better place. He does it as the co-founder of Sencity, a company that uses what are called persuasive technologies.

◀ Steven Bai and Sencity create visuals and experiences to enhance urban environments, including (middle right), the TetraBIN.

Persuasive technologies in the digital realm are well known. Using our past choices, apps and websites prioritise the information they offer, to keep us online longer so we see more ads and buy more products. However, Bai's company has a different goal. It creates persuasive technologies in the real world, where people live and work, to subtly encourage them to make better choices and have better experiences.

On paper, this makes Bai an 'anti-disciplinary designer and interaction design researcher'. Which leads SAM to ask him, "But what do you actually do?" Bai pauses, and then he laughs.

"Well," he says. "That's a tough one. I think it's easier to say that in my work, I'm trying to answer a question: what does the next generation of public infrastructure look like?

"Our city hardware – things like lighting poles, bus shelters, public bathrooms, even rubbish bins – are all really old. We want to figure out how to make infrastructure and city hardware that actually improves people's lives. Basically, we want to reimagine cities as operating systems," he says.

One of Bai's first projects, as a Sydney student, was the TetraBIN at Sydney's Vivid festival of light and ideas in 2014. Here he reimagined the humble street rubbish bin as a Tetris-style game. Each time a piece of rubbish was put in the bin, it was detected and a Tetris-like shape was generated in LED lights, which played to the previous piece that was generated. This 'gamification' element engaged people, and hundreds of children queued up to use it at Vivid. But the persuasion element was there as well.

"You probably use a rubbish bin 10 times a day, but you rarely think about it," says Bai. "But I wondered if we could turn something very mundane into something exciting? And by making it exciting, could we entice people to think about the rubbish they produce and care more about the environment around them?"

"IT'S REALLY HARD, BECAUSE ESSENTIALLY THE WAY WE RUN CITIES HAS TO CHANGE COMPLETELY."

— Steven Bai

In the same vein, Bai is aware of one city that installed an interactive game on the pedestrian button at traffic lights. It dramatically reduced the incidence of jaywalking. Less successful was an initiative in New York that put free internet kiosks on the street. They were discontinued because they were mostly being used to access adult-content websites.

As ideas evolve, smaller and cheaper technology is making more possible. Bai now travels to cities internationally, transforming everyday places, objects and surfaces into visual and interactive experiences that add an element of play to otherwise dreary city environments. His greater goal is to reinvent the places where we live so they become 'smart cities'. In the same way that smart homes have connected 'helpers' like Google Home and Amazon's Alexa, Bai imagines the day when our cities will have infrastructure elements that connect with each other to make life easier for the people who use them.

Bai's urban ambition is underpinned by what was a singular university career. Completing a Bachelor of Design Computing with First Class Honours, his research into persuasive technology earned him the University Medal. He also took home the prestigious John C Harsanyi Medal, which is awarded to outstanding international students. So it is a formidable mind that is now set on solving some of the world's problems.

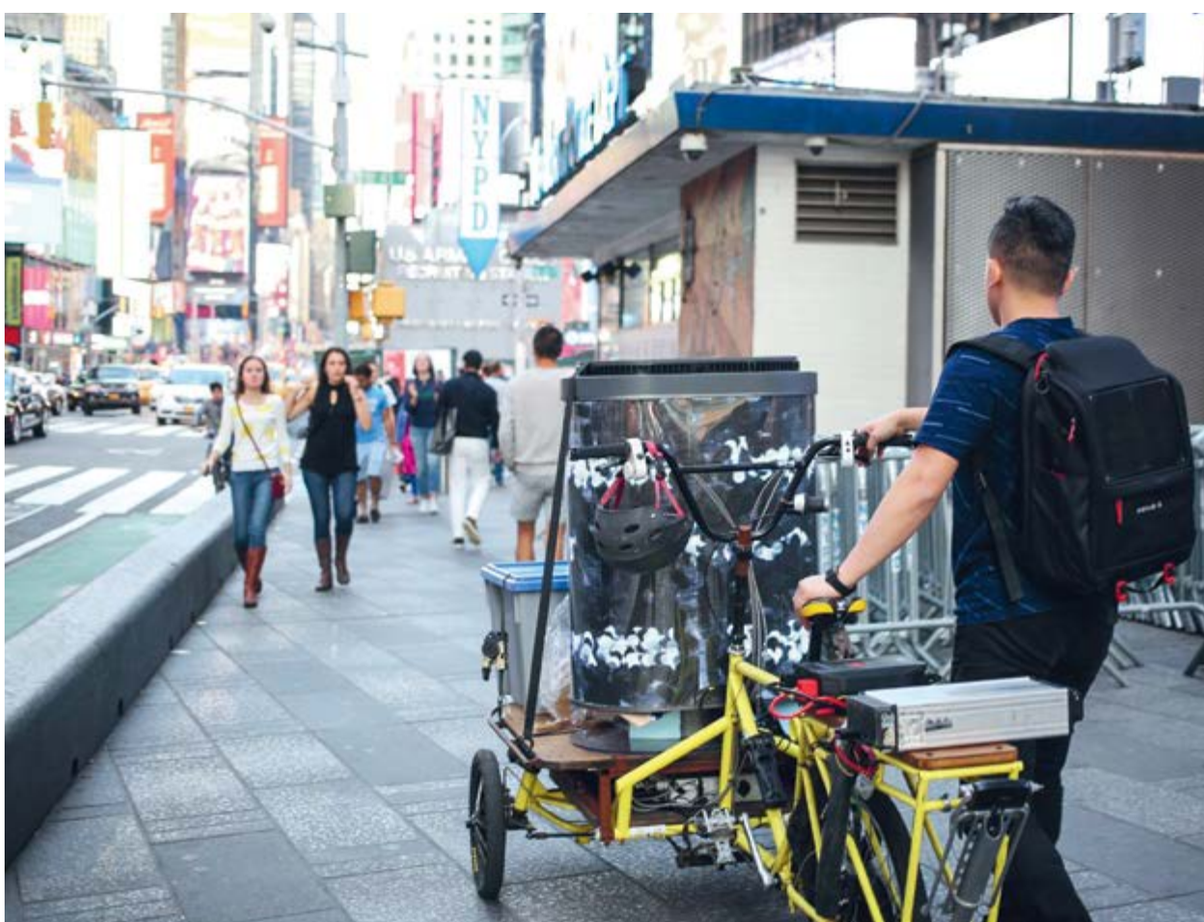
There are challenges, of course – big ones. The biggest problem, as Bai sees it, is that until now, cities have been making piecemeal changes. "It's really hard," he says, "because essentially the way we run cities has to change completely. A place like New York City is run in such an outdated, old-fashioned way – it won't cope with big changes to its population, and we need to fix that."

Bai's interest in public environments grew from both his Chinese childhood and his education in Australia. At 15, he participated in an exchange program with a high school in Hobart and loved it so much he decided to stay on. "I thought, 'Wow, you can do computer science in high school? And art? And choreography? That's amazing." (That's right: in addition to his day job, Bai is an accomplished illustrator and dancer. As a youngster, he was also a competitive swimmer.)

