2021

Annual Report

FORREST RESEARCH FOUNDATION

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NICOLA AND ANDREW FORREST:

> "The Forrest Research Foundation is unleashing energy – the energy in young minds which we need now more than ever."

DRS ANDREW FORREST AND NICOLA FORREST,
CO-CHAIRS OF THE MINDEROO FOUNDATION AND
GOVERNORS OF THE FORREST RESEARCH FOUNDATION

Foreword

In business, it is well known that if you want to innovate, demolish hierarchies. As Beth Comstock, former Vice Chair of General Electric, described it:

"Abandon hierarchies where everybody conforms, and embrace more horizontal, collaborative networks where people are free to come together as chance and need dictate. And make sure to add a few people with unusual experience into the mix."[1]

This is one area where philanthropy can help universities to step beyond their institutional boundaries – and build new ways of working.

A recent study at Cornell University on how to get academics in different fields to collaborate found that the creation of "agnostic" physical space matters. In setting up such a hub for students, scientists, artists and everyone in between – called the Soil Factory – a creator concluded that the trick to "breaking down academic silos is decentralization, dispersion and undisciplining."[2]

Fewer hierarchies – more unexpected collisions of people and ideas.

Forrest Research Foundation (FRF) is part of a global trend that accepts that the old way isn't working – and that something radically different is required to solve the world's greatest challenges, from ending global warming and eradicating hunger to conquering diseases, improving the quality of life of livestock and developing new, zero-emissions technologies.

That is why FRF is dedicated not to one university, but to all five of Western Australia's major academic institutions, and it's why we offer scholarships and fellowships to all disciplines, from performing arts to theoretical physics.

In 2022, our second hall at FRF will be completed.

Reflecting our philosophy of breaking down silos, the site will bring together not only residential accommodation for Forrest Scholars and Fellows, but also a Minderoo Foundation office and short-stay accommodation for visitors, with the proceeds ploughed back into FRF.

It's a radical concept, it's self-sustaining and it lies at the heart of the kaleidoscope of work FRF does – from developing new medical technologies to protect the eyesight of astronauts on long-distance space flights, to modelling atomic collisions to better understand nuclear fusion.

FRF is unleashing energy – the energy in young minds, which we need now more than ever. Please come down to FRF and see it in action – for yourself.

Nicola and Andrew Forrest

[1] https://hbr.org/2016/03/innovation-springs-from-the-unexpected-meeting-of-minds
[2] https://phys.org/news/2022-06-academic-silos-undisciplinary-approach.html

Message from the Chair

Another year has passed in the storied history of the Forrest Research Foundation — another year in which we have seen the global challenges and constraints generated by the COVID-19 pandemic manifesting on our own shores. Those challenges and constraints serve to remind us of the global vision and aspirations of the Foundation and of Andrew and Nicola Forrest, whose philanthropic enterprise created it.

Those aspirations are reflected in the research work of our Scholars and Fellows which is recounted in the following pages: food security; — human health covering research into treatments for cancer, bacterial infections, cognitive decline, depression and various aspects of mental health; — environmental protection covering coastal erosion, endangered species, coastal flooding, insect populations and the sustainability of shark and ray populations in Western Australia; — technology covering the planning and operation of electricity transmission networks, hydrogen liquefaction and biomedical and industrial applications of titanium and ceramic materials; — cosmology and black holes; — astronaut physiology; — geochemistry; — archaeology; — rock art; — animal welfare. Simply to list the research activities, both post-graduate and post-doctoral, supported by the Foundation is to pick up a sense of the boundary-pushing efforts of those who pass through Forrest Hall.

2021 bought challenges other than those generated by the direct impact of COVID-19 — there was a setback in the progress of the second stage of Forrest Hall due to the collapse of the builder before its completion. That setback has been met and overcome with the engagement of a new builder and, at the time of writing, the imminent completion of the building. The enlarged complex will ensure that the Foundation's operations are sustained and expanded.

There are many people who have contributed to the work of the Foundation in 2021 and who should be acknowledged. In particular, I thank the Governors who include the Vice-Chancellors of all of the Western Australian universities, participating in what is an important State-wide collaborative exercise, supported by the donors and their philanthropic arm, The Minderoo Foundation and hosted by the University of Western Australia.

I especially acknowledge the work of the Selection Committee which is rigorous, time-consuming and voluntary. I thank Grant Donaldson, who has chaired the Committee for some years and who retired during 2021. I thank Professor Robyn Owens who has taken over from Grant Donaldson in the role of Selection Chair. Rochelle Gunn, the Foundation Program Co-ordinator was indefatigable in her commitment to the work of the Foundation, including her secretarial support for the Governors.

As Professor Paul Johnson notes in his Director's Report, this will be his last Report as he retires from the Foundation in 2022. Paul has been at the helm of the Foundation since 2017 when he succeeded the inaugural Warden, Mark Cassidy who subsequently served as a valuable member of the Governors. It is fair to say that Paul Johnson has been instrumental in the development of the Foundation during his time as Warden. In particular, he has established and maintained the critical 'home-away-from-home' ethos for Scholars and Fellows and their collegial and informal interdisciplinarity — all of which are features critical to the Foundation's distinctive character. On behalf of the Governors, I thank him for his contribution and for his generous readiness to extend his departure date to allow for the appointment of his successor.

The Forrest Research Foundation entered 2022 on a sound financial basis. It will soon begin a new and exciting phase in its development with the appointment of a new Director and commencement of operations at Forrest Hall 2.

The Hon Robert French
Chair

Our Values

We will:

- set ourselves ambitious targets
- strive to be the very best we can be
- surprise ourselves and others with what we achieve
- demonstrate integrity, inclusiveness, humility and generosity in work and in life
- support, encourage and respect each other
- make a positive impact on the world around us.

←
The Western Australian green birdflower (Crotalaria cunninghamii) is the inspiration for the logo of the Forrest Research Foundation

Director's Report

2021 did not deliver the 'return to normality' that had been hoped for around the world after the huge disruption wrought by the COVID pandemic in 2020.

Mutations and variants of the COVID virus caused governments, organisations and individuals to continue or even extend public health measures that have saved lives but disrupted life. Although Western Australia's tight border controls entirely prevented community transmission of COVID and allowed social life to continue in an unconstrained and mask-free manner, they have, nevertheless, had a significant impact on academic institutions, including the Forrest Research Foundation.

Our university libraries, laboratories and lecture halls were untouched by the restrictions and limitations common in most countries, but the benefits of isolation and closed borders came at the cost of academic mobility. For the Foundation, this meant another year with no Visiting Fellows and none of the intellectual engagement and exchange that comes when senior researchers from overseas spend time with Forrest Scholars and Fellows. It also meant many fewer applications from international candidates for our Fellowship and Scholarship programs. This led the Selection Committee to pare back the number of awards offered with the expectation that both applications and awards will increase in number as the world opens up in 2022.

Recognising that 2021 was a year for focusing on the local rather than the international, the Foundation has been active in supporting early-career researchers in the Western Australian universities. The second round of the Prospect Fellowship scheme – our rapid response to the COVID-induced collapse of employment opportunities for recent PhD graduates – led to the appointment of a further eight Fellows in January, joining the twelve Prospect Fellows appointed in September 2020.

The Foundation also launched a new Fellowship scheme in Creative and Performing Arts. Recognising that the career pathways and achievements of early-career researchers and practitioners in creative and performing arts are different to those experienced by most early-career researchers, we established these fellowships with different eligibility and selection criteria. Our first two outstanding Creative and Performing Arts Fellows were appointed in December and will commence their fellowships in 2022.

Although Forrest Scholars and Fellows have not been able to travel, they have been very active at home. Eight PhD theses were submitted during the year by Forrest Scholars, and Scholars and Fellows produced dozens of publications and were recipients of multiple academic prizes and awards. The Scholars and Fellows Council, in its first full year of operation, held 30 academic seminars promoting cross-disciplinary engagement and exchange and a similar number of social and well-being events.

