

2020  
National  
Institutes  
Grant Report

## Introduction

The Australian National University has a special charter to advance the cause of learning and research in general, and take its rightful place among the great universities of the world. When the Australian Government established ANU in 1946, it endowed the University with support from the National Institutes Grant. This secure and reliable funding has made possible the long-term pure and applied research that marks ANU as a nationally and internationally significant research institution. That long-term research has translated into transformational outcomes and invaluable benefits for Australia and has created a unique academic environment where nation-building, impactful work can occur across and between the disciplines. Selected examples of the work ANU has delivered this year are explored below.

All of the projects and programs related in the stories of this 2020 National Institutes Grant Report have benefited from the Grant's funding in the short or long term. They are just some of the ways in which the National Institutes Grant allows ANU to make unique contributions in the areas of our responsibilities to Indigenous Australia, the Asia-Pacific region, public policy, excellence in research and innovation, and protecting the future of research.

The National Institutes Grant helps to develop Australia's national unity and identity, and to engage with its Indigenous and non-Indigenous histories and cultures, and with modern Australia's place in the world. It allows ANU to serve Australia in public policy, developing evidence-based solutions to address major issues confronting governments, business and communities. The National Institutes Grant also helps create a high-quality 'training-ground' environment for future-research and academic leaders.

The ANU National Institutes Grant Framework governs the expenditure and accountability of the National Institutes Grant to ensure its purpose continues to guide its investment. The Framework strengthens the strategic focus that: underpins expenditure; enhances expenditure accountability and transparency; enables the flexibility and agility needed to meet existing and emerging strategic and national priorities; and promotes the ability of ANU to expertly deliver on key activities of national significance.

ANU continues to deliver on its core purpose of distinctive excellence in research, education and public policy.

Further information on the National Institutes Grant at ANU is available at [anu.edu.au/about/national-institutes-grant](http://anu.edu.au/about/national-institutes-grant).

## Contributing to Indigenous Australia

**The National Institutes Grant enables ANU to support the development of Australia's national unity and identity, including by improving Australia's understanding of itself and the history and culture of its Indigenous peoples.**

### **\$50 million endowment for Indigenous students' scholarships**

ANU respects and celebrates Australia's First Nations Peoples and their exceptionally rich histories and cultures. The University takes seriously its responsibility, and its privilege, to lead on reconciliation in Australia. The National Institutes Grant has contributed to a culture at ANU in which Indigenous Australians can fulfil their potential. To help more First Australians join ANU, the sector-leading Kambri Scholarships were created to unlock university and personal opportunities for Indigenous Australians, provide major financial support and a tailored student experience that sets students up for academic, professional and personal success. Kambri scholars benefit from a financial, academic and pastoral program developed by the ANU Tjabal Indigenous Higher Education Centre; receive individualised support, mentoring and leadership training; and participate in specialised activities, funded by the University. Fundraising to support the Scholarships is underway, and

ANU will match \$25 million in donations 'dollar for dollar' to help establish a \$50 million endowment to fund the scholarships in perpetuity from investment returns. The endowment will fund at least 30 scholarships for undergraduate and postgraduate studies per year worth up to \$30,000 annually.

Under the leadership of Aunty Anne Martin AM, Director of the ANU Tjabal Centre, student success is based on support and engagement through the entire student experience. The Scholarships allow Indigenous students from across the country to focus on their studies at ANU and go on to fulfilling careers. Kambri scholar Izayah Davis said the Tjabal Centre helped him to deal with the challenge of being away from campus and maintaining an effective study regime, in a year that was difficult for all students. Mr Davis is focusing on the field of health and science, and has a long-term goal of returning to the Kimberley and giving back to his community – exemplifying the leadership and service of ANU students.

### **Empowering Indigenous communities to fight COVID-19**

Remote Indigenous communities present a unique COVID-19 challenge and their leaders were among the first to request border closures. The communities have a very high risk of rapid transmission if COVID-19 enters because of close community interactions and higher rates of existing chronic illness. Contact tracing training was essential to prepare for the unthinkable, but it would look very different to contact tracing in urban centres, and locals on the ground had to be at its core. There were language and cultural challenges, and in many places no telecommunications for phone and SMS tracing. The adopted 'right place, right time, and right person' approach to contact tracing used local Indigenous practitioners who already understood cultural nuances, for example who could speak to whom. Western Arrerente man, Damien Willie said it might take him a few hours to find someone when remote contact tracers would need a week. He said that language and trust were important to success and ensuring people gave honest answers. The ANU Research School of Population Health's deep experience in public health communication to remote communities was built over many years through the National Institutes Grant. The school's five customised online training modules with topics such as contact tracing, interviewing, data management and using PPE in remote areas, have more than 300,000 completions. A database of trained community members is ready for public health units when they need contact tracing in remote communities.

### **Translating COVID-19 messages vital for Indigenous health**

COVID-19 has highlighted the need for a coordinated national framework of interpreters and translation services for Australia's Indigenous languages, so that all Australians can be informed in the event of a national emergency or natural disaster. Translating crucial COVID-19 health messaging into many Indigenous languages has been an urgent task for Indigenous community members, academics and language researchers. To help ensure messages are correct, culturally appropriate and delivered to Indigenous communities in appropriate ways, the Centre of Excellence for the Dynamics of Language (CoEDL) based at ANU, established a resource and information clearing house for translated materials, which is now online. The race to translate sensitive messages, such as restricting numbers at funerals and 'sorry camps', has shown the vital need for a central communications group for Indigenous communities to be established and built into emergency plans. Director of CoEDL, Professor Nicholas Evans, said that rather than just translating words and phrases, it's about taking apart a complex concept and rebuilding it using existing aspects of your language to convey the message and its importance. "That takes real skill and intimate knowledge of a language and its speakers," Professor Evans said.

### **Indigenous composer scores top classical gong**

Composer, ANU lecturer and Dharug descendant Dr Christopher Sainsbury was recognised with the inaugural National Luminary Award at the 2020 Art Music Awards in September. Dr Sainsbury founded and drives the Ngarra-Burria: First Nations Composers program. According to the judging panel, his work in the "critically important" program has had "a national impact in both training emerging First Nations composers and redefining their role and future within Australian art music". Dr Sainsbury has changed the landscape of Australian music by

empowering Indigenous composers to tell Indigenous stories through new classical music. Previously, Indigenous culture was often filtered through the work of non-Indigenous composers. Because of the program, which has run for five years, the Indigenous voice is being expressed more broadly through classical music, jazz music and art music. Many Indigenous composers from the program are now working with leading music festivals and groups. The award should raise their profile further. The Australasian Performing Right Association and Australasian Mechanical Copyright Owners Society, and the Australian Music Centre, present the Art Music Awards annually.