He stayed with a Tasmanian family for the remaining three-and-a-half years of high school and then enrolled at the University of Sydney, living on campus at Sydney University Village. "I was very inspired by the alumni who came before me, particularly Craig Barratt (BSc '83 BE(Elec) '85), who has done great things at Google, and by the way the uni approaches learning," he says. "I didn't want to just graduate with a degree. Sydney is all about the whole person, and that really excited me."

Mainly, though, Bai credits the University with fostering his love of collaborative learning. "I couldn't do what I do now without learning to work with teams," he says. "And the University certainly encouraged that. It's a very collaborative place. When you reach out to lecturers and tutors and alumni, they're always happy to help.

"I didn't realise it until just now, but that sense of reaching out and helping each other – that's what smart cities are all about. Connecting. Helping. Making every day a little bit easier."



With a hands-on approach to new projects, Bai is closely involved with both the creative and practical sides of his company, Sencity.

ON MY MIND: WILL TREGONING

Will Tregoning (BA(Hons) '03 PhD '07) is a co-founder and Executive Director of Unharm, an organisation that aims to make drug use as positive, ethical and safe as it can be. Here, he talks about discrimination and the decriminalisation of drug use.

Chances are, you take discrimination against people who use drugs for granted, even if you have used prohibited drugs yourself.

Use of illegal drugs could be called normal in Australia. Most adults under 60 have used a prohibited drug, usually cannabis. As with alcohol, most people who use these drugs have positive experiences. That's why people always have, and will, use drugs.

Despite the general perception of who drug users are, the truth is that wealth, employment and a tertiary education are all correlated with increased likelihood of drug use. This is counter to common myths: that drug use is a phenomenon from the fringes of society, and inherently problematic.

Those myths help perpetuate discrimination and we now live in a society where discrimination against people who use drugs is socially condoned. There are many legal behaviours, such as rock fishing or smoking cigarettes that are more dangerous than most illegal drug use. It's not risk that defines 'drugs'. They're defined by the perceived legitimacy of discrimination against the people who use them.

People higher up the social ladder have more ways to hide their drug use. They have more discreet ways to buy and use drugs, and the advantage of not seeming like the stereotypical drug user. This means the effects of discrimination at a personal level are most acute among people who are already disadvantaged.

There are many problematic instances of discrimination by powerful organisations that should have a commitment to equity – for example, in healthcare settings, and by police, employers and insurance companies.

Discrimination promotes silence and secrecy. I've been close to people who have struggled with their drug use and I've seen how terrible it has been for them and the people around them.

If you use drugs, it's crucial to learn to do so in a safe and positive way, and to seek help when problems occur. Secrecy and silence only make this harder.

The situation is similar at the level of policy. Honest engagement in problem-solving is precluded by the notion that drug use is always and inherently wrong.

Typically, solutions proposed for drug-related problems have one camp saying "drug use is a criminal justice issue" and the other saying "drug use is a public health issue". Strangely, the problem-solving always excludes people who use drugs. It's like devising a road-safety program with no role for people who drive cars.

Such a position is largely a result of the criminalisation of use, itself among the most obvious examples of discrimination. It imposes a barrier between people who use drugs and the people who are working towards solving drug-related problems.

This was clear when, reporting on the National Ice Taskforce consultations in 2015, then Assistant Minister for Health, Fiona Nash, observed: "From Lismore to Geraldton, police said the same thing: 'We can't arrest our way out of this – we need help from the whole community'."

This statement came at the end of a decade in which the number of drug user arrests in Australia doubled to 135,000. This trend continues, even though decriminalisation is supported by most Australians and the World Health Organization, and drug user arrests are not endorsed or even mentioned in the National Drug Strategy 2017-2026.

What Nash didn't say is that by legitimising discrimination, the criminalisation of drug use promotes stigma and social marginalisation. It alienates a big group of people with a great deal to contribute to the creation of safe, healthy and resilient communities: drug users ourselves.

Learning from the same-sex marriage example, we need a 'coming out' movement for people who use drugs. We need to show you can use drugs and live a flourishing, socially integrated life. We can change culture and laws through a movement that starts with visibility and defiance. And in the face of a discriminatory and failing drug control regime, we need to do that. Now.

The views expressed in On My Mind are not necessarily those of the University.

Illustration by Harry Slaghekke

There was a time when 3D printing was a revelation. Now, it's a revolution, with biomedical 3D printing being used to create human tissues and body parts.

Fit to print

Written by Rebekah Hayden
Illustration by James Jirat Patradoon
Photography by Louise Cooper

Print me up, Scotty. The ideas that led to 3D printing were coming together in the early 1980s. Zreiqat's team uses this machine to print bone substitute.

It's never good news when you're told you'll need a medical transplant or replacement – especially when this presents a whole range of new problems, such as rejection or insufficient access to suitable transplant material.

The challenges have been enormous, but a good-news solution is emerging. It is now possible to print human tissue and body parts using biomedical 3D printing machines. The potential of this technology is immense and at the forefront of developments are University of Sydney researchers, Dr Carmine Gentile and Professor Hala Zreiqat.

Dr Gentile's focus is on repairing heart damage. Starting his career in Italy, then working around the world, he now lectures at the University and leads the Cardiovascular Regeneration group based at the Kolling Institute at Royal North Shore Hospital. He knows the difference 3D printing technology can make. "Every 10 minutes, an Australian suffers a heart attack," says Dr Gentile. "Once the heart tissue has been damaged, there is no real treatment for the patient."

What this damage can mean for people who survive heart attack is an underperforming heart and disability. Major damage usually requires heart transplantation or bypasses using blood vessels from the patient. Both options present serious difficulties, but regenerating and implanting heart tissue could change all that.

"We're developing an approach that uses biological material – in this case, cells taken from the same patient – to generate living heart tissue to replace the damaged heart tissue," Dr Gentile says.

The human heart is made up of contracting muscle cells with blood vessels providing oxygen and nutrients to the areas within the muscle wall. Dr Gentile and his team realised that to give the newly grown heart cells the best chance of being accepted into the patient's existing heart tissue, they'd have to mimic the heart's own microenvironment. Despite a challenging process, they have been able to do just that.

They've called the combination of human heart cells grown in the laboratory 'cardiac spheroids', or the more graspable 'mini hearts'.

"Every 10 minutes, an Australian suffers a heart attack. Once the heart tissue has been damaged, there is no real treatment for the patient."

— Dr Carmine Gentile

Professor Hala Zreiqat and her team draw knowledge from across the University community to contribute to leading-edge medicine.

The broad concept is not new. Other researchers around the world have managed to 3D print alternate layers of blood cells and muscle cells. What makes Dr Gentile's approach unique is that the mini hearts more fully integrate all the cell types present in the human heart, including preformed blood vessels. These cells are used as bio-ink in a bioprinter that was custom-made for Dr Gentile and his team.