This is my final Director's Report as I will retire in 2022 so I wish to convey my thanks – to Governors present and past for the opportunity to lead the Forrest Research Foundation over the last five years; to academic and professional colleagues in the five Western Australian universities and the Minderoo Foundation for their unstinting commitment to the goals of the Foundation; to the Foundation's Program Co-ordinator Rochelle Gunn for her outstanding support; and to the Forrest Scholars and Fellows whose passion for research and the pursuit of new knowledge has been a privilege to behold.

Professor Paul Johnson
Director

A GLOBAL SCHOLARSHIP AND FELLOWSHIP PROGRAM...

Scholars and fellows come from around the world


POLAND
JAPAN
CHINA
VIETNAM
INDIA
SRI LANKA
BANGLADESH
ETHIOPIA
SINGAPORE
MAURITIUS
AUSTRALIA
NEW ZEALAND


FORREST HALL

We want to:

Eradicate hunger

Conquer disease

Protect the planet

Develop new technologies

Extend human knowledge

Live wisely

Through our research we work out how to:

- Manage the ocean's fisheries
- Develop cancer therapies
- Understand past societies and cultures
- Protect endangered species
- Produce renewable energy
- Track the evolution of the universe
- Create new chemical compounds
- Tackle the mental health crisis
- Prevent coastal erosion and flooding
- Grow more food with fewer chemicals
- Improve the management of disease
- Expand Australia's space science capability
- Support the aged care workforce
- Visualise nanomedical technologies
- Develop quantum technologies
- … and much more …

Eradicate Hunger

We work to find ways of producing more food while using less land, water, chemicals and pesticides so that we can feed the world's growing population.

MONICA DANILEVICZ (UWA)
uses drones and machine learning to monitor, predict and improve the yield of advanced crops.

KRISTINA HEIDRICH (UWA)
is assembling data on fishing catches over the past 70 years to support policy for the sustainable management of global tuna fisheries.

XUYEN LE (UWA)
uses plant genetics to understand the molecular mechanisms by which plants take energy from the environment and use it to grow.

DR KATE LOUDON (Murdoch)
is developing new sensing technology to improve on-farm assessment of beef cattle quality and value.

DR SAM LYMBERY (UWA)
is finding ways to manipulate the behaviour of damaging invasive ants in order to reduce reliance on pesticides and restore ecosystem balance.

SAMALKA WIJEWEERA (UWA)
is investigating the biochemical processes that determine salt tolerance in wheat.

RESEARCHER PROFILE

MONICA DANILEVICZ

Food security in times of climate change

What sparked your interest in agriculture?

Growing up, my father's career meant that our family lived in various parts of Brazil. I was always excited to move because I was curious to experience what life was like in other cities. It made me realise the diversity of weather and vegetation types, which led to new dishes and traditions. Food production and its availability can shape the community, so I was particularly interested in agriculture's role in providing food security and its impact on the environment.

What is the main goal of your research?

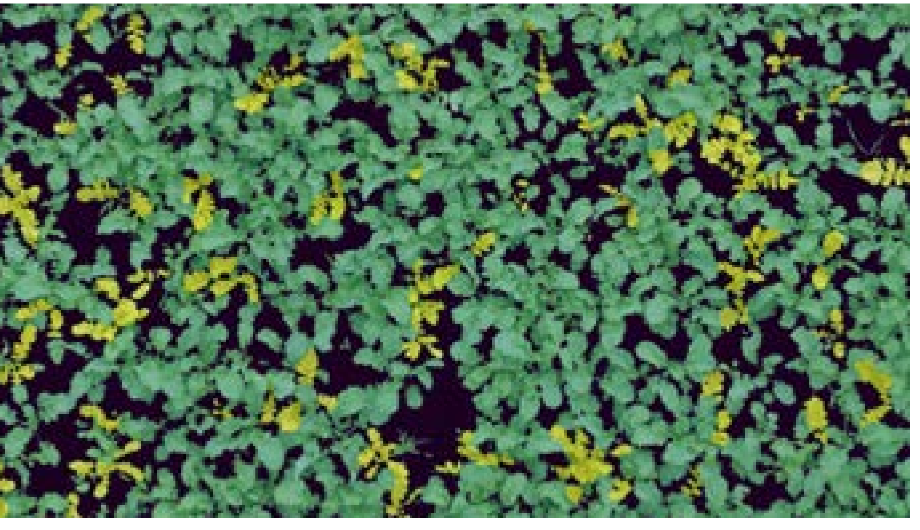
My Ph.D. project aims to enhance agricultural processes through machine learning algorithms and drone surveys, developing decision support tools for breeders and crop growers. For example, one of the models developed can help breeders identify high-yielding varieties in a field trial, helping accelerate the development of crops with superior performance.

What is the problem you are attempting to solve?

Climate change poses a threat to food security worldwide, increasing extreme weather events and shifting the distribution of agricultural lands. It will affect many aspects of our lives, from increased food prices to rethinking the logistics involved in farming and food distribution. A key aspect of maintaining food production during these changing conditions is identifying exactly what the crop needs to thrive. Many industries have turned towards technology to modernise their practices to help mitigate the impact caused by climate change, and agriculture is no different.

“The important thing is not to stop questioning. Curiosity has its own reason for existing. One cannot help but be in awe when one contemplates the mysteries of eternity, of life, of the marvellous structure of reality. It is enough if one tries to comprehend only a little of this mystery every day.”

Albert Einstein



↗
Weed detection in canola using image processing and AI

What resources are available?

New cameras are being used in agriculture to help farmers see beyond human capacity. Hyperspectral, multispectral and thermal cameras can capture information from the crop at wavelengths beyond what we can see with the naked eye, allowing farmers to make better decisions regarding when to harvest and treat any problems that may be occurring in the field. Many studies show the application of cameras deployed in the field to detect drought stress, weeds and the emergence of pests among crops, which can support informed management decisions on the farm. However, processing images to extract all that information about the health of the plant and its potential yield is not easy, requiring expert knowledge to develop the algorithms that will process the raw data into actual information.

Why use Artificial Intelligence?

Artificial Intelligence (AI) is a common technique used in several areas, particularly with image analysis, as it can continuously analyse vast amounts of data and provide measurable results. In many cases, the accuracy obtained by using AI models for image analysis exceeds what humans would be able to achieve. AI models are trained using massive amounts of labelled images, and because they analyse images pixel by pixel, they are less likely to overlook details or suffer fatigue. AI models are currently being developed for agricultural applications with good results and may present an alternative to help protect food production on farms. Using AI in agriculture has huge potential, and many companies have started commercialising these AI-powered tools for image analysis, indicating a path to the future.

How will your research impact the world?

The threat that climate change poses to food production across the globe causes different issues in each region. My research hopes to provide tools specifically designed for particular climatic regions around Australia, integrating the visual information from the crops to their associated data, allowing Australian farmers to remain productive for longer in the affected regions and produce enough food to contribute to global food security.

Why choose WA as the location for your research?

The main reason I came to WA was to work with my supervisor, Prof. Dave Edwards. Towards the end of my Master’s, I was exploring many Ph.D. options worldwide, but working with Prof. Edwards with the support of the Forrest Research Foundation was the most exciting option. I could see myself doing meaningful research that would be directly applicable to solving problems in agriculture.

Additionally, I was offered an apartment at Forrest Hall and all of the benefits that come with it, such as academic and social events which bring scholars and fellows together in a friendly community, allowing us to expand our networks.

Monica Danilevicz is a Forrest PhD Scholar in the School of Biological Sciences at UWA.

Conquer Disease

We combine our knowledge of physiology and medicine with the latest scientific advances to find new ways to tackle disease and improve human health.