## **Indigenous banana cultivation dates back over 2,000 years**

At Wagadagam on the tiny island of Mabuyag in the western Torres Strait, ANU archaeologists have found a site with retaining walls, stone arrangements, shell arrangements, rock art and a mound of dugong bones. The soil shows clear evidence of intensive banana cultivation and stone flake tools have plant residues along their cutting surfaces. This is gardening dating back 2,145 years in the Torres Strait, historically seen as a line separating Indigenous groups who practiced agriculture in New Guinea and hunter gatherers in Australia. It is the earliest well-dated evidence for plant management in the Torres Strait. Third-year PhD student, Kambri-Ngunawal scholar Robert Williams, was lead researcher on the project and was mindful of how his research could affect a First Nations' community. He said it was important to him to make a connection with the Goegmulgal people of Mabuyag and ensure they understood the research really belongs to them. His work represents a shift in the discipline: research into First Nations' communities led by First Nations' peoples.

## **The lost Australian stories etched in ancient trees**

Boab trees are among the oldest living organisms in Australia: some are more than 1,500 years old. Local people used boab trees as food, medicine, fibre and shelter; and they created intricate artwork on the tree's nuts and trunks. These trees record the stories of Indigenous and non-Indigenous people in the region not captured in any other form. Archaeologists are now working with Kimberley Indigenous communities to document and contextualise the tree carvings. This first systematic archive of carved boab trees is using state-of-the-art technology to capture accurate 3D records of the markings. Boabs lack foliage for much of the year before blooming with large and fragrant flowers. They are still immensely important to Kimberley Indigenous people as markers of landscape and place, and they make popular camping spots. The three Kimberley study sites are at an early mission, a pastoral property and an Indigenous settlement. Researchers record all carvings to learn about this cultural and artistic practice, and about the daily lives of people living on missions and pastoral properties before and immediately after European contact. The team is also examining unpublished and published Kimberley documents for context and other evidence.

# **Contributing to Australia's understanding of, and role in, Asia and the Pacific**

**The National Institutes Grant enables ANU to support the development of Australia's national unity and identity, including by improving Australia's understanding of its Asia-Pacific neighbours, and its place in the international community.**

## **5,000 rare and unique maps are now available online**

More than 5,000 unique maps from the Asia-Pacific Map Collection are now available on Open Research for people to download and enjoy for free as part of an ongoing project by the ANU College of Asia and the Pacific. The collection is home to a variety of topographic, cadastral, aeronautical, and thematic maps, some of which date back hundreds of years. The earliest map, dated 1662, is a full map of Batavia, the old capital of the Dutch East Indies, with all its forts. Sixty of the antique maps were donated by University of NSW Emeritus

Professor Clive Kessler. Of the 'one of a kind' pieces, the Roti Map is a pre-1907, locally produced and hand-drawn representation of Dutch political structure, showing all villages on the island.

The collection also features a 76 year-old inclinometer, created in 1942 in Australia to aid the Allied military forces with surveying during World War II. Other notables in the collection are a booklet of 30 historic Papua New Guinean photos, a 19-inch Phillips terrestrial globe from 1945, and a rare map from 1896 of Catholic Missions across New Zealand, Tahiti, Samoa, Hawaiian Islands, Tonga and other islands.

Apart from their interest and beauty, the maps are useful for practical purposes. They have been used as reference material in a range of research projects including those looking at historic and contemporary infrastructure comparison, the recreation of historic journeys, and Pacific nation land ownership. The collection can be, and is being, accessed from all over the world with almost 130,000 downloads in one year to May 2020.

## **Asian plan to help world recover from COVID-19**

The *Asian strategy for recovery and reconstruction after COVID-19*, co-authored by Professor Peter Drysdale from the ANU Asian Bureau of Economic Research, is a plan developed by a group of former senior officials and prominent academics of leading Asian countries. They advise nations from the region to coordinate financial, trade, public health and food security policies in the wake of the pandemic. The proposal aims to avoid the danger of the region's individual nations acting in narrow self-interest with the almost certain unintended consequence of a deeper and prolonged economic downturn. Asian economies, which were set to overtake the rest of the world's total combined GDP in 2020, are crucial to ensuring the global economy successfully navigates the crisis. The group says the key to success is cooperation among Asian nations and calls for ASEAN to convene a regional leaders' conference that would also include ASEAN +6 dialogue partners, including Australia, India and China. This meeting could move rapidly on six key objectives, among them expanded bilateral currency swap arrangements to strengthen regional safety nets; the development, production and equitable distribution of diagnostic tests, a vaccine and treatments across Asia; and keeping medical and food markets open.

## **Stone tools reveal how island-hopping humans made a living**

In the quest to find the route of humans to New Guinea and Australia about 65,000–50,000 years ago, researchers at the ANU College of Asia and the Pacific have favoured the 'easier' northern route across the islands of north-east Indonesia to north-western New Guinea, over the southern route through Timor to north-western Australia. They went to Obi on the northern route, the first archaeologists to do so. Cave excavations revealed that people lived there from at least 18,000 years ago, when sea levels were about 120 metres lower and the climate was drier and colder. They left the caves about 8,000 years ago when the climate became warmer and wetter, and the jungle thicker. Heavier-duty stone edge-ground axes replaced shell axes over this time. These Obi people appear adept on both land and sea, hunting in the rainforest, foraging by the sea, and possibly making canoes for voyaging between islands. As the forest grew more dense, they probably used axes to clear forest patches and hunt food. Routine travel to surrounding islands and those further afield is supported by findings of obsidian (which had no known source on Obi), and types of shell beads in the caves, similar to those from islands further south. These findings are the first direct archaeological evidence of these islands as steps in humans' migration through this region.

## **Researchers confirm site of Genghis Khan's winter home**

Even marauders and invaders whose empires cross continents have to have a home base and command post, especially over winter. Historians and archaeologists have long debated where Genghis Khan had his. New research from ANU has produced compelling evidence that the site of Avruga in eastern Mongolia was his winter base camp, or *ordū*. A team led by ANU archaeologist, Dr Jack Fenner, took a series of radiocarbon dating samples from what little remains of the main part of Avruga. They showed conclusively that the site was occupied during the lifetime of Genghis Khan (about 1167–1227AD) and extended beyond the time his son, Ogedei Khan, took over

after his father's death. The site has evidence of religious or ceremonial functions at Avraga that extended into the Yuan Empire in China, which was part of the Mongol Empire's southern expansion. Genghis Khan may well have had four *ordū*, but the historical documentation appears to indicate the one at Avraga was his main camp, probably for both spring and winter, and where he started the campaign against his southern neighbours.