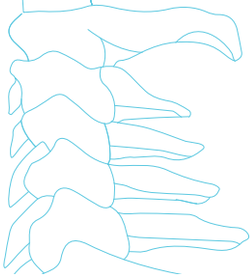
The bioprinter, called 'Reggie' by Dr Gentile's students, from the name of the Spanish company that built it, has a nozzle that sets down a layer of water-based hydrogel, and another nozzle that applies the cell-containing bio-ink. The resulting tissue mimics the mechanical and physical properties of the human heart and, since each patient has different requirements, a computer can vary the geometry of the multiple layers.

Dr Gentile's mini heart research also offers the promise of an alternative to testing drugs on animals or with standard cell cultures. In a 2017 study, Dr Gentile and his team found that since mini hearts can be made with a patient's own cells, they can be used to identify potential side effects that a person may experience from particular heart medications.

While Dr Gentile is mending hearts, Professor Hala Zreiqat is building bones. Born in Jordan, she's a powerhouse of energy and ideas, and her achievements saw her win the 2018 NSW Premier's Award for Woman of the Year. As head of the University's Biomaterials and Tissue Engineering Research Unit, she has developed a technique of 3D printing ceramic bone so it acts as a scaffold that contains all the ingredients needed for the body to foster bone growth at the site of the defect.

Bone is the most transplanted substance in medicine, with loss or damage resulting from accidents, disease or developmental issues. Current treatments require either grafting from a secondary site, which is problematic when there has been large bone loss, or inserting metal implants which frequently need replacing as the body changes over time.

"What we're working towards is taking a CT scan of the bone defect and feeding it straight into the printing machine, which hopefully would be sitting next to that operating theatre," Professor Zreiqat says. "This is where the uniqueness of our material and discovery comes in. You can design any shape or size, so it can be applied to a really large or small bone defect."



Healthy bone undergoes a constant process of renewal and bone growth. The bone substitute developed by Professor Zreiqat's team incorporates 'smart materials' which contain trace elements and nanoparticles designed to promote bone growth. The non-toxic ceramic is porous, so blood and nutrients can penetrate it. Over time, the ceramic degrades as it is replaced by new bone.

A major challenge in producing ceramics suitable for bone replacement is matching the impressive load-bearing and shock absorption of actual bone. To approach this and other problems that have arisen during research, Professor Zreiqat encourages cross-collaboration between a wide range of disciplines.

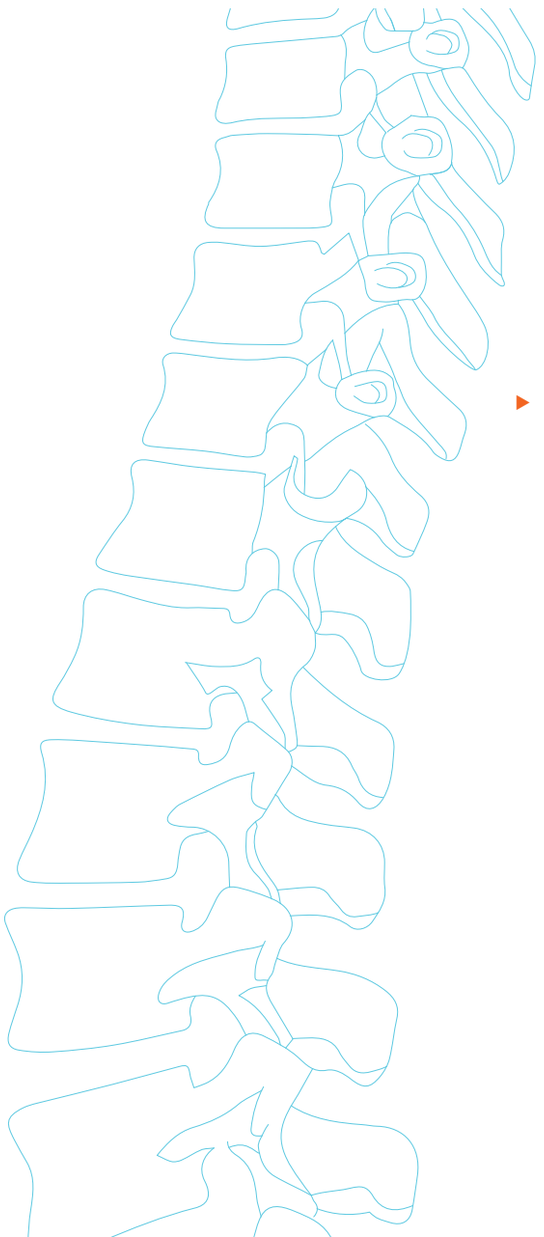
Her team includes material scientists, cell and molecular biologists, chemical engineers, physicists and clinicians.

In the future, she also expects to work with designers and architects.

With four patents on board, and clinical trials expected to begin in two years, her interdisciplinary focus is paying off.

"Science and discoveries are all built around problems you don't know the answer to," she says. "So we draw expertise from each other to develop something new. For example, in our approach to materials, we thought about what would happen if we changed the architecture of that material? Working with the mathematical modelling people, we found that just by changing the architecture, you can significantly affect the quality and the type of bond that forms with the body. It's big, right?

"I always think of the first coffee house that was opened in England back in the 1650s. When it opened, people started getting together from different disciplines to interact, and that's where innovation and discovery started to happen in England. A multidisciplinary focus fosters an environment for innovation." ●



While real bone can be in short supply, Professor Zreiqat points out that 3D printed bone is made from materials that are plentiful.

HELP MAKE THE LEAP

To learn more about these groundbreaking ideas or help advance the work, call Julia Tauber on +61 2 8627 8818 or email development.fund@sydney.edu.au

> "You can design any shape or size, so it can be applied to a really large or small bone defect."
>
> — Professor Hala Zreiqat

A job translating educational books in Pakistan gave Lila Ram an insight that was to change his life. He now works to create equal educational opportunities for his country's children.

Learning by heart

Written by Cybele McNeil
Photography by Danial Shah

Discovering the world of books is still a clear memory for Lila Ram (MEd '07).

He was 12 years old and going to play at the home of his classmates, both children of a local school teacher. Their father, as Ram was about to discover, had a vast library. When he walked through the door and set eyes on the rows of books, Ram struck a secret deal with his friends: "I told them, 'If I take one book and bring it back safely, can you give me another?'"

They agreed and Ram found himself quickly working his way through short stories, poetry and novels, many of which were translations of classics into his mother tongue, Sindhi. The school teacher father soon heard about the deal. "I was afraid he would be angry," Ram remembers. Instead, he encouraged the young boy to keep borrowing.

This exposure to literature and learning was an opportunity for Ram that many Pakistani children still don't have, especially in rural Pakistan, where he was born and grew up.

In his home city of Karachi, Lila Ram has dedicated himself to giving children a better future through education.


Q Mobile

Pakistan has an estimated 25 million children who don't go to school. The barriers to education include a preference for educating boys over girls, extensive use of corporal punishment, persistent poverty and hugely disruptive natural disasters. A lack of teacher training and infrastructure also affects the quality of education that can be delivered.

As well, there are some rural areas of Pakistan where it's said to be dangerous to go to school due to the activities of extremists.