AKILA BALACHANDRAN (Murdoch) is developing new chemicals that modify the growth and survival of cancer cells, in order to develop targeted cancer therapies.

DR JESSICA BUCK (UWA/Telethon Kids Institute) is working to find new combinations of medicines that increase the effectiveness of radiotherapy for children with brain cancer.

DR LUCY FURFARO (UWA) is examining bacterial infection during pregnancy to see whether bacteriophages (viruses that kill bacteria) can protect neonates from infection.

DR GEORGIA HAY (Curtin) works with interdisciplinary medical specialists to find more effective ways for them to pool their expertise in the diagnosis of rare diseases.

DAWID MAKOSA (UWA) is examining the molecular mechanism that drives age-related cognitive decline, with the aim of finding treatments to preserve cognitive function in the elderly.

DR KIERAN MULRONEY (UWA) is developing and taking forward into clinical trials a new diagnostic test system for life-threatening infections.

JESSICA MURRAY (Curtin)
studies the fundamental biology of therapy-resistant melanoma in order to support the development of improved treatment.

GLADYMAR PÉREZ CHACÓN
(Curtin/Telethon Kids Institute)
is investigating whether the effect of some whooping-cough vaccines on the infant immune system may also prevent food allergy.

BHEDITA SEEWOO (UWA)
is working to understand the fundamental mechanisms by which repetitive trans-cranial magnetic stimulation of the brain can treat medication-resistant depression.

DR RACHEL ZEMEK
(UWA/Telethon Kids Institute)
is exploring ways in which the body's immune response to cancer surgery can be reprogrammed to kill any remaining cancer cells.

Protect the Planet

THALLES ARAUJO (UWA)
is developing a warning system for coastal erosion using state-of-the-art computer modelling that simulates sea level, waves, currents and sediment transport.

CELINA BURKHOLZ (UWA)
is studying the impact of rising sea temperatures on kelp forests in order to identify ways of increasing the resilience of kelp.

MATT HEYDENRYCH (UWA)
is developing new genetic and epigenetic tools to assess animal populations and to provide the information needed to support endangered species.

EMILY HOFFMANN (UWA)
studies the conservation of endangered amphibians so that we can better understand the causes of population declines and work towards preventing future extinctions.

We aim to ensure that our children, and their children, can marvel at a natural world that is as beautiful, bountiful and diverse as the one we enjoy today.

DR GIOVANNI POLVERINO (UWA) develops bio-inspired robots to manipulate the behaviour of highly invasive fish in order to reduce their capacity to reproduce and thereby protect native species.

DR ARNOLD VAN ROOIJEN (UWA) is developing nature-based solutions to protect Australia's coasts from flooding and erosion.

DR BRENTON VON TAKACH (Curtin) combines genetic data with field observations to support the conservation of endangered mammals in northern Australia.

DR CHONG WEI (Curtin) is investigating the way marine animals hear sound in order to understand how undersea noise is impacting the marine environment.

DR MARK WONG (UWA) analyses the world-wide decline in the number and diversity of insects in order to develop new guidelines to preserve insect populations and maintain ecosystem resilience.

MARIE WINDSTEIN (Murdoch) examines how variation in environmental conditions affects the sustainability of sharks and rays along the coast of Western Australia.

RESEARCHER PROFILE

CHONG WEI

Caught out by COVID

↗
6 January 2022;
finally back to Perth

Chong Wei's research career has taken his family across the globe, from China to the USA, Singapore and Australia.

After accepting a Forrest Research Foundation Fellowship, he arrived in Perth with his wife, Renny and their two young sons, Caleb, then four, and baby Leo, just one.

They loved their new life in Perth, complete with an apartment at Forrest Hall, and a visit back home to China to celebrate the Lunar New Year with their family was planned.

They could never have foreseen the heart-wrenching two years that lay ahead.

March 2019

We moved into Forrest Hall and were warmly welcomed into the community. We held our boys' 5th and 2nd birthday parties here with our new friends and colleagues and, later that year, celebrated our first Christmas in Perth. We were all excited about our upcoming trip to China to celebrate the Lunar New Year.

8 January 2020

We arrived in Fuzhou, China, our hometown, and enjoyed two fun-filled weeks with our family and friends. We heard reports of a virus in Wuhan, but the news said it was nothing serious.

23 January 2020

The sudden lockdown in Wuhan shocked everyone. During the days that followed, panic quickly spread across the country as the situation worsened dramatically.

We were required to remain at home; streets all over the city were suddenly empty, reminding me of eerie scenes in zombie movies. The news about the travel ban in Wuhan made us very nervous. We tried desperately to change our flights, without success. Our return flights to Perth were booked to depart on February 1.

31 January 2020

We received the devastating news that Australia had issued a travel ban on China, just hours before our flight. The following day we drove to the airport to try our luck but were unsuccessful. Rochelle (Rochelle Gunn, Program Coordinator, Forrest Research Foundation) called all airlines for us, but no flights could take us. The travel ban would be reviewed every two weeks so we spent the next month hoping and praying for a miracle.

6 March 2020

The virus had started to spread throughout the world.

We flew to Bangkok, Thailand, attempting to take a detour back to Australia, and commenced a fourteen-day hotel quarantine. The second week of the quarantine was mentally excruciating. We were literally counting down the hours to leave as news emerged of more and more countries closing their borders.

20 March 2020

Australia closed its border, once again just hours before our flight. The moment I saw the news my heart sank and my mind went completely blank. My little boys gave me such a long hug as if, somehow, they had suddenly grown up. Our lives were about to change.

↘
January 2020: celebrating New Year with Grandparents

21 March 2020

We had no choice but to fly back to China, straight into another fourteen-day hotel quarantine.

In the beginning, it was a struggle for all of us. We were stranded with nowhere to stay and no car. My parents' apartment was under a government resettlement project, so they were required to move out and their rental apartment was too small to accommodate us all long-term.

The short-term rental market was almost impossible. We had to temporarily stay at my cousin's spare single flat, in a remote suburb far from the city, with no school. 'Temporary' became almost a year.

We found ourselves completely isolated without friends or family to offer support and had no social life at all. We were more than an hour's bus ride to our parents so spending time with them was limited. Gatherings were restricted and most of our closest friends were in other cities or countries. To make matters worse, our surrounding neighbours were renovating their flats. The constant sound of drills and sledgehammers was deafening, to the point that we could barely hear each other and our boys became very scared.

The tiny flat had a dining table that I could use as a desk but without air conditioning, it was unbearably hot in summer. Each day we took a taxi to the nearest Starbucks so that I could work on my research and the kids could have their quiet moments in the prepaid playground. We would not leave until sunset.

I became completely overwhelmed by the uncertainty, anxiety and stress. I had trouble sleeping and couldn't stop blaming myself for our predicament. Late at night, lying in bed, I felt like a drowning man, desperately clinging to anything I could possibly reach.

Renny was my greatest support during these dark times. She convinced me that blaming myself was futile.

We had to make a plan. We agreed that Renny would focus on taking care of the kids including teaching them English so they could catch up at school once we returned. I made a promise to Renny and our two boys that I would do everything possible to continue my work and find a way back to Perth.

It was a huge setback for my research because I couldn't access the facilities and resources I needed. I felt stressed and powerless when new publications from my peers were out while I was still making slow progress.

I spent several days clearing my mind and made a detailed list for my research. I called it my 'research map', which included everything I could do under the circumstances and each milestone I needed to achieve; which data I could analyse remotely, which paper/funding applications I could write and what I needed to do in preparation for my research once we were back in Perth.

I contacted all of the international researchers with whom I had worked or collaborated, explained my situation, and managed to find a way to share some data. I made plans to visit the researchers/institutions in China that I had connections with, attempting to use all the resources that I could obtain in China, such as using some of the devices in my former Ph.D. lab. My 'research map' kept me focussed, releasing me from my negative thoughts, and somehow got me back on track; slowly, but moving forward positively.