## **Mapping the Pacific's COVID-19 success**

An interactive map tracking Pacific responses to COVID-19, published by ANU specialist website Policy Forum, has a world of data to help create the best possible understanding of COVID-19's effect on the Pacific region. *Mapping the Pacific's COVID-19 Success* is a window into repositories of data and commentaries, updated weekly and presented in a way that allows the user to explore, understand and engage with it productively. The Pacific region has responded strongly to the pandemic. Pacific island governments displayed enormous resilience, with effective collaboration between departments, governments, civil society groups and regional organisations a hallmark of their success. In particular, they issued timely and relevant communications on the three key issues the COVID-19 pandemic exacerbated: economic hardship, climate action and health security. The analysis on the map comes from researchers and scholars on the ground, observing and analysing government responses and their impact on communities in the region in human terms. The researchers offered the map freely as useful data and insights for researchers, public servants and members of the public. In the second half of 2020, the map was viewed by almost 8,000 individuals, many in Melanesia, Polynesia and Micronesia.

## **Contributing to public policy**

**The National Institutes Grant enables ANU to provide a national, regional and international public policy resource that addresses major issues confronting governments, business and communities.**

### **Economic hibernation, not freezing, the key to economic re-emergence**

In March 2020, Australia needed an economic framework to absorb the shock of the nascent COVID-19 pandemic. Professors Rabee Tourky and Rohan Pitchford, and ANU alumni June Ma, rapidly developed a framework for managing the economy while the health authorities responded to the pandemic. They used contacts in the business community to promote their framework. They also coined the term Economic Hibernation to describe the proposed framework. Their policy framework involved, broadly, the idea that the government facilitates the transmission of low interest rates by doing whatever it can to encourage renegotiation of loans, credit lines and debt forgiveness by private banks. They proposed a detailed institutional framework including banks, the RBA, ASIC, and APRA to implement these suggestions. Later that month, Prime Minister Scott Morrison adopted the notion of Hibernating the economy, and the term has since been used internationally. The concept also had policy impact, including APRA loosening its borrowing rules and ASIC promoting the idea of not foreclosing on delinquent loans. It led to the setting up of various mechanisms aimed at coordinating bank policies during the period of Hibernation. Importantly, the ACCC authorised appropriate coordination amongst banks, which was a crucial step in the proposal. Adopting the Hibernation strategy helped deliver a successful economic recovery for Australia. As anticipated in the Pitchford-Tourky-Ma framework, the banking sector played the role of 'shock absorber' to the recession, which could have been a catastrophic financial event for the nation had appropriate interventions not been made.

### **Finding pathways to global economic recovery**

Public health steps to contain the COVID-19 pandemic have significantly disrupted the global economy through both supply and demand channels and affected global financial markets. COVID-19 and the macroeconomy is a research program that brings together 40 eminent economic scholars from 20 countries in a forum for

understanding the global and country-specific financial market and macroeconomic impacts of the pandemic. The forum, centred at ANU Crawford School of Public Policy, is exploring the new financial market and economic linkages between countries, and potential mechanisms for recovery from the crisis. In response to the pandemic they are monitoring, for example, conventional and unconventional monetary policies, interactions between fiscal and monetary policy in mitigating pandemic effects, commodity prices, income and intergenerational inequality, and short-term and long-term impacts on the labour market. The aim is to inform policymakers in both emerging and developed economies and to enhance the quality and quantity of academic research for the world's recovery. The program builds on established ANU expertise and networks to inform policymakers on issues they are grappling with as they find their way through the crisis.

### **Informing Australia's COVID-19 response with modelling**

Modelling of different scenarios with all known information can help informed decision making during a disease outbreak when new information comes to light almost every day. Associate Professor Kathryn Glass, Research School of Population Health, contributed to several modelling projects for the COVID-19 response. Early work with the University of Melbourne identified the impacts of an uncontrolled COVID-19 outbreak on the health system, and estimated likely personal protective equipment requirements—particularly mask usage. Work began with models for flu that were adjusted as more information came in to be more appropriate for COVID-19. As numbers initially increased in Australia, the team modelled health surveillance strategies to advocate for higher testing rates and broader testing patterns. More recent research, with La Trobe University and the University of Melbourne, helped quantify long-term testing requirements across states and territories. Associate Professor Glass has also been collaborating with the ANU Crawford School of Public Policy on the economic impact of more-or-less stringent social distancing measures. The modelling shows that the best thing for the economy is to bring it under control quickly, even if that means a short-term period of quite hard lock down.

### **Pandemic will cause globe US\$21 trillion in economic pain**

Research led by Professor Warwick McKibbin and Roshen Fernando of the ANU Centre for Applied Macroeconomic Analysis modelled six scenarios, from best-case to worst-case, of the impact of the coronavirus on the world economy. They found that even under the best-case scenario (coronavirus contained mid-2020) the global economy would lose up to US\$14.7 trillion dollars. With expected further waves of the pandemic, economic losses will climb quite steeply. For Australia, a worst-case scenario of four waves of COVID-19 over two years would see our economy lose US\$172 billion. The economic impact shows the world must work together to overcome long-term damage and the deep problems in existing institutions revealed by the pandemic. Implemented policies are needed at the national level for most foreseeable problems, as is greater cooperation across countries. The analysis also examined other key economic impacts of COVID-19 including the impact on government spending, wage subsidies and household transfers, country risk assessments, and potential mortality and morbidity rates. This research saw Professor McKibbin appointed to the Australian Treasury Expert Panel on COVID-19. The research, and an update commissioned by the Asian Development Bank Institute in Tokyo, has fed into policy development in Australia, Korea, Japan, US, UK, International Monetary Fund and the World Bank.

### **World's largest study shows carbon pricing reduces emissions**

Carbon pricing works to strongly reduce emissions. That's the conclusion of the world's largest study on the issue by researchers at the ANU Crawford School of Public Policy and Macquarie University. In the study of carbon emission trends from 142 countries since carbon pricing began in the 1990s, 43 countries had a carbon price of some type by the end of the study period. Those 43 countries had on average lower annual growth rates of carbon dioxide emissions from fossil fuel combustion than countries without a carbon price. In the five percentage point difference between the two groups, two points appear to be due to the carbon price and the remainder

are attributable to other factors including improving technologies, renewable energy policies and differences in fuel tax rates. Putting a price on carbon should reduce emissions, because it changes relative prices in favour of cleaner options; and when it is used with complementary policies such as support for low-carbon research and development, evidence indicates it is a serious emissions reduction strategy for a market-oriented economy.