Ram had another obstacle. His father passed away when he was aged two, leaving his mother to care for him and his three siblings in the poor rural town of Tando Bago in Pakistan's Sindh province. As custom dictated, Ram's eldest brother became the family breadwinner, though he was just a teenager himself.

While many nearby towns didn't have schools, Ram's town did, thanks to a local philanthropist who took it upon himself to build one. Ram excelled at his studies, first at school and later at university. After graduating, he held down odd jobs, including writing and translating for magazines and other small publications.

"Here was a nine-year-old boy who preferred to walk four kilometres to another school that doesn't beat its students, because he wants to learn."

— Lila Ram

It was translating educational books that gave Ram an insight that set him on a new path. "I noticed our educational resources for children weren't based on science, logic and evidence," he says. "Education resources need to stimulate questions, an urge for more knowledge and a logical approach. This was lacking."

These ideas stayed with him and he thought about them often.

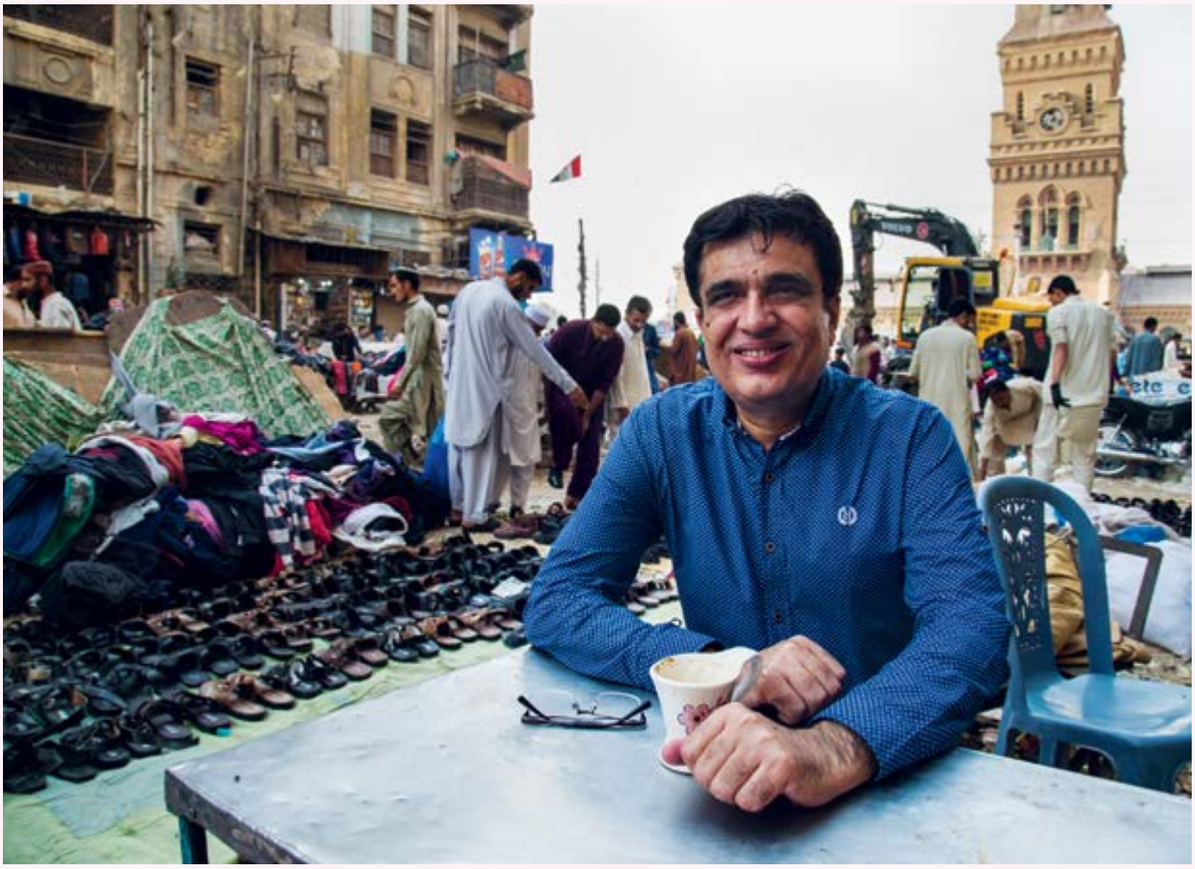
Ram finally landed a prestigious job as an engineer at a gas corporation, an opportunity that promised a great career. But he remembers looking out over the stretch of pipelines each day with the feeling there was something missing. "Every day when I came home, I found myself cursing my job," he says.

With a wife and two small children to support, the thought of throwing in such a hard fought-for livelihood seemed near impossible. But Ram knew that what he really wanted to do was work in education. A job came up at a teachers' resource centre in Karachi and he decided it was time. Ram took the job and has never looked back.

Working at the centre, he was part of the effort to train teachers to rethink traditional teaching methods where the students are passive. Instead, the teachers were encouraged to be more

▲ A typical school bag of a young student in Karachi.

▲ A big priority is bringing girls into education. Part of this involves promoting sports and reading by distributing relevant materials in schools.



Ram is part of the push to retrain teachers in Pakistan so they involve students more actively in the learning process.

student-centred, allowing students to actively shape and direct their learning.

Soon, Ram wanted to complement the hands-on experience in education and teaching with academic study. He heard of opportunities for postgraduate studies in Australia, but didn't see himself as a candidate as he thought such an offer was only for people from privileged backgrounds. And of course, it would mean being separated from his young family. It was only because of strong encouragement from friends and colleagues that Ram applied for a Master of Education (Research Methodology) at the University of Sydney.

In 2006, he arrived in Sydney, the furthest he had ever been from home. Adapting to a new country and a new education system was a huge challenge. Ram says he made it through thanks to the University academics and counsellors who also became friends. They still catch up regularly via email.

On returning to Pakistan, Ram was chosen from a large number of applicants for a role with the United Nations Children's Fund (UNICEF), managing schooling programs. Today, he works for another international development aid agency.

Much of his work is in the field, monitoring the basic education programs he helped set up. These programs aim to increase the enrolment and retention of students, especially girls, in public schools which were severely affected by catastrophic floods in 2010 and 2011. There is also a focus on improving education and promoting health and hygiene in marginalised rural communities.

Several experiences have stayed with Ram. After those devastating floods in rural Pakistan, temporary tent schools were erected in what are called Internally Displaced Persons camps. In the tents were hundreds of little girls going to school for the first time. Ram remembers the delight in their eyes as they first took a pencil in their hand, then seeing their pride in eventually being able to read, write, and draw.

Another memorable experience was encountering a little boy walking along a long road in a rural area. Ram stopped to ask where he was going and was told "school". Ram asked why he didn't go to the local school. The boy said it used too much corporal punishment.

"Here was a nine-year-old boy who preferred to walk four kilometres to another school that doesn't beat its students, because he wants to learn," Ram says. The encounter led him to engage with the school to end its culture of corporal punishment.