I also listed all of the possible avenues that could bring us back to Australia, including a travel exemption application and a Global Talent Independent (GTI) visa program application. That list was designed to keep our hopes alive.

We made a concerted effort to celebrate anything good that happened, to keep spirits up, dark thoughts at bay and maintain a healthy atmosphere for our kids.

↗
A family trip
to Shanghai

Looking back, the past two years feel like a long, emotional rollercoaster ride, the likes of which I have never experienced.

July 2021

After home-schooling our boys for almost a year, we decided to move back to the city and enrol them in the school near my parents' apartment. As a sacrifice, I had to be separated from my kids. They stayed with Renny at her mother's apartment, while I stayed with my parents. It was another blow because spending time with them and hearing their innocent laughter was my greatest motivator.

Throughout the following months, I enjoyed the time with my parents and kept in touch with my friends and colleagues via texts and emails every day. This regular communication really boosted my mental health as did the weekends when I could spend quality time with Renny and the boys.

↗
First day at school

October 2021

The Australian Government announced a reopening timetable that was closely related to the vaccination rate. Checking the vaccination rate in Australia became the first thing I did every morning. I had a growing feeling that we were about to see the light at the end of the tunnel.

December 16, 2021

The day after Australia opened its borders to working visa holders, we boarded the plane to Sydney, relieved that our two-year journey was almost over. Almost, because we still had to get back into Western Australia.

January 6, 2022

After completing a three-day hotel quarantine in Sydney, we flew straight to Darwin, a detour to get us back to Perth. We were overjoyed to return to our apartment in Forrest Hall and begin our fifth and final fourteen-day quarantine, for we were finally home.

April 2022

Looking back, the past two years feel like a long, emotional rollercoaster ride, the likes of which I have never experienced. Every time there seemed to be hope, the hope was dashed. I applied for a travel exemption from the Australian Government fourteen times, but all were rejected. I was hoping that I could get a GTI visa to come back, but the processing was delayed for months due to COVID. I was waiting for the opening of travel bubbles, but they were postponed again and again, and never happened.

To many, my two-year journey may sound very unlucky, but I have never believed more strongly that we are truly blessed, and that I am a very fortunate man to have my family who always back me up, my friends who always cheer me up, and the Forrest Research Foundation and my Curtin Supervisor who always support me. I am also proud of myself that I kept my word to keep moving forward and never gave up.

They say, 'what doesn't kill you makes you stronger', so yes, thanks to this unique experience, I AM STRONGER.

I wish to thank my Curtin Supervisor Christine (Prof. Christine Erbe, Director of Centre for Marine Science and Technology), who never stopped searching for ways to obtain a travel exemption for me, and Paul (Prof. Paul Johnson, Director, Forrest Research Foundation), who always answered my emails where I talked of my confusion, difficulties and frustrations. Those meant a lot to me and gave me strength because I knew I was never fighting alone.

I am immensely grateful to Forrest Research Foundation for retaining our apartment for two years, rent-free, allowing us to pay for living costs in China, and for giving me a two-year extension of my fellowship.

Finally, I wish to make mention of my mentor and friend, Prof. Whitlow Au, at the University of Hawaii, who ignited my passion for my research and sadly passed away in February 2020.

Dr Chong Wei is a researcher in marine bio-acoustics at the Centre for Marine Science and Technology at Curtin University and a Forrest Post-doctoral Fellow.

We explore the potential to find new ways of making and using the molecules, materials and machines that support our modern way of life.

Develop New Technologies

DR HOUDA ENNACERI (Murdoch)
is devising new technologies to improve the efficiency of producing bio-fuels from microalgae.

DR PETER KRAUS (Curtin)
develops new computational models to predict the conductivity of novel materials for use in semi-conductors.

DR JASON ESHRAGHIAN (UWA)
draws on neuroscience, electronic engineering and machine learning to develop new types of medical technologies driven by ultra-efficient artificial intelligence algorithms.

DR DAVID GOZZARD (UWA/ICRAR)
is developing laser technologies to replace radio communications between satellites and earth, thereby massively increasing the rate of data transmission.

DR MARCUS KORB (UWA)
is developing new iron-based catalysts to replace reliance on toxic metal catalysts.

ASJA KROEGER (UWA)
develops computational models of chemical interactions which lead to the development of new chemical catalysts.

DR JACOB MARTIN (Curtin)
is developing new carbon ‘sponges’ that can hold hydrogen, and which will provide a new method for storing and transporting hydrogen fuel.

MASNUN NAHER (UWA)
is creating novel molecules which can replace conventional electronic devices such as transistors in the construction of molecular integrated circuits.

DR SHIMUL NATH (UWA)
is developing novel semiconductor thin films for next-generation curved infra-red sensors.

MANOU ROSENBERG (UWA)
uses advanced mathematics and artificial intelligence to improve the planning and operation of electricity transmission networks.

DR ARMAN SIAHVASHI (UWA)
is producing new understanding of the process of hydrogen liquefaction and storage which will support the development of hydrogen as a clean fuel.

JINCHENG WANG (ECU)
is finding ways of applying additive manufacturing (3D printing) techniques to existing and new titanium alloys for biomedical and industrial applications.

MINGXIN YE (UWA)
is developing strong non-toxic bio-compatible ceramic materials that can be used as an alternative to titanium in artificial hip and knee implants.

RESEARCHER PROFILE
DAVID GOZZARD

Laser communication in space

↗
David breathing a sigh of relief with the telescope safely installed on the rooftop. (Supplied: ICRAR)

Recently, my colleagues and I swung a half-tonne telescope onto the roof of the physics building at the University of Western Australia. For a tense moment, my career hung from a crane hook.

The telescope is the first of its kind in the southern hemisphere and represents a new generation of space communications using lasers. Dubbed the Western Australian Optical Ground Station (WAOGS), we hope it will be part of a global network receiving high-definition TV from astronauts on the moon, when NASA returns there in 2024.

Increasing data transmission from space is crucial if we want to benefit from this data and improvements in technology.

So why do we need lasers in space? It may seem hard to imagine in our age of global streaming services, but transmitting HD video from space is incredibly hard. While Earth has seen a revolution in telecommunications, satellites and spacecraft are stuck in the era of dial-up internet. In space, there's no 4G data connection. There are no fibre-optic cables drooping down from orbit.

Satellites transmit their data with radio frequency (RF) technology that has barely changed since Neil Armstrong zipped up his space-boots. We rely on these satellites for communications, weather observations, crop monitoring, mapping, bushfire and disaster response, and a huge range of other applications. Increasing data transmission from space is crucial if we want to benefit from this data and improvements in technology. If our laser communications can fix this data bottleneck, we can free satellites to be more useful and open up the possibility of super-fast space-laser internet being delivered to anywhere on the planet.

Why laser communications?

Laser communications have several advantages over radio, including significantly faster data rates and greater security. Radio waves and light are both forms of electromagnetic waves, just of different frequencies. The higher the frequency of the electromagnetic wave, the more information that can be transmitted each second.

The push to higher frequencies to transmit more data is the difference between 4G and 5G mobile phone networks. Australian 5G networks can transmit data dozens of times faster than the older 4G networks. With more and more people demanding ever more from their internet connection, the 4G networks can not transmit data quickly enough (that is, they do not have enough "bandwidth") to supply everyone's needs.

The same is true for spacecraft. With an increasing number of satellites, each generating more and more data from ever-improving sensors and cameras, radio communications do not have enough bandwidth to transmit all that data back to Earth. A satellite equipped with a laser transmitter will be able to downlink its data to Earth at rates tens of thousands of times faster than it could with a radio transmitter, overcoming our data bottleneck problems.