## **Tax shake up needed for a more equitable Australia**

A dual income tax system proposed by the Tax and Transfer Policy Institute at ANU would be more efficient, simpler and fairer than the existing inefficient, complex and inequitable system. The current system distorts the flow of savings across our society and economy, and encourages Australians to engage in costly tax planning schemes. The institute's report on the taxation of savings proposes all labour be taxed under a progressive tax schedule similar to the existing tax system, and that savings be taxed independently at a single or less progressive tax rate. Australian household savings are mostly in owner-occupied housing (41 per cent of total wealth), superannuation (17 per cent), investment properties (16 per cent), bank accounts (5 per cent) and shares held outside of superannuation (2 per cent). These assets are now variously taxed through stamp duty, GST, personal income tax, discounted personal income tax, and the special treatments of superannuation, dividends, negative gearing and trusts. The beauty of the dual income system is that it has been tried and tested in other countries, and it can be implemented in stages by targeting in turn, superannuation, dividend imputation, stamp duty and owner-occupied housing.

## **Grand challenge receives Australian Senate recognition**

Social cohesion is the glue that enables society to function well, advance common goals, and foster individual and community well-being and a thriving democracy. Recognising that a decline in social cohesion was associated with higher costs of security, business and health, the National Institutes Grant invested in establishing the Australian Social Cohesion: Exploring New Directions (ASCEND) through the Grand Challenge scheme. The evidence-based approach of ASCEND measures positive community impact, identifies practical methods to engage communities and develops financial instruments to encourage sustainable investment in social cohesion projects. ASCEND contributed to the Australian Senate Inquiry into nationhood, national identity and democracy, which sought to understand more about the health of our civil society and what it means for our democracy and national identity. ANU academics made five key submissions in the disciplines of Law, History, Democracy and Social Cohesion, and contributed to six additional submissions from key national institutions and groups. Seven ANU academics appeared before the committee in public hearings. Much of the content ANU contributed was cited throughout the committee's final report. Most notably, the committee has directly taken on board the University's recommendation of establishing a national research centre on migration, citizenship and social cohesion.

## **Excellence in research and innovation**

**The National Institutes Grant enables ANU to maintain and enhance distinctive concentrations of excellence in research and education, particularly in areas of national importance to Australia.**

### **Prime Minister's Science Prize to gravitational-wave research**

The value of long term and reliable National Institutes Grant funding was perfectly expressed in the 2020 Prime Minister's Prize for Science for the work of a lifetime by two ANU physicists. Professor Susan Scott and Professor David McClelland from the Research School of Physics, and two other members of the ARC Centre of Excellence for Gravitational Wave Discovery, Emeritus Professor David Blair, University of Western Australia, and Professor Peter Veitch, University of Adelaide, received the award for their roles in the detection of the 'impossible'

–gravitational waves. Such discoveries take the vision, innovation, tenacity and prodigious research efforts these scientists have shown over three decades. The award is fitting acknowledgement of the role of Australian researchers in this landmark achievement in physics. Australia, led by ANU, is one of the four partners in the Advanced Laser Interferometer Gravitational-wave Observatory (LIGO), which detected the waves in 2015 after a century-long search. The detection of gravitational waves opened a new window on the universe and led to a new era of gravitational-wave astronomy, allowing scientists to unlock many age-old mysteries.

Gravitational waves are ripples in space and time from violent events in the Universe. The waves detected on 14 September 2015 came from the collision of two massive black holes 1.3 billion years ago, more than 10,000 million, trillion kilometres from Earth. The LIGO twin detectors that picked up the signal are instruments of the utmost sensitivity. Each of the Australian scientists and their teams contributed in a different and vital way: Professor McClelland in filtering out the crackle of quantum interference; and Professor Scott with mathematical models that work out which event in the Universe generated the waves. Under Professor McClelland's leadership, ANU has supplied equipment and techniques that are used in the Advanced LIGO detectors.

The Prime Minister's Prize for Science awards the advancement of knowledge through science with outstanding achievements in scientific research.

### **Finding Australia's COVID exit**

Associate Professor Kamalini Lokuge is one of the few people in Australia who has repeatedly controlled high-risk pathogen outbreaks, such as the West African Ebola outbreak where she prompted contact tracing to identify and control transmission. The ANU College of Health and Medicine epidemiologist combined a grasp of on-the-ground reality with solid research to find a key to Australia's successful public health response. Her research showed that exhaustive testing of patients with respiratory symptoms was the most efficient and feasible means of detecting community transmission of COVID-19, whether social interaction was normal or restricted. Once community cases are identified, detailed and meticulous contact tracing, both upstream and downstream (terms Dr Lokuge coined), finds anyone the patient had contact with while they were sick, and, just as importantly, how they got sick. This contact tracing combined with quarantining and testing of all contacts is the best-known way of eliminating community transmission, even while lifting containment measures, and of controlling the disease rapidly if it reappears. The other factor is ensuring the public, with all its diverse communities, understands and trusts the government's health messaging so that they comply with necessary measures such as locking down. Dr Lokuge's now familiar approach was unknown just one year ago.

### **The food poisoning find that could save lives**

The foodborne bacterium, *Bacillus cereus*, causes food poisoning through toxins that help the bacteria to multiply, and induce diarrhoea and vomiting. The toxins also come with a backup plan. A previously found diarrhoea and vomiting toxin directly binds to cell membranes and punches holes in it to kill the cell, prompting the immune system to react to the infection. Researchers have now discovered another toxin that's equally capable of destroying cells: if the first toxin is lost or neutralised by the immune system, the second can continue the mission. The newly discovered toxin, called non-haemolytic enterotoxin, operates similarly to the first, but the two aren't functionally identical. For example, one toxin might be better at killing a certain type of cell than the other, which could be important for treatment. Bacterial resistance to antibiotics is growing. A new approach of creating proteins that can neutralise the toxin activity and restrict the spread of the infection could complement the existing antibiotic regime. However, nothing beats prevention: washing hands properly, preparing food to safety guidelines and using heat to destroy most bacteria and their toxins. Food poisoning affects more than 4.1 million Australians every year and in some cases can cause death.

## Gene research could lead to cancer breakthrough

Professor Eduardo Eyras and his team are studying how cells transform during development of the type of brain tumour called glioma. Cancer is driven by the genetic alterations in cells, triggered by causes such as exposure to radiation, continuous inflammation or ageing. Around 1,700 people are diagnosed with brain cancer every year in Australia. Glioma is the most common form, making up around 70 per cent of all malignant brain cancers. The team showed that gene isoforms (variations of a gene that can change the way genetic information is used) in cancer are different to normal cells and produce different proteins. The changes can be minor or major. In the case of glioma, they're affecting a process that's essential for the maturation and function of brain cells. Glioma tumours are hard to cure since, by the time they become symptomatic, they are quite advanced in their course. Treatment is generally limited to radiotherapy and chemotherapy, but the tumour presents frequent resistance and relapse. The team's results might help develop early markers for glioma and thus open more treatment options. They could also be applied more broadly to other types of tumours and even diseases with similar characteristics.