Ram is still as passionate about reading as he was when he was 12, and regularly has his own writing published. He is an admirer of the famous Sindhi poet Bhitai, and was also influenced by Leo Tolstoy, a writer deeply concerned about the lives of the poor, who used writing to change society. Ram works in education because it too has transformative power.

"Education is all about changing lives," he says. "It is about self-esteem, about giving our children the skills not just to cope with life and survive, but to become responsible citizens of Pakistan and promote peace, harmony and equality in society."

You may have noticed it on retail websites and in shop windows: the Afterpay logo is suddenly everywhere. Though not an overnight success, it wasn't far off.

On the money

Written by Jocelyn Prasad
Photography by Stefanie Zingsheim

Run a business from your bedroom, get a degree, work as an investment banker, start another business, get married, list your company on the stock exchange. Celebrate your 27th birthday.

The CV of Nick Molnar (BCom '12) is enough to exhaust the most ambitious millennial. And his latest business just happens to be the highly successful Afterpay, a company offering a 'buy now, receive now, pay in four instalments' service to its retail consumers.

The company's rapid rise has surprised no-one more than Molnar himself. As CEO, he has pedalled hard in the last year to build up the business infrastructure while dealing with runaway demand for its services. The numbers tell the story. Raising its first round of money in August 2015, Afterpay is now a 'unicorn company', that is, a startup valued at $1 billion – a statistical rarity in the startup universe.

Molnar has a relaxed nature and smiles easily. At the same time, he often has to run on little sleep and gives the impression of a man with a tireless appetite for work. This drive is reflected elsewhere in the Molnar clan. After selling the family jewellery business, his father Ron had barely been retired a week before he became restless enough to take up Uber driving, a job that sees him regularly send potential clients to his son's company.

The Afterpay mechanism is simple enough. By shopping with participating retailers, shoppers are able to pay for individual purchases in four fortnightly payments. Afterpay pays the retailer immediately after the transaction and the retailers pay Afterpay a fee for each transaction. A big plus for retailers is that Afterpay bears full responsibility in recovering money from the customers on the due dates.

For the critics who say Afterpay encourages greater consumer debt, Molnar counters that most of Afterpay's customers are millennials, whose budget-conscious spending habits were shaped by the global financial crisis.

"I'd just turned 18 when the crisis hit, and the lesson was: only spend money you have," he says. "Afterpay is a budgeting tool rather than a credit tool and our customers have a clear preference for debit cards."

The company's latest financial results attest to the success of the business model. It has 10,000 retailers on the books – ranging from boutique operators to massive retailers – and more than 1.3 million consumers.

The *We Love Afterpay* Facebook page is further testament to the company's popularity, being a hub for retailers to tout their wares to a 100,000-plus following.

While a student at Moriah College, Molnar worked in the family jewellery business at Sydney's Wynyard train station. He says he was the worst employee possible, but the job fuelled his innovative streak.

"I was always entrepreneurial, trying to come up with a way to trade my next product and make a dollar," he says. "I was importing and selling headphones from Japan when I was at school. There was always something."

A rugby scholarship sent Molnar to the University of Sydney, where he enrolled as a commerce student majoring in finance and international business.

"My studies gave me the basis for many of my key decisions in my journey at Afterpay," Molnar says. "My finance major provided analytics, financial modelling and attention to detail. Mergers and Acquisitions, run by Senior Lecturer of Finance, Angelo Aspris (BCom(Hons) '05 PhD '09), was without doubt my favourite subject."

He dovetailed his study with his first e-commerce enterprise, leveraging his parents' relationships with suppliers to sell jewellery on eBay. When he was 19 and working out of his bedroom, Molnar was the biggest eBay seller of jewellery in Australia.

Despite his success as an e-tailer, Molnar still felt the need for a 'real job' after leaving university. He kept the business going but became an investment banker. "I was probably making five times more selling jewellery than in the investment banking job. It reached the point where the guy who hired me said, 'I'll keep your job open for 12 months, but you should be running the jewellery business full time'. He actually pushed me down the entrepreneurial path, and for that I am forever grateful."

The man who hired him was venture capitalist, corporate advisor and latter-day campaigner for a more equitable economy, Mark Carnegie, who, aside from mentoring Molnar, told him there was more money to be made in mass-produced lower priced jewellery than high-value products.

During one of his regular order-posting trips to the post office in Bellevue Hill, Molnar was approached by neighbour Anthony Eisen, then Chief Investment Officer at investment company Guinness Peat Group. Eisen's curiosity was piqued by seeing Molnar's bedroom light on late in the evenings. The two hit it off, later cementing their relationship by co-founding Afterpay.

Molnar had retail experience and Eisen, financial expertise, but lacking some technical knowledge, they partnered with Touchcorp, a company accomplished in processing payments for large scale operations including the Medicare HICAPS rebate program.

The partnership led to a full merger of the two listed businesses last year, with Afterpay Touch Group relisting on the Australian Stock Exchange in June. Originally priced at $1, the shares now trade at $6, helped by the fact Afterpay has signed up retailing behemoth Wesfarmers, expanded into New Zealand and made the move into the travel industry via an agreement with Jetstar.

If Molnar feels the pressure, he doesn't show it, saying he's humbled and energised by what he does. "As you keep peeling back the layers, there's just so much more opportunity, with the chance to build a positive legacy," he says.

He does have his quiet place though, for clearing the mind and recharging the batteries, and that's on the ski slopes. He doesn't get there as often as he used to but it's one of the few places where all he has to focus on is his next turn. ●

> "I was always entrepreneurial, trying to come up with a way to trade my next product and make a dollar."
>
> — Nick Molnar

◀ Nick Molnar at the Afterpay main office in Sydney's Surry Hills.

BOOKS THAT CHANGED MY MIND: DR JAMES FRASER

Illustration by Harry Slaghekke

One of the first jobs tackled by Dr James Fraser (BA(Hons) '04, PhD '16) after he graduated, was cataloguing artefacts at the National Museum of Afghanistan in Kabul, helping to take an inventory of collections plundered by the Taliban. Since then, he has had a globe-trotting career, and is now Senior Curator of the Nicholson Museum. An early book choice might explain why.

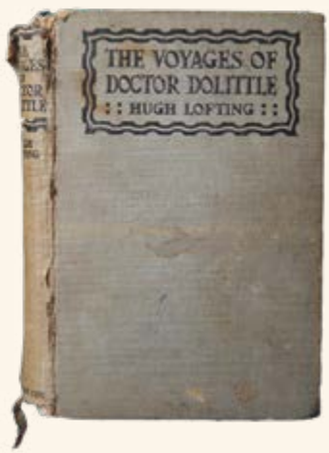
The Voyages of Doctor Dolittle (1922)

by Hugh Lofting

After a long car trip spent teasing my sisters when I was seven years old, my parents dragged me into a second-hand bookshop, threw a tatty hardback at me, and cried "enough! Just shut up and read". And my world changed.

Hugh Lofting wrote *The Voyages of Doctor Dolittle* in 1922. The story is narrated by nine-year old Tommy Stubbins, who becomes the Doctor's apprentice. From the back seat of a 1980s Toyota, I peered through Tommy's eyes into a world that was as dazzling to me as Dorothy's Technicolor Oz.