Laser transmitters also have other advantages. They are smaller and lighter than radio transmitters, which is important for spacecraft, where every extra kilogram adds tens of thousands of dollars to the launch costs. Lasers are more directional than radio waves — they can be more precisely pointed at the receiver on the ground. This means multiple spacecraft transmitting on the same frequency won't interfere with each other, as radio does. And that data is much harder for an eavesdropper to intercept.

But the atmosphere is in the way

However, to make laser communications work, we have to overcome a major challenge: atmospheric turbulence. Slight differences in temperature, pressure and composition modify the refractive index of the air and deviate the path of the beam. This is why you see shimmering above a hot road, and why stars twinkle. The atmospheric turbulence can degrade the quality of the laser beam link and in turn limit the rate at which data can be sent.

One solution to this is "adaptive optics", which was previously developed for studying galaxies in the deep universe. Large astronomical telescopes detect the distortion caused by the atmosphere and deliberately deform their mirrors in the opposite way. By counteracting the distortion, the telescopes capture a clearer, sharper image. The same techniques can help laser receivers capture a good quality link through atmospheric turbulence.

The telescope erected on our physics building is the first in a planned network of optical ground stations across Australia and New Zealand.

↖
Scientists install WAOGS at the University of Western Australia (Gfycat)

↘
Spacecraft are suffering from a data bottleneck, but shooting giant lasers into space may help solve that. (Supplied: ICRAR)

Super-fast space internet

If the problems caused by atmospheric turbulence can be overcome, this will open the way to superfast space-based internet on Earth. Light travels about 50 per cent faster in the vacuum of space than it can through a fibre optic cable, so data going via satellites can get to the other side of the globe a fraction of a second faster than through the undersea cables that currently underpin international communications. This means satellite links have lower "latency".

Low latency is important for financial markets, where a few milliseconds can make millions of dollars difference to the value of stocks. This is the economic driver behind Elon Musk's Starlink network, which will eventually comprise tens of thousands of communications satellites. In the next few years we can expect to see an explosion of companies launching large numbers of communications satellites, all vying to shave milliseconds off the time it takes to get high-value data between continents.

An Australia-NZ optical ground station network

The telescope erected on our physics building is the first in a planned network of optical ground stations across Australia and New Zealand. This network will eventually be made up of four ground stations in Western Australia, South Australia, ACT and New Zealand which will form the Australasian Optical Ground Station Network (AOGSN). The stations will work together to "hand over" a satellite from one station to the next as it passes over Australia, coming into view of one ground station as it passes out of view of another. By spreading the stations out, there's a lesser chance their operation will be interrupted by weather.

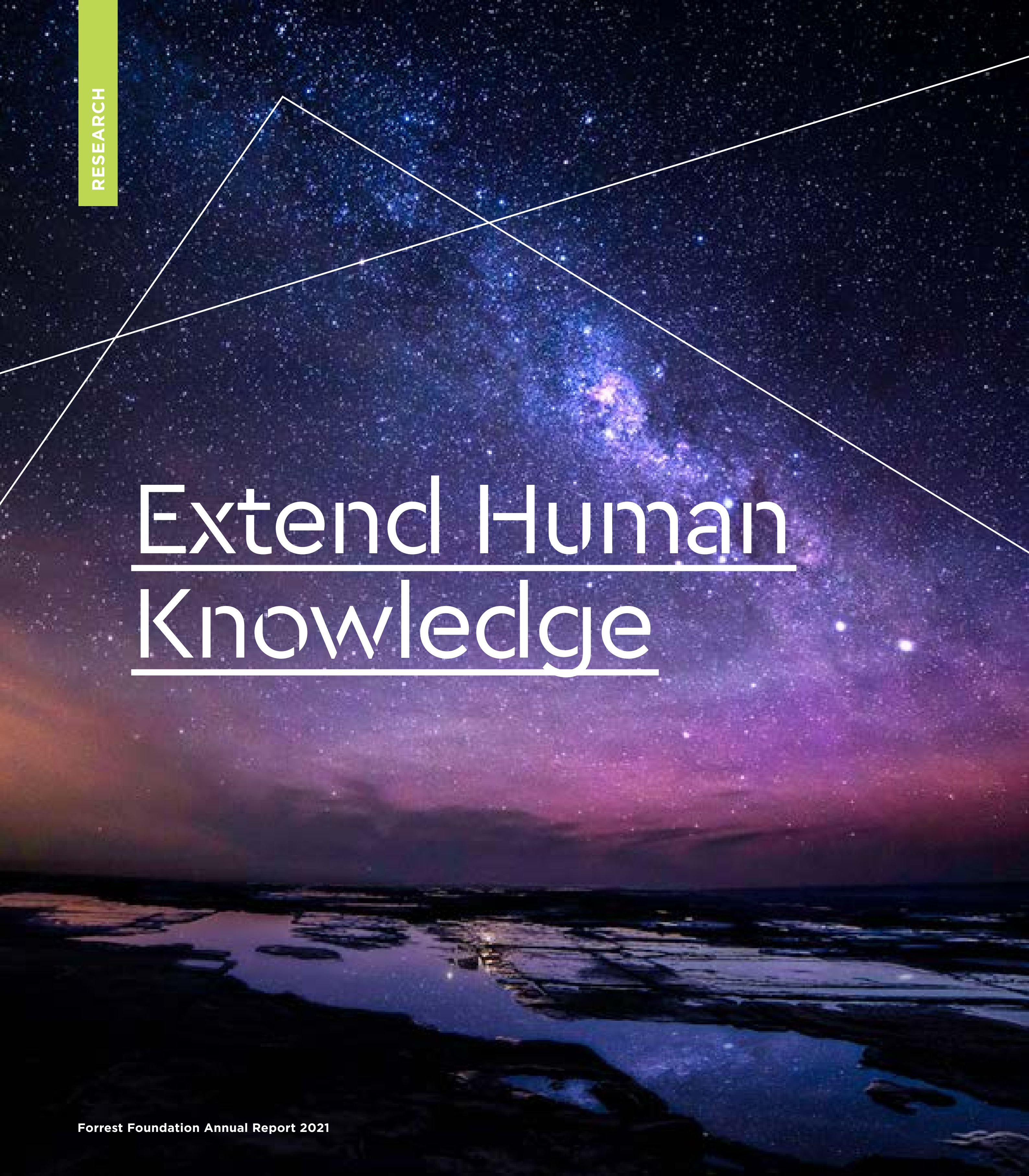
The AOGSN is currently under construction, and it will be a few years before the network reaches its full capacity, as technologies are developed and tested. It's envisioned the AOGSN will be the backbone infrastructure for space-based internet communications in Australia and New Zealand.

This could be of particular benefit to those in rural areas of Australia who don't have access to fibreoptic broadband speeds and it will be an important element of Australia's growing presence in the global space economy. It could also continue a grand Australian tradition.

When Neil Armstrong and Buzz Aldrin first stepped onto the Moon during the Apollo 11 mission in 1969, the TV images were received by a tracking station at Honeysuckle Creek in the ACT, and the CSIRO's Parkes radio telescope (also known as Murriyang or 'The Dish') in NSW. Sascha Schediwy, head of the research group responsible for designing and building the WA Optical Ground Station, says lasers will play a crucial role in the next human missions to the Moon. "It's likely to be how we'll see high-definition footage of the first woman to walk on the Moon."

Dr David Gozzard is an experimental physicist in the International Centre for Radio Astronomy Research (ICRAR) and a Forrest Foundation Postdoctoral Fellow at UWA.

This is an abridged version of an article originally published by the ABC Science unit on the ABC News website.



Extend Human Knowledge

We seek better understanding of fundamental questions about the nature of matter, the structure of the universe, and our place within it.

DR NICHOLE BARRY (Curtin/ICRAR) is exploring how the Universe underwent a change creating the very first stars and galaxies 13 billion years ago, known as our Cosmic Dawn.