## Health messages to help stop patient harm in hospitals

The ANU Institute for Communication in Health Care mission to tackle ineffective communication in healthcare has gone global. It now leads the International Consortium for Communication in Health Care (IC4CH) which is driving healthcare communication research and training for improved patient safety and outcomes internationally. Communication failure is almost always at the core of the half-million incidents of harm in Australian hospitals each year. Misunderstandings between patients and clinicians, failures to clarify ambiguities, and confusions in the handover process or in emergency departments are just some of the causes. The problem is getting worse around the world, as its importance becomes more critical. More than 50 million shift handovers take place each year in Australian hospitals. Cutting-edge research by consortium members will help drive new healthcare communication methods and training. Australian research includes listening in to and observing emergency departments in 'real time', transcribing recordings verbatim, de-identifying them and analysing them for risk points and misalignments. The two million words of authentic hospital interactions are informing best practice and training for safe and compassionate health care. IC4CH members include ANU, University College London, Lancaster University, Nanyang Technological University, University of Hong Kong and Queensland University of Technology.

## Discovery could lead to new malaria treatments

In 2018, about 405,000 people died among the 228 million cases of malaria in the world. The *Plasmodium* parasites that cause the disease are becoming more resistant to the drugs used to treat malaria. The race is on to identify new drug targets for malaria, and learn more about the parasite's biology and the proteins responsible for multi-drug resistance. For 20 years, researchers around the world have been trying to understand the function of the protein, PfCRT, and why it is essential for parasite survival. An ANU team has answered these questions and also shown that PfCRT can be inhibited by drugs, indicating its natural function is a 'druggable' target. It could pave the way for the design of novel drug therapies. In addition to killing the parasite outright, these drugs could be used in combination therapies to nullify the multi-drug resistance caused by PfCRT and thereby restore the activities of existing drugs. Such therapies could combat multi-drug resistant malaria. The team is also positioned to understand the causes and constraints that are dictating the evolution of PfCRT in different parts of the world where malaria is of concern.

## Advancing Australia's COVID-19 testing capabilities

When COVID-19 hit Australia, ANU was able to rapidly mobilise expertise already in place, supported by the National Institutes Grant, and respond very quickly. Testing was one critical area for development and expansion as its capacity would make the difference between controlling the infection or not. A group of about 70

academics and students assembled to develop a testing program to detect both acute and previous infection. They trialled many and varied testing procedures. The testing kits developed, along with ANU sample handling and testing procedures, were enhanced by a phone app with end-to-end capacity from enrolment to testing and providing results. The program focused on ANU staff and students housed in conditions where physical distancing was not possible, like residential halls, but could be rolled out quickly in other areas, such as nursing homes or Indigenous communities. The team's work was used, for example, in antibody testing of some 3,000 samples from Victoria during its COVID-19 outbreak. The kits were also used in daily sewage testing covering the ACT in May 2020, in a project of national interest. Testing sewage is a validated rapid and inexpensive way of tracking coronavirus spread. With social distancing easing, it can continue to be an early warning device.

## Excellence in research and innovation (environment and resources)

### Bushfire impact on the ground

In October 2019, the indications for a catastrophic fire season were already clear to Dr Marta Yebra. She flew to the NSW Rural Fire Service headquarters in Sydney, to contribute her knowledge of bushfire fuel condition to firefighters. Her team's research added to existing RFS data to inform predictions about where a fire could spread, and decisions on prioritising areas with resources and equipment. Researchers gather detailed information on fuel conditions and flammability based on vegetation types and structures, and fuel moisture content, from satellite remote sensing and laser scanning from airplanes. That informs the timing and location of hazard reduction burns to prepare for the fire season for fire services and land managers, and predicts the difficulty of suppressing bushfires during the fire season. A landscape that is extremely flammable readily burns if there is an ignition source and severe fire conditions such as high temperatures and strong winds. With climate change, such conditions are more common and the window for fire season preparation with controlled burns ever shorter. Dr Yebra wants to ensure all data is fit for purpose and readily available to firefighters to help guide their decisions.

### Eureka prize win

The value of long-term dedicated research work, supported by National Institutes Grant funding, has been highlighted by the Eureka Prize for Outstanding Science in Safeguarding Australia, awarded to ANU Associate Professor Steve Madden and colleagues from The University of Sydney for their work on next-generation technology. The team's work is combining the power of light and sound to create a microchip used by defence platforms. It could also play a key role in 5G and other future wireless technology. The work is focused around new methods for on-chip optical processing of microwave signals, and holds a long string of world first results that could not be achieved with conventional electronics. The research over a 16-year timeframe has overcome long-standing fundamental and arduous materials science challenges to make practical real-world devices. The work is now acknowledged as a viable new technology by industry and partly supported by large organisations such as L3 Harris and Lockheed Martin.

### Quantum chemistry calculation record

In just half an hour, but based on a career's work, Dr Giuseppe Barca from ANU Research School of Computing broke a world record and opened new supercomputing research horizons in areas where experiments are too expensive or simply impracticable. Dr Barca ran new algorithms on the Summit supercomputer at the Oak Ridge National Lab in the USA, to predict the quantum mechanical properties of large molecular systems with the highest accuracy. Calculations of this type have the potential to solve important problems in energy generation, fuel production, water purification, and the manufacturing of medicines, foods, textiles and consumer goods. The

world record was for the largest Hartree-Fock calculation ever performed (it's a method that helps determine the electronic structure and the energy of a quantum mechanical molecular system). The calculation used 26,268 NVIDIA V100 Graphics Processing Units (GPUs) and simulated 20,063 water molecules—a scale described as 'massive'. GPUs are computationally more powerful and energy-efficient than CPUs, but much more difficult to harness. Using tens of thousands of GPU cores with such efficacy is a computational grand challenge.

## **Indian Ocean phenomenon spells climate trouble for Australia**

In 2019, a large positive Indian Ocean Dipole cut off one of the major sources for southern Australia's winter and spring rainfall. It set up the extremely hot and dry conditions for the terrible Australian fires of 2019–20. These historically rare events have become much more frequent and intense during the twentieth century, and are expected to worsen if greenhouse gas emissions continue to rise. The research team from ANU and the ARC Centre of Excellence for Climate Extremes, working with scientists from institutions in Australia, USA, Indonesia, Taiwan and China, used coral records from the eastern equatorial Indian Ocean to reconstruct Indian Ocean Dipole variability over the last millennium with unprecedented precision. Only ten of these events have occurred since the year 1240, but four of them have been in the last 60 years. The 1675 event was up to 42 per cent stronger than the strongest event on the instrumental record, in 1997. By causing positive Indian Ocean Dipole events to become stronger and more common, we are now upping the odds that an extreme event like 1675 could happen again.