The world of Doctor Dolittle celebrates intellectual curiosity for its own sake – a world in which the Doctor chases a rare jabizri beetle through the jungle like an excited schoolboy, or furiously scribbles notes onto the lining of his hat while conversing with the Great Glass Sea Snail.

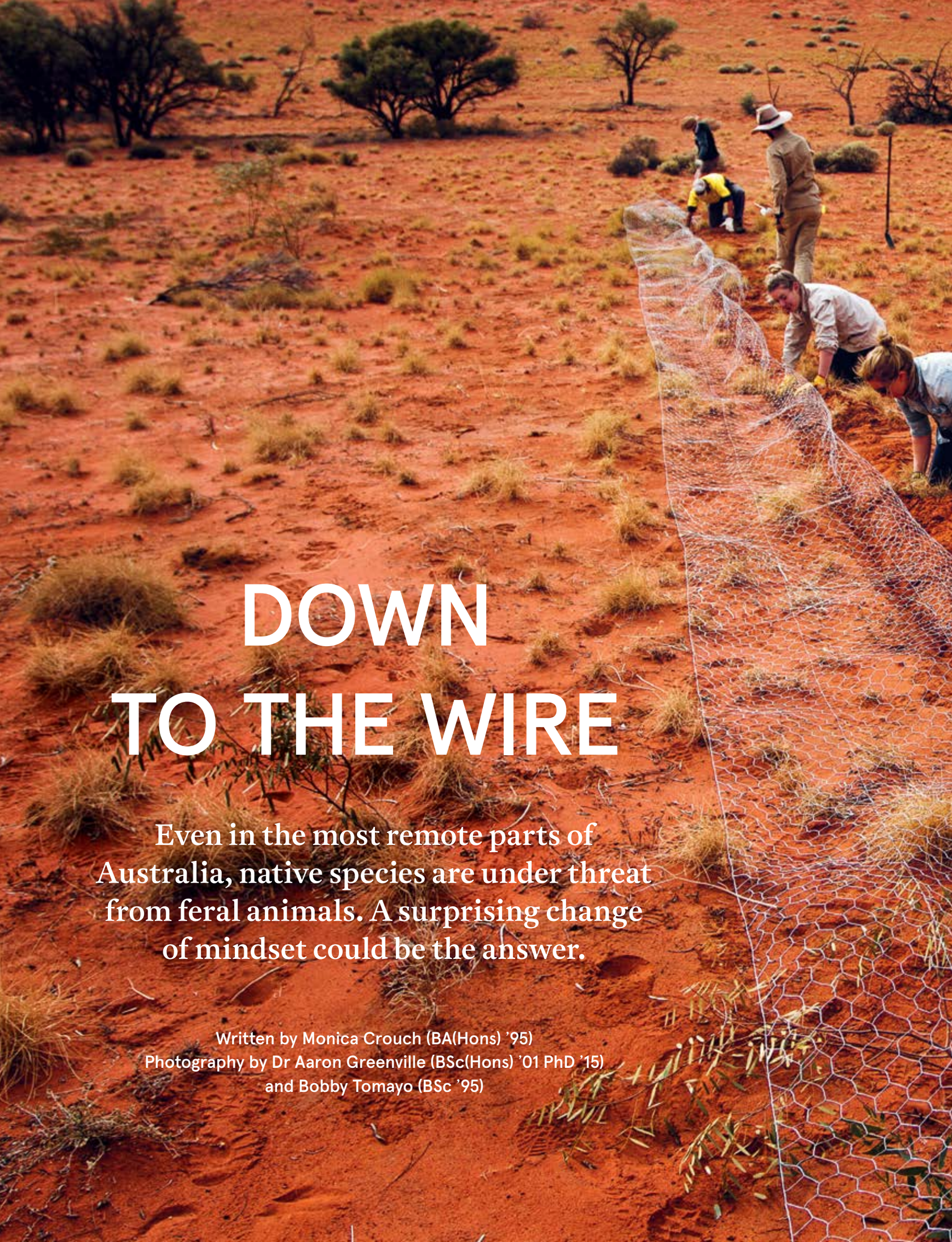


"I learned that the world's horizons are limitless, and you can set your own rules for exploring them."

When the Doctor decides to go on a voyage, he explains to Tommy that he selects his destinations through Blind Travel: he blindfolds himself, lets the atlas fall open, and drops a pencil. When Tommy dropped his pencil, it landed on Spidermonkey Island, a floating island off South America, and that is where Tommy and the Doctor went.

Imagine the fireworks those words ignited in my seven-year-old brain, as I learned that the world's horizons are limitless, and you can set your own rules for exploring them.

Like Tommy Stubbins, I grew up wanting to experience the thrill of discovery. I had never heard of an *–ist* before, but the Doctor was a naturalist, a botanist, and a linguist, and I have no doubt that I was drawn towards becoming an archaeologist by following Doctor Dolittle's footsteps.



DOWN TO THE WIRE

Even in the most remote parts of Australia, native species are under threat from feral animals. A surprising change of mindset could be the answer.

Written by Monica Crouch (BA(Hons) ’95)
Photography by Dr Aaron Greenville (BSc(Hons) ’01 PhD ’15)
and Bobby Tomayo (BSc ’95)

At Ethabuka Reserve, Queensland, Professor Chris Dickman and volunteers install a shelter to protect small native animals from predators.

AT FIRST GLANCE, YOU MIGHT THINK A REMOTE CORNER OF THE HOT, SANDY SIMPSON DESERT IS ALL BUT LIFELESS. YET RESEARCH HAS BEEN GOING ON HERE FOR 28 YEARS.

WHY? BECAUSE IT'S TEEMING WITH LIFE.

“There are not so much seasons here as long periods of dormancy interrupted by bursts of productivity,” says Professor of Ecology and Evolution, Glenda Wardle. Chris Dickman, Professor in Terrestrial Ecology, adds, “It’s a vast, expansive, open desert landscape. There are rich colours, red sand, green vegetation; and after rain, the yellow, the blue, the purple, the white – all the wildflowers that come up.” They're talking about Ethabuka Reserve in southwest Queensland, a one-time cattle station where the two professors and a support team of volunteers work up to four times a year.

There is life and beauty, but there are some wicked problems here too. Climate change is beginning to raise its ugly head, with early indications that rainfalls are becoming more intense and dry spells longer and hotter. But that’s not all. European settlement brought with it not just cattle grazing, but also foxes and cats – feral animals that have chewed through an entire strata of native animals. “Pretty much all the medium-sized fauna that used to occur through arid Australia, that’s gone,” Professor Dickman says.

The list of losses is long, from rat kangaroos to desert bandicoots, mostly from foxes and cats. Australia has lost 30 species of native mammals in the last 200 years; more than the rest of the world put together.