HARRISON CADDY (UWA) uses computational fluid dynamics to examine blood flow within the eye in order to study the vision disorder affecting astronauts on long-duration space flights.

DR INDIA DILKES-HALL (UWA) is exploring archaeological evidence of the relationship between people and plants in pre-modern human migration.

DR MATTHEW DODD (UWA) uses new methods of geochemical analysis to decipher changes in the Earth's ancient geological record, and the interplay between phosphorus, carbon and oxygen.

NICHOLAS LAWLER (UWA) uses next-generation genetic sequencing to study the effect of millimetre wave light on DNA, with the aim of developing new forms of non-invasive therapies.

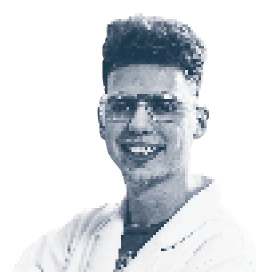
SEAN LI (UWA) is developing an automated methodology for the rapid identification of the molecular structure of organic compounds from mass spectrometry data.

DR BEN MCALLISTER (UWA)
is developing novel quantum technologies including single photon counters for the identification of 'dark matter'.

ANA MOTTA (UWA)
studies the ancient rock art of the Kimberley to understand the way Indigenous Australians interacted with and cared for their environment in past times.

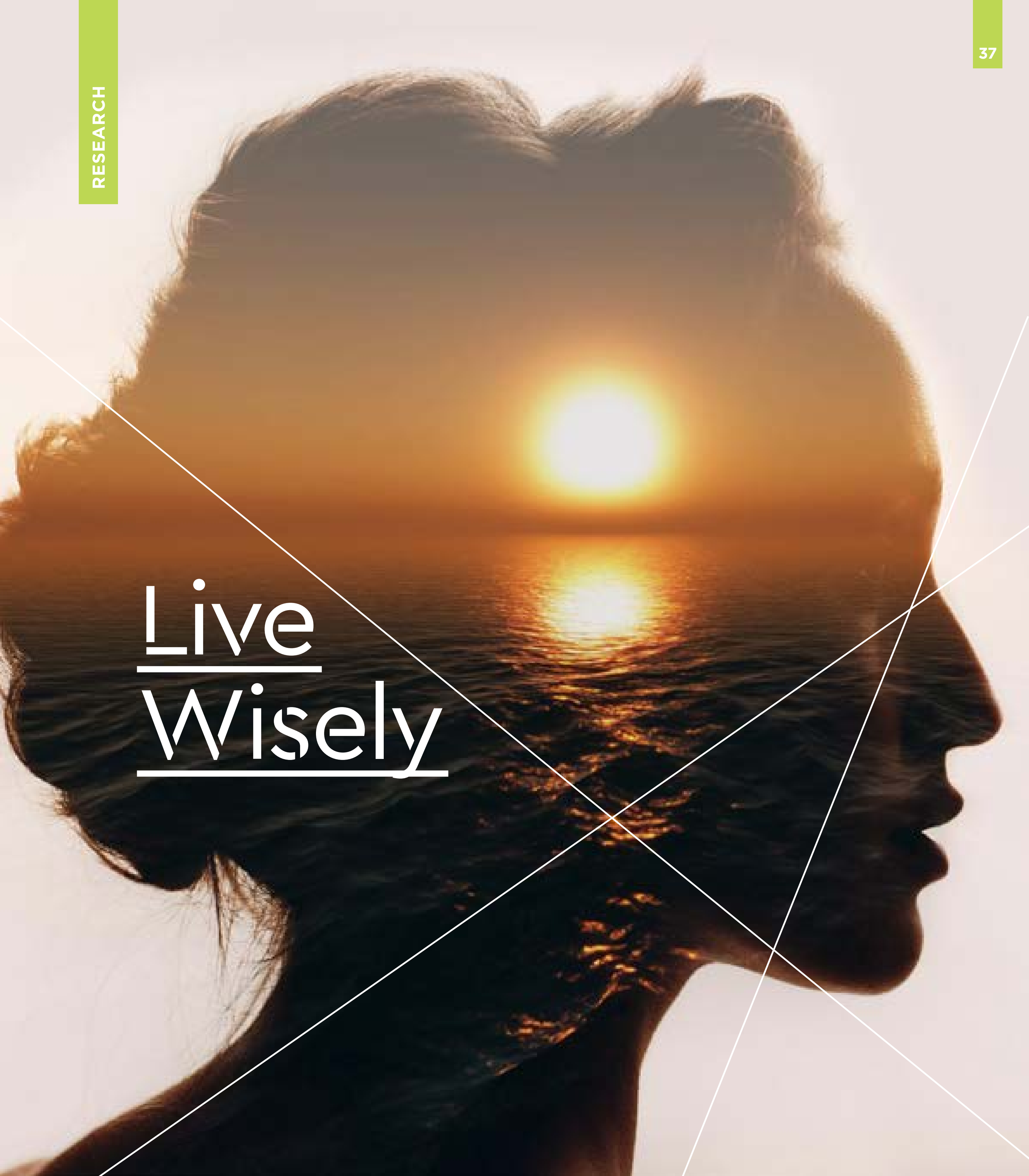
TYRONE O'DOHERTY (Curtin)
uses new techniques to discover (invisible) black holes within our galaxy, giving us new insights into the processes of cosmic evolution.

LIAM SCARLETT (Curtin)
models the pattern of atomic and molecular collisions to provide fundamental understanding of the physics of low-temperature plasmas in nuclear fusion technology.



ADAM WDOWIAK (UWA)
works on the creation of a novel class of human-designed molecules – triangulenes – and investigates their properties and potential uses.

Live Wisely



DR SHANNON ALGAR (UWA)
uses modern mathematics to analyse the physiological characteristics of individual livestock animals to improve both animal welfare and livestock husbandry.

LIYUWORK DANA (Curtin)
is developing a new index to map the location and extent of food insecurity among Australian households and identifying ways to improve assistance to these households.

DR FRANCESCO DE TONI (UWA)
investigates the way Australians express their emotions when talking about health and illness in order to enhance the communication skills of health-care professionals.

CLAIRE DOLL (UWA)
uses survey tools to understand public preferences for different types of parks and open spaces to help local governments make evidence-based decisions about future investments.

We examine the way life is lived to find better ways for individuals and for society to respond to challenges and embrace opportunities.

GRACE GOH (UWA)
explores how our body clocks – our time-keeping genes – work to influence health and longevity.

DR NICOLE HILL
(UWA/Telethon Kids Institute)
works to prevent the occurrence of self-harm and suicide in young people.

DR JULIE JI (UWA)
uses laboratory and real-world experimental methods to examine the way internal mental landscapes affect our behaviour, with the aim of ameliorating depression.

DR ANDREA RASSELL (UWA)
uses media art to present visualisations of 'invisible' nanomedical technologies, and to engage the public in discussion of these innovative technologies.

DR CATRIONA STEVENS (UWA)
studies migrant workers in the aged care sector and develops practical proposals to better support this workforce and the older Australians for whom they care.

DR MICHAEL WILSON (Curtin)
is constructing predictive models of the way in which workplace stress accumulates over time in order to develop workplace interventions to prevent stress.

↗ Photo by v2osk on Unsplash

RESEARCHER PROFILE

ANDREA RASSELL

Six images reveal how we 'see' data and capture invisible science

As an experimental video-maker working at scales smaller than molecules, I surround myself in a variety of scientific visualisations.

In reading popular media on scientific discoveries, I sometimes encounter claims that a particular scientific visualisation is, in fact, a photograph, for example: "first ever photograph inside a hydrogen atom".

We live in a post-photographic world; a world in which visualisations use different ways of "seeing" data and scientific phenomena.