## **How Australia's burrowing frogs handle the heat**

Some of Australia's burrowing frogs, three of the nine species of *Neobatrachus*, have a genetic anomaly which allows them to occupy and survive in harsher, drier environments. These three species have four sets of chromosomes (polyploids), rather than the usual two sets (diploids), and each has evolved the doubling separately. The polyploids have higher genetic diversity: they are transferring genetic material from one population to another at a much higher rate than the diploids. This distinct genetic makeup could be what helps the frogs survive in harsh climates. *Neobatrachus* diploids appear to be suffering the early impacts of climate-induced habitat loss, but the polyploid species seem to be avoiding this fate. Polyploids can mate occasionally with the diploids to produce rare hybrids which can mate back to a polyploid and pass on genes from their diploid parent. That enhanced genetic diversity could be their passport to surviving extreme environmental conditions. The ANU researchers worked with biologists from Ghent University in Belgium and the South Australian Museum.

## **New partnership to help stop catastrophic bushfires**

In response to recent catastrophic bushfire conditions—and to reduce their significant ecological, economic, health and social costs—ANU and Optus are together developing an innovative national system to detect and extinguish bushfires. The ANU-Optus Bushfire Research Centre of Excellence is to be a hub of advanced research and novel hi-tech. The goal of the five-year project is to detect a fire within one minute from ignition, communicate the location to extinguishing agent, deploy accurately targeted aerial vehicles and extinguish within five minutes. To develop and demonstrate ground and aerial based systems for early fire detection and extinguishing, ANU will apply current research into fire ignition risks, and work with Optus and other industry partners on early detection through ground-based and aerial sensors, integrated communications and computer systems, and real-time data analytics. The proposed extinguishing technology is auto-piloted water gliders—low cost, but accurate, fast and versatile. Technology will be demonstrated to fire management agencies within the first year and trials in the ACT will guide future research and design of an integrated Australia-wide defence system. In the longer term, a state-of-the-art fire detection sensor for geostationary orbit with high sensitivity and ground resolution is planned to be launched on the next generation of Optus geostationary communications satellites.

## Discovery triples greater glider species in Australia

Greater gliders were once common in forests along the Great Dividing Range from northern Queensland to southern Victoria; now they are listed as vulnerable and declining. The possum-sized marsupial, previously thought to be one species, can glide up to 100 metres and eats only eucalypt leaves. Their considerable variability in size and physiology across the range is now confirmed, from the DNA, as profound enough to distinguish three separate species. Researchers from ANU, James Cook University, University of Canberra and CSIRO used diversity arrays (DArT) sequencing to confirm the multiple species. Identification and classification of species are essential for effective conservation management. The distinction into three species highlights the vulnerability of greater gliders—each has smaller populations and ranges, and is even more vulnerable, than the previously recognised single species. This highlights the conservation concern for all three species in areas heavily damaged by the 2019–20 fires and subject to alarming clearance rates. Greater glider populations in the Blue Mountains in NSW and Central Highlands in Victoria have seen spectacular declines and other areas have borne localised extinctions. The increased vulnerability should be a consideration in future conservation status decisions and management legislation.

## Researchers help endangered birds beat deadly parasite

Forty-spotted pardalotes nest in the hollows of old trees using grass, tree bark and soft feathers found on the forest floor. Their snug nests keep chicks warm and dry, but attract parasitic flies, *Passeromyia longicornis*. When the pardalote eggs hatch, the fly maggots burrow into the skin of the baby birds to feed on their blood and kill nine out of every ten chicks in some areas. The parasite could be the end of an endangered species already suffering major population declines from habitat loss. Enter a team from the ANU Research School of Biology which is part of the Australian Government's National Environmental Science Program. The researchers found a cheap and clever way to help the birds to fumigate their own nests. Pardalotes spend a lot of time and energy looking for bird feathers for building nests. They stuff wire dispensers with sterilised chicken feathers treated with bird-safe insecticide and hang them in trees near pardalote nests—and the pardalotes use them. Nests with treated feathers had 95 per cent chick survival compared with the eight per cent survival rate when feathers were untreated. This new tool for areas where these birds still survive means they might still produce enough offspring to prevent extinction.

## Asian–Australian racism during early stages of pandemic

A survey of the experiences of racism during the COVID-19 pandemic and impacts on the lives of Australian young people aged 16–25 by ANU and Centre for Multicultural Youth has revealed some hidden costs of racism. The Victorian multicultural youth surveyed commonly experience direct racial discrimination and racism online but very few are reporting their experiences or even confiding in friends and family. And they are making major changes to their everyday lives in order to avoid experiencing racism. In a survey of 376 young multicultural people, 85 per cent reported at least one direct experience of racial discrimination, with one-third having more than six experiences. Online the statistics were worse. The direct experiences included name calling, hitting, being excluded from activities, being threatened, experiencing poor service and unfair treatment. More than 90 per cent reported consciously adjusting their behaviour in public to reduce their exposure to racism and avoiding situations and places. The report of the survey will help drive tailored policy and service responses. It also highlights where further exploration is needed, for example on the factors preventing young multicultural Victorians from reporting racism, or even sharing their experiences with family and friends—and how this is impacting their mental health and wellbeing during an already stressful time.

## Longitudinal study tracks social and financial impacts of COVID-19

The COVID-19 Impact Monitoring Survey Program tracked financial and social impacts on, and the outlook of, Australians from February 2020. The longitudinal study by ANU Centre for Social Research and Methods

sampled more than 3,000 people at several points throughout the 10 months to gain information that informed policymakers, and community leaders and members. Aspects examined included income and working hours in all age groups and in the employed and self-employed, volunteering, and health and wellbeing. By April two-thirds of Australians said they felt anxious or worried about their own and others' safety and more than 600,000 had lost their jobs due to COVID-19. Perceived levels of job insecurity were very high. Declines in employment and income were largest for those aged 18–24 years; those aged 65 years or more, women and people born in non-English speaking countries were disproportionately affected. However, Australians at the very bottom of the income distribution benefitted from the economic hardship measures the Government had put in place. Mental health and wellbeing took a toll but, on a positive note, Australians enjoyed a greater sense of social trust in April than they did in February.

Self-employed people had fewer working hours and income than employees. They, compared to employees, had less confidence that their current income was sufficient to meet expenditure and were three times more likely to access retirement savings and/or superannuation early. Almost half had profits decrease substantially or eliminated, or had gone out of business; almost a third did not think their business would be viable over the next two months on trends at the time.

By April, about 66 per cent of Australia's seven million volunteers had stopped their volunteer efforts, taking with them the benefit of their 12.2 million hours per week and services that otherwise would not be provided. They lost the significant life satisfaction that volunteering gave them. By May, Government measures had helped stop further job losses and declines in working hours and the steadier jobs outlook had boosted Australians' sense of wellbeing. Life satisfaction appeared to be almost back to pre-COVID-19 levels. However, young people were still doing it tough, with 18–24 year-olds – the group with the largest job impact – feeling the most anxious. Mental health outcomes for young Australians worsened by October to the worst for the pandemic, and significantly worse than before it, while the overall Australian population remained almost steady.