Controlling the foxes and cats has proved near impossible. Professor Dickman has trialled a highly targeted fox poison at Ethabuka, but to be effective, it requires consistent deployment over a much bigger area. Feral cats present extra problems because they’re not as tempted by baits, preferring live prey. After a big bushfire goes through (about every 25 years) and wipes out sheltering vegetation, the native mammals are left even more exposed to predation.

After many years fighting this losing battle against the invaders, Professor Dickman had a radical shift in thinking – instead of trying to eradicate the ferals, why not focus on protecting the native animals? He devised a surprisingly simple solution, constructing refuges of wire mesh – long, low, tunnel-like structures into which the small mammals might retreat when threatened by a fox or cat. The big question was, would they use them?

Storm over the dunes on Cravens Peak Reserve, Simpson Desert, Queensland. The team also conducts research in Ethabuka Reserve, Carlo Station and Tobermorey Station – a total area of 8000 square kilometres.

See more Aaron Greenville photography at: aarongreenvillephotography.format.com

Turns out the answer is yes. “From what we can see using a variety of behavioural assays, the small animals are keenly aware that these things provide shelter. If you disturb them, they just head straight to the tunnels – there’s a very strong response,” Professor Dickman says.

Another indicator is that the native mammals are eating more food from dishes left near the refuges than dishes left out in the open.

It’s a thrilling result for Professor Dickman. “The shelters are being used by insectivorous mammals, hopping mice, mulgara, sandy inland mice, lizards, even some birds – button quails are running up and down inside them.”

Professor Wardle focuses her plant lens. “You know what Chris is really building out there?” she says. “Plants.” Like plants, the wire-mesh gives protection to the small mammals. “These shelters are important because dry spells are predicted to be longer, which will delay the return of protective plant cover after fires.”

The team supporting the professors on these expeditions includes their long-serving research personnel, Bobby Tomayo (BSc ’95) and Dr Aaron Greenville (BSc(Hons) ’01, PhD ’15), both of whose photos you see with this story, along with a clutch of PhD students and volunteers. All agree it’s a rewarding experience, and that looking after natural ecosystems ultimately adds to the wellbeing of people as well.

“AUSTRALIA IS HOME TO WORLD-RECORD NUMBERS OF SPECIES IN A VERY ARID AREA.”

– Professor Chris Dickman

HELP THIS WORK CONTINUE

To support the research and animal protection work happening in the Simpson Desert, or to find out more, call Melinda Deering on +61 2 8627 8818 or email development.fund@sydney.edu.au

▼ To understand this complex environment, Professor Dickman and the team collect all the information they can.

▼ This narrow-nosed planigale (*Planigale tenuirostris*) was an exciting find. It was only the 13th they’d seen in 28 years.

That said, the work isn't for everyone. There's the searing heat (up to 50 degrees in summer), relentless flies, flooding rains, dust storms, and bushfires sparked by lightning.

But for arid-zone ecologists, this is paradise. It has to be: a three-week stint at Ethabuka involves four-wheel drives packed to the gunwales with scientific equipment, personal belongings and food for the entire time, and 36 hours' driving over three days just to get here. Water comes from bores. It's about as far from five-star as you can possibly get.

Ethabuka was destocked of cattle in 2004. It is one of two cattle properties acquired by Bush Heritage Australia as a result of the team's findings; the other is Cravens Peak Reserve.

Let's start with the plants, which Professor Wardle describes as "the backbone of biodiversity". "If you go out there expecting a void with sand, the first shock you get is how vegetated it is," she says. There's spinifex, saltbush, gidgee trees and coolabah trees. After big rains (about once a decade), there's a great burst of herbs, peas, daisies and wildflowers.

Then we come to the small mammals: the mulgara (a carnivorous marsupial), dunnart (insectivorous marsupial), hopping mice, the sandy inland mouse and the long-haired rat. There are at least 50 species of snakes and reptiles, including geckos, dragons, skinks and goannas. They're joined by insects and spiders, bees (one of Professor Wardle's PhD students has named several new species), those ruthless flies, button quails, emus, echidnas, kangaroos and the occasional dingo. "Australia is home to world-record numbers of species in a very arid area," Professor Dickman says.

In piecing together a holistic picture of this ecosystem, researchers have taken a clip from the ear of every mammal they've caught, and from the toe of every lizard, leading to a store of some 8000 tissue samples from 12 different sites. These samples are being used in a new study linking ecological and evolutionary processes in this dynamic system.

Combined, it's a treasure trove of long-term information on the animals and plants of the Simpson Desert and how they change over time – invaluable data on species now facing rapid climate change.

Though conditions can be tough, these expeditions are rewarding for all who take part. Professor Dickman describes a culture of helping one another, come what may. Professor Wardle says each group of volunteers quickly get to know each other in a way city life precludes. Going home can be surprisingly difficult. People find the experience so profound they've been known to upend their lives: change relationships, jobs, even futures.

Perhaps it's not so surprising in this changing environment that people change too. ●

▼ One less native mouse. A feral cat caught during a camera monitoring program. Photo supplied by Desert Ecology Research Group.

▼ Undaunted by floods, bush fires, dust storms and locust plagues, Professor Glenda Wardle co-founded the project with Professor Dickman.

CLASSNOTES

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NISHADI LIYANAGE

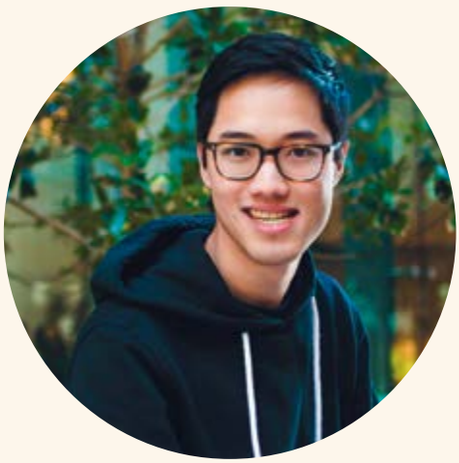
Nishadi Liyanage (MSust ’14) is a sustainability and risk management professional in Sri Lanka. She has worked with organisations such as the United Nations Development Programme and Sri Lanka’s largest conglomerate, John Keells Holdings, for more than seven years. Now at MAS Holdings, her focus is on women’s advocacy and corporate social responsibility. As a Local Pathways Fellow, Nishadi is part of the United Nations Sustainable Development Solutions Network Youth, and a Global Shaper with the World Economic Forum. She studied at the University of Sydney through an Australia Awards Development Scholarship, and is an active member of the Sri Lanka Association of Australia Awards Alumni. Passionate about Education for Sustainability (EfS), she volunteers to conduct school and university programs.

EMANUELE CENTOFANTI

Emanuele Centofanti (MMgt(CEMS) ’16) gained his bachelor's degree in his home country of Italy, but moved to his father’s home country, Australia, for his master’s, attracted by the multicultural environment. He studied further in Canada and the Czech Republic, while also consulting with Deloitte, Skoda Auto and General Mills. Joining the IBM Centre of Excellence in Bratislava as Project Administrator, he became Iteration Manager leading a team of 10 that was responsible for important clients. While there, he was made an Agile Champion and Advocate for promoting Agile principles of adaptive planning and evolutionary development. He is now with reinsurer SwissRe as Assistant Vice-President for Strategic Initiatives.