A photograph is an image made from photons of light reflecting off an object and striking a photosensitive surface such as a film or a digital sensor. Because light carries information relating to shape, texture and colour, photographs are representations (images of the object) that retain some semblance of the original.

However, we live in a post-photographic world; a world in which visualisations use different ways of "seeing" data and scientific phenomena.

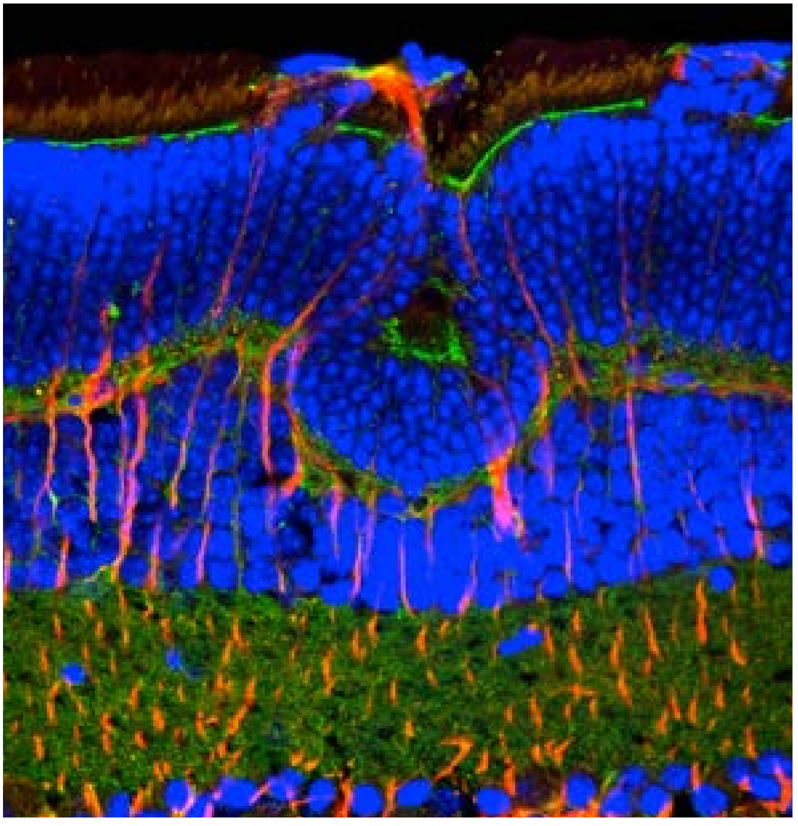
The following visualisations cover a range of scales, from geological to quantum. They were made using techniques that illustrate the vast differences between the processes of photography and scientific visualisation – and in some cases the potential for blending the two.

1. Australia from 700km above Earth

Grayson Cooke is a media artist working with data from satellites in low Earth orbit. These satellites have sensors that record electromagnetic radiation, including ultraviolet, infrared and visible wavelengths of light.

This still image, from Cooke's Open Air project, is made up of multiple frames captured over a year over the Gulf of Carpentaria, and combines infrared and visible wavelengths.

This image can be considered part photograph, because it is partially made using visible light. But it is also part data visualisation, because it utilises invisible infrared radiation, data that has been given the visible quality of colour.



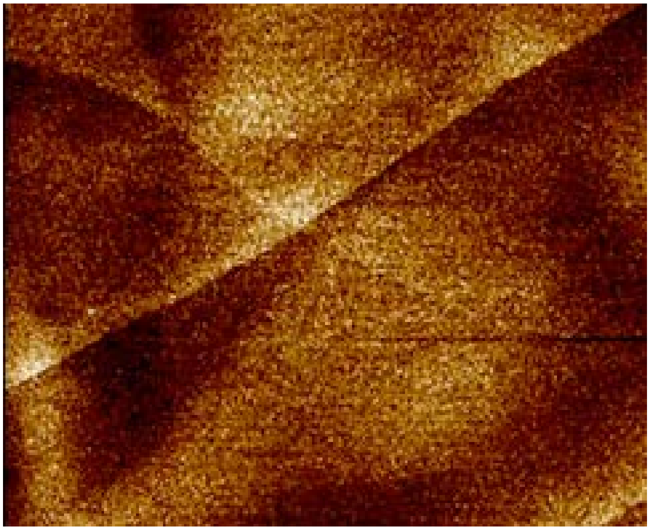
2. Fluorescing rat retina

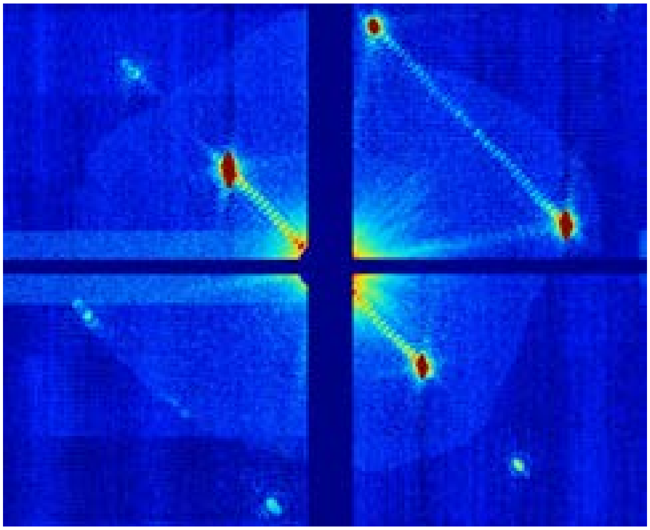
Confocal microscopy is a technique that uses fluorescent dyes — commercially manufactured antibodies with fluorescent molecules attached — to specifically bind to cell and tissue proteins in biological specimens. The fluorescent molecules become visible when they are excited by lasers from the microscope, and can be imaged using a photodetector or a camera.

In this example of a rat retina, different cell-surface proteins have been targeted, and antibodies with coloured molecules have been used to differentiate the types of cell in the retina, revealing the layered structure of the tissue. The image is a photo of fluorescent molecules, but not directly of the tissue itself.

↖
12 months Over the Gulf of Carpentaria. Grayson Cooke, Author provided (no reuse)

On the other side of a molecular divide, digital micrograph (2013) Andrea Rassell, Author provided (no reuse)





3. Graphene under an atomic force microscope

Above is a micrograph of graphene, a substance with multiple layers of carbon lattices stacked like sheets of paper. The image was taken with an atomic force microscope.

Microscopic imaging is traditionally a direct optical image-capture process. Light waves are reflected off an object and amplified via lenses in the microscope, allowing the viewer to directly observe details in a magnified state.

However, this process does not work for phenomena at the nanoscale (a nanometre is one-billionth of a metre). Light waves in the visible spectrum are too large to strike objects under 400 nanometres in size, and therefore cannot be reflected back to be captured by a light microscope.

The atomic force microscope uses an alternative method of detection — a probe that functionally resembles a stylus on a record player, to scan and "feel" its way across a sample.

The sharpness of the probe tip, typically a few nanometres wide, determines the resolution of the micrograph. This allows visualisation of phenomena smaller than anything that could be detected with light.

The spatial data the instrument produces — values corresponding to depth, width and height — are translated via a number of instrumental and computational processes to create the micrographs. This process translates tactile data into visual data.