Working Australians lost, on average, 167 hours of work worth more than \$5,000 each, from the start of March to the end of October. With the work hours lost came production downturns with a total estimated loss of around \$47 billion or 1.3 billion hours. The analysis showed weekly work hours dropped for both males and females between February and April, followed by a steady uptick but not back to February levels. The greatest loss of working hours was for Australian workers who completed Year 12, but not a university degree. Workers born overseas in a non-English speaking country lost a substantially larger number of work hours than an otherwise equivalent Australian-born worker.

## **Spread the word: the search for our #Familspeak**

The Australian National Dictionary Centre at ANU collected 'Familspeak' for their second annual appeal for contributions to the Australian National Dictionary. Most families have special words and expressions. They might be expressions that one member of the family uses, variants of traditional expressions or a different meaning for a common word or phrase. The words could be euphemisms for less acceptable words, children's words, or words or expressions that were once more widely known but are now only retained within a small number of families. Contributions from the public are a very important way of alerting the researchers to new words. Although not all terms make it into the dictionary, all are recorded and placed in an ongoing archive of the language used by Australians.

## **Study finds 'high level' of COVID-19 vaccine**

Almost three-in-five Australians (58.5 per cent) said they would definitely get a COVID-19 vaccine once it was available, according to analysis led by the ANU Centre for Social Research and Methods in late 2020. But six per cent of the population said they definitely wouldn't and seven per cent said they probably wouldn't get the vaccine. These findings come from the first representative longitudinal survey of more than 3,000 Australian

participants examining demographic, attitudinal, political and social attitudes, and COVID-19 vaccine hesitance and resistance. Vaccine hesitancy or resistance across Australian society was higher in females, those living in disadvantaged areas, those who reported that risks of COVID-19 were overstated, and those who had more populist views and higher levels of religiosity. Some characteristics of those more likely to get the vaccine were higher levels of household income, practised higher levels of social distancing, had more confidence in their hospitals, or were older than 55 years. The almost three-in-ten Australians likely to get a vaccine but still not certain, could be swayed by public health messaging. But for a significant minority of the population with strongly held beliefs, alternative policy measures may well be needed to achieve sufficient vaccination coverage to end the pandemic.

## The future of research

**The National Institutes Grant enables ANU to maintain and further develop the University's strong focus on research, and the University's educational philosophy that its students are part of a community of scholars.**

### Eyes in space spot bushfire danger zones

The 'black summer' bushfires of 2019–20 demonstrated that the challenge of detecting fires before they become deadly and spread, has never been more vital.

The ANU Institute for Space (InSpace) awarded \$1 million to a multidisciplinary team to build an optical system for a shoe box-sized satellite that can detect changes in forest fuel load and vegetation moisture levels across Australia through infrared detectors. This compact and lightweight system still ensures the sensitivity and ground resolution of other major detectors and telescopes. The project builds on the University's expertise in infrared-sensor systems, and will specifically tune the technology to detect changes in Australian plants and trees such as eucalypts, which are highly flammable.

Led by InSpace mission specialist and remote-sensing expert Associate Professor Marta Yebra and instrument scientist Professor Rob Sharp, the ANU team will partner with other researchers and the private sector to complete the project and launch the new satellite into low-Earth orbit. The satellite, to be designed, developed and built at the ANU Mount Stromlo campus, will advance Australia-wide bushfire management and prevention. The high-resolution infrared images and data of fuel conditions will aid firefighters on the ground and help them plan ahead of bushfire seasons. Well-targeted controlled burns can reduce the frequency and severity of bushfires, and their long-term impacts on Australia's people, economy and environment.

The new satellite will be the first in a constellation of Australian satellites that monitor the landscape and environment, and are designed to benefit Australia's property management, insurance, geological, agriculture and defence industries. A gradual build-up of capacity to monitor bushfire risks in Australia will begin with long-term monitoring. Within the next five years, the project aims to monitor changes to landscape and environment in real time—a game-changing advance for fighting fires.

### Supercomputer simulation could show us how to stop COVID

Gadi—the Southern Hemisphere's most powerful and fastest supercomputer—has entered the fight against COVID-19 by helping reveal how the coronavirus invades human cells. Its high-resolution modelling accurately replicates the true behaviours of cell receptors in the first step of infection by the virus. With that knowledge, researchers could find vulnerabilities in the virus binding process, and target drug design accordingly. The world-first vital information about regions of the receptors that could be potential vaccine or drug targets will allow researchers to use the computer to screen drugs that bind to the receptor complex. Those drugs would prevent

the changes necessary for virus binding and stop the virus from infecting human cells. So powerful is Gadi, it is a member of the elite US-led COVID-19 High Performance Computing Consortium. It can run simulations on 800,000 atoms in a key receptor in our bodies that the coronavirus is exploiting to attack our cells. Over 19 days, 48 processors completed 64 simulations at the molecular level, spending around 13 million hours of computing time – that’s about 1,500 years for one human on a single computer doing constant calculations. Gadi, housed at the ANU National Computational Infrastructure, is the only supercomputer in the Southern Hemisphere powerful enough to do these simulations.

## **ANU at forefront of Australia’s quantum future**

The CSIRO roadmap for the emerging quantum industry recognises the key role of ANU in shaping Australia’s next-generation technology, and as a leader in quantum research, education and commercialisation. Quantum technology can transform this century, especially in the areas of computing, communications, sensing and imaging. Australia is a genuine world-leader in quantum research, and ANU is translating that research excellence into commercial applications to create a major new high-tech industry for Australia that generates serious revenue and jobs. This new industry would include innovations such as enhanced medical imaging, accelerated drug design, human-machine interfacing, precision mineral exploration, climate and weather modelling, and secure defence communications. ANU is the largest producer of quantum-related start-up companies in Australia. One is Quantum Brilliance, which is building quantum microprocessors that promise to transform the future of computing. The university is involved in four quantum-related ARC Centres of Excellence and the ANU Institute for Space (InSpace), as well as hosting key national facilities and research infrastructure. The ANU Masters of Science in Quantum Technology was used in the CSIRO roadmap as an example of pioneering education programs helping prepare the future quantum workforce. It takes a breadth of students from different disciplines and instils technical knowledge and also the entrepreneurial skills, industry knowledge and networks to succeed.