NEAL TURNER

After a year at Kodak’s Australian research lab, Neal Turner (BSc ’91) made what turned out to be a good choice to go back to school. At the University of California (UC) Santa Cruz, he earned a PhD by computer modelling the supersonic jets expelled by young stars. This led to the University of Maryland and modelling jet-like laser ablation plasmas, then black hole accretion at UC Santa Barbara. He later won a fellowship at NASA’s Jet Propulsion Laboratory, run by Caltech, where he now supervises the 12 scientists of the Interstellar and Heliospheric Physics Group. Members develop space telescopes and interplanetary probes to investigate the origins of galaxies, stars, planets, the solar wind, and planetary magnetospheres.



ARISTEA MELLOS

After graduating, Aristea Mellos (BMus(Hons) '10) won a scholarship to continue her composition studies at the Eastman School of Music in New York. Completing her master's in 2012, she moved to New York City as assistant manager of the Knights chamber orchestra. In 2014, she founded the Ritsos Project fine arts festival in Greece, which staged free art and performance events during the Greek economic and refugee crisis. She graduated from the Eastman school in 2017 with a doctorate in composition. Her work has been supported by the Presser Foundation, the Australia Council for the Arts, and the American Australian Association, and her music has been broadcast and recorded by ABC Classic FM and Tall Poppies. Hear her music at **aristeamellos.com**

MING CHAN

At the start of his studies, Ming Chan (BDesArch '16) dreamed of changing the world through design. After graduating, he brought what he'd learned in his architecture degree to the digital space. He was an experience designer at professional services firm, PwC, and now works in the Virtual Reality (VR) team, creating experiences to change how car dealerships work, for safety training in organisations, and a new way to design retail spaces. He has performed live VR art at TEDxSydney and co-wrote a whitepaper with a pioneer of VR, Mark Pesce. Ming has just launched Lernable (**lernable.com**), a startup that connects people wanting to learn a skill with a skilled mentor. This embodies Ming's own aspiration: never stop learning.

SHAELEE ROOKE

Shaelee Rooke (BA(Psych)(Hons) '11) now works as an actor and producer. Graduating from the Bristol Old Vic Theatre School in 2013, she co-founded Paperbark Theatre to present new Australian writing to international audiences. She co-produced Paperbark's debut production of *This is Where We Live*, also playing the title role. The production received critical acclaim and awards at the Edinburgh and New York Fringe Festivals. In 2017, she produced Paperbark's production of *The Dark Room* in London, picking up nominations for several Off West End awards. Shaelee is also part of comedy trio Darcy, Rooke & Hinds, and is assistant producer for the Sleeping Trees. Next, she will appear in the UK tour of the play, *One Small Step*.

PATRICK HESP

Being in rock bands in New Zealand somewhat hampered the early tertiary studies of Professor Patrick Hesp (PhD '83). Even so, his career has seen him become an international expert on coastal dune geomorphology and dynamics. He has held academic and non-academic positions in Australia, Singapore, the United States, New Zealand, South Africa, Namibia, Israel, Holland, China, Brazil, Italy, Thailand and France. He is currently one of only 21 Strategic Professors at Flinders University, with a staff of 1200 academics. In 2017, he was a China Presidents Fellow, conducting research on the world's largest blowouts (wind eroded troughs and basins) on the Tibet Plateau. In 2017, he was awarded the Distinguished New Zealand Geographer Award and Medal by the New Zealand Geographical Society.

ASK SYDNEY

If you have a burning question, we'll find an expert at the University who can answer it for you. Nothing is too obscure. Email your question to sam@sydney.edu.au

Q. If nothing can escape from a black hole, how can the mass of a black hole be known and therefore have an effect past the event horizon?

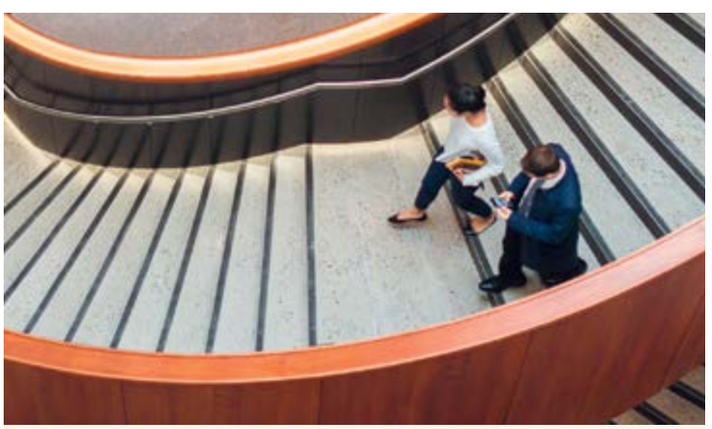
A. Nothing has to escape a black hole for us to be able to calculate its mass. In Einstein's general theory of relativity, gravity is produced when massive objects (like planets) bend space-time, which is a state that envelops everything. (Editor: to learn more, see the star collision story on page 5). The more massive (or dense) an object, the more it bends space-time so, in effect, the stronger its gravity. Black holes are among the most massive objects in the universe. When an object gets caught in the gravity of a black hole, the shape of the object's orbit tells us how much the black hole is bending space-time. From that, we can calculate the black hole's mass.
Answered by Geraint Lewis (CertEdStud '04), Professor of Astrophysics at the Sydney Institute for Astronomy in the School of Physics.

Q. Why do planes suddenly drop sometimes? Is it air pockets, like people say?

A. The effect is called windshear (or wind gradient), a difference in wind speed and/or direction over a relatively short distance in the atmosphere. The aeroplane drops due to a very concentrated 'downwelling' column of air that pushes it downwards very rapidly, in the same way an 'upwelling' column of air pushes it up very rapidly. Severe turbulence is the result of an aeroplane flying through a series of alternating downwelling and upwelling air currents.
Answered by Warwick Holmes, Executive Director of Space Engineering in the School of Aerospace, Mechanical and Mechatronic Engineering.

Q. I've been wrestling with Schrödinger's equation for the helium atom. Has it been solved? If it has, I'd be disappointed but grateful to know.

A. Erwin Schrödinger was an Austrian theoretical physicist who was awarded the 1933 Nobel Prize in physics. His work suggested the very quantum-physics idea that atoms could have the properties of particles and waves at the same time. He came up with equations to prove this and predict the behaviour of various atoms. A particularly tricky equation was for helium, one of the most important elements in the Universe, being the fuel for our sun and most other stars. What made this equation complicated is that helium has a heavy nucleus orbited by two light electrons. But there is indeed a solution now. We can solve the equations by using an approximation in which the two electrons are considered to be so light they don't really move the nucleus around. It's like our model of the solar system, where the sun sits at the centre and is not moved (much) by the small planets around it. You may have to find another equation to wrestle with.
Answered by Stephen Bartlett, Professor of Physics at the Centre for Engineered Quantum Systems in the School of Physics.

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