## **New infrared telescope to spot cosmic hidden treasures**

A new infrared telescope, designed and built by ANU astronomers, will monitor the entire southern sky in search of new cosmic events. The Dynamic REd All-Sky Monitoring Survey (DREAMS) will propel Australia into the emerging field of transient astronomy – the study of cosmic events almost in ‘real time’. A transient survey of the southern sky in the infrared has not been done before. The fully automated 0.5 metre telescope and infrared camera snaps 3.75 square degrees (20 times the Moon’s size) and can map the entire southern sky in three clear nights. Infrared telescopes can study dusty and distant regions of space that are impenetrable to optical telescopes. Continuous and rapid monitoring allows searches for varying and explosive phenomena. Data captured by DREAMS, which is 10 times more powerful than its nearest competitors, will help detect the source of gravitational waves, and the collision of neutron stars and black holes. Surveying the sky in the infrared had been limited by the cost of the cameras, not by the telescope. Infrared cameras using indium gallium arsenide technology, developed with collaborators at MIT, is an economical alternative and the telescope uses six such cameras. The telescope, located at Siding Spring Observatory in northern NSW, will be completed in early 2021, with operations beginning soon after.

## **New organic material unlocks faster electronic devices**

The next generation of ultra-fast electronic chips could be made from a new organic material that is one carbon atom: thin, bendable, powered by light not electricity, and much more powerful and faster than the current crop. Researchers at the ANU College of Engineering and Computer Science have observed properties in the material that make it a contender for super-fast electronic processors and chips. They see it as a perfect building block for flexible next-generation electronics. The team controlled the growth of the organic semiconductor material, stacking one molecule precisely over another. In 2018 the same team developed a material that combined both

organic and inorganic elements. They have now improved the organic part of the material and removed the inorganic component. It's made from just carbon and hydrogen, which would mean devices can be biodegradable or easily recyclable, avoiding the tonnes of e-waste generated by current generation electronic devices. The actual devices might still be some way off, but this new study is an important next step and a key demonstration of this new material's immense capabilities.

### **'Big picture' economist wins top prize**

Professor Markus Brueckner has won the 2020 Young Economist Award from the Economic Society of Australia, the most prestigious award for a young Australian economist. The annual award honours Australian economists under the age of 40 who have made a significant contribution to economic thought, economic knowledge, and the application of economics to public policy and public debate. Professor Brueckner, based in the ANU College of Business and Economics, was recognised for the focus and relevance of his work, and his "uniquely impressive" research track record. The society noted three elements in the award citation: his work is always big picture and covers the major issues of our time, for example the effectiveness of fiscal policy during times of financial crisis, the economic determinants of civil war, and economic issues related to democratic transitions; his research has attracted the attention and citation of some of the world's top economists, in the very best journals; and he has made a significant impact on policy through numerous projects with the World Bank, covering diverse topics across the globe. Professor Brueckner is an advocate for open public debate in economics.

### **Australian invention can save lives and boost productivity**

A potent new Australian technology – microwearable sensors – will give wearers an instant read-out of body water or hydration level. Microwearables are low-cost, 'sticker-like' electronic sensors that go just a hair's breadth into the skin to access vital health biomarkers in a minimally invasive and pain-free way. This is personalised medicine to the max. Doctors and patients can fine-tune treatment to precisely suit their condition at the time. The technology is one avenue to tackling the rising risk of heat stress and dehydration for workers, adventurers, the elderly and the sick. Versions of the device can also monitor vital signs for early diagnosis of heart attack or sense inflammatory markers of infectious diseases such as COVID-19. The microwearable sensors can be manufactured in bulk and are on a fast-track for development and release for public use for a range of health conditions. The University's strategic cutting-edge partners, health-tech company WearOptimo and Canberra-based healthcare solutions provider Aspen Medical will manufacture in Australia and take the sensors to the world market. In the words of Vice-Chancellor and President, Brian Schmidt, "the tech may be micro; the impact will be huge".

## **Fostering the next generation**

These six next-generation researchers and academics represent the wealth of talent set to emerge from the high-quality training ground of ANU.

### **Radhika Chaudhri**

PhD candidate at the ANU College of Law and former solicitor at Canberra Community Law, Radhika Chaudhri, knows how economic abuse compounds victimisation in domestic violence cases. Almost all women who experience physical and sexual violence are also subjected to economic abuse, which undermines a victim's financial security and ability to leave abusive relationships. Ms Chaudhri's doctoral research studies how four equitable doctrines – duress, undue influence, unconscionable conduct and the Garcia doctrine – engage with

economic abuse. She is also studying Australian cases over the past 10 years and highlights a trend by judges to think about domestic violence as a series of acts of violence, rather than as an continuous relationship typology. Exposing this trend is a valuable first step in shifting courts' attitudes so that they can be more responsive in cases with domestic violence.

## **Felicity Gray**

Felicity Gray's PhD work at the School of Regulation and Global Governance explores the possibilities and limitations of nonviolent alternatives for protecting civilians – “how can you protect people without a gun?” She says the global notion that the protection of civilians requires military force narrows conversations on the best responses to threats to civilian populations and minimises the effort and investment into other approaches for protecting civilians. She is focused on how the nonviolent practice of unarmed civilian protection works. Felicity spent 18 months interviewing protection personnel, and researching in conflict zones, observing how unarmed civilian protection groups operate. She interviewed, observed and learned from key people in places like Myanmar and South Sudan. And she had to manage safety for herself and those she talked to and worked with. She is now back in Australia, beginning the analysis and writing.

## **Thaum: Aqeel Akber, Prithvi Reddy, Mahasen Sooriyabandara**

Higher degree students Aqeel Akber, Prithvi Reddy and Mahasen Sooriyabandara founded their start-up company Thaum to use their exceptional problem-solving skills and theoretical knowledge of physics intuition gained through research, for practical real-world applications that benefit society. They are working with CSIRO amongst other organisations on commercializing a diverse range of solutions including revolutionising telehealth services for remote patients across Australia and auto detecting AI detection of whales at sea for environmental conservation. Having won top prizes four years running at both GovHack and HealthHack, the three credit their problem-solving prowess and business success to the research-led education at ANU, being allowed to have early involvement in research and tailor projects to their areas of interest. Co-located on the ANU campus this environment fosters access for the team to a range of deep multi-disciplinary expertise and knowledge, a benefit many other start-up ecosystems could not offer.”

## **Yiheng Hu**

Global food security and biodiversity is threatened by the rapid dispersal of pathogens, accelerated by humans in recent years. Timely detection is essential to limit their spread, as are international regulations in step with advances in plant disease diagnostics. It is currently very difficult to quickly diagnose emerging plant diseases, and climate change will exacerbate stress on plants and thus their susceptibility to pathogens. In his PhD research, Yiheng Hu is focusing on modern plant disease diagnostics based on detection of pathogen components, high-throughput image analysis, remote sensing and machine learning. Different diagnostic approaches can be integrated in detection frameworks working at different scales and account for sampling biases. High throughput sequencing technologies are also essential for keeping abreast of pathogen threats. Some of these cutting-edge technologies were developed or are under development at ANU.