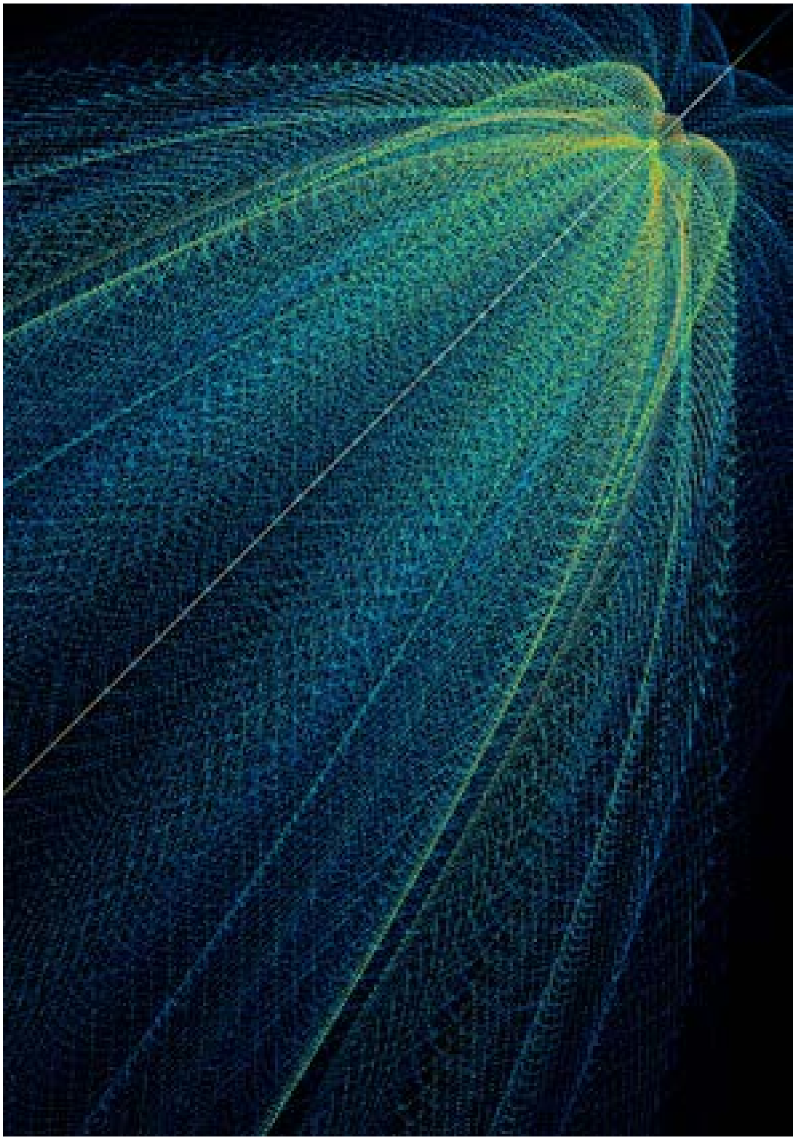
4. X-rays scattered by a protein

X-ray scattering simulations are a common technique for determining the form of a molecule. This example shows a simulation of the X-ray scattering pattern of a protein (known as GroEL), which is about 60,000 atoms (10 nanometres) in diameter.

The X-rays scatter, changing direction depending on their interaction with the atoms in the protein. These atoms may be more or less dense in certain areas.

This type of visualisation is created when a beam of X-rays is directed at a protein sample. The X-rays scatter, changing direction depending on their interaction with the atoms in the protein. These atoms may be more or less dense in certain areas.

The patterns of the X-ray scattering can be measured and reverse-engineered to figure out the structure of the protein that created them. Crystallographers use computational analysis to recover the three-dimensional structure of the protein.



↖
Video still from Movement I: Nanomorphology (2018) Andrea Rassell, Author provided (no reuse)

Nanocrystallography of the GroEL protein (2011) Andrew Martin, Author provided (no reuse)

↗
Fluorobenzene, calculated image (2011) Ula Alexander, Author provided (no reuse)

5. Theoretical images of molecules

This is a calculated image of a fluorobenzene molecule at 25°C.

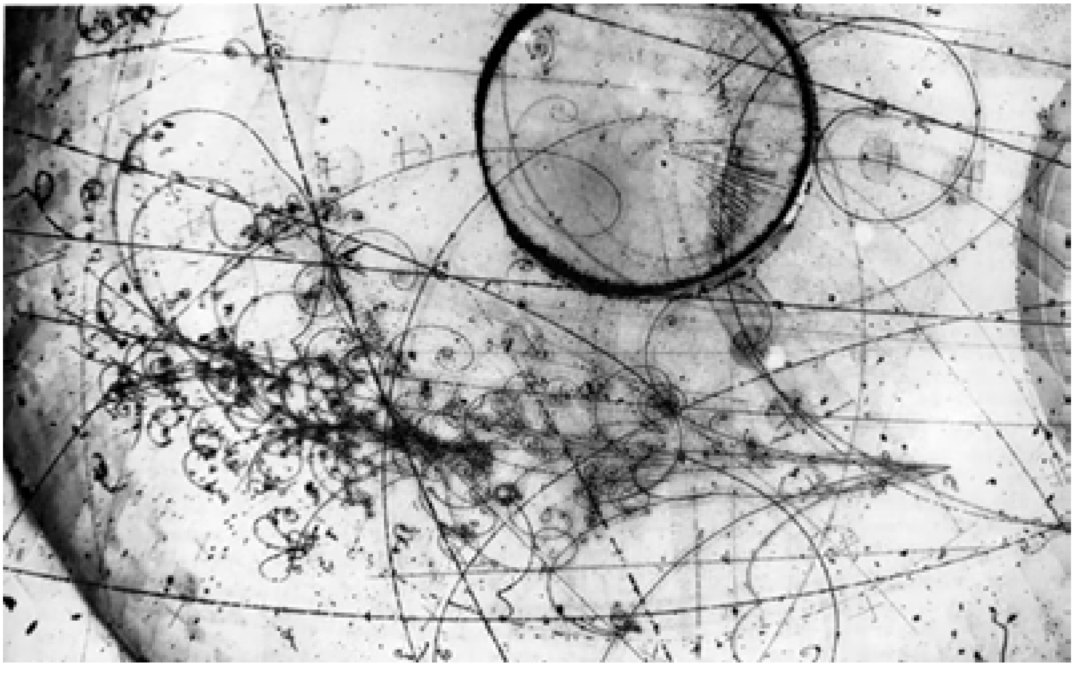
Calculated images are used to determine the changes that occur during a molecule's rotation as it interacts with light. They are made using data from experiments, and the information in the calculation is modified until the calculated pattern matches the experimental one.

The image is a probability map of how likely the molecule is to absorb and emit light, and the artificial colourisation is assigned based on how likely this is. This is dependent on the molecule's shape, the atomic vibration inside the molecule, and the rotation of the molecule in space.

Calculated images are used to determine the changes that occur during a molecule's rotation as it interacts with light.

The image is constructed from a series of horizontal one-dimensional images, which are stacked together to form the two-dimensional pattern. Following the dots in any of these series is like following an energy ladder corresponding to the initial amount of rotation of the molecule.

If the molecules are cold, and therefore not rotating much, these series are short, whereas warmer, faster rotating molecules will create a longer series of dots.



↖ Neutrino interaction in the Fermilab 15-foot Bubble Chamber (1976) Fermilab

6. Bubble pathways of particles

A bubble chamber is a cylinder filled with pressurised liquid that forms bubbles in response to particles moving through it. While the particles themselves cannot be photographed, these paths of bubbles can.

Particle beams flow into the chamber, and the formed bubbles are allowed to grow to about 1mm before flash photographs are taken from multiple angles.

Through looking at how these "images" are constructed, we can see that they are often not really images at all in the traditional sense of the word.

Rather than capturing "how something looks", data visualisation involves translation of a feature into a visual form, or by finding a physical process that can be visualised.

Sitting alongside these images of complex, small-scale scientific phenomena are numerical data, tables, graphical representations and interpretations. And so perhaps it is true that scientific visualisations alone cannot represent what is, but merely give a sense of what is.

Perhaps it is true that scientific visualisations alone cannot represent what is, but merely give a sense of what is.

Dr Andrea Rassell is a filmmaker, media artist and interdisciplinary researcher in science art and a Forrest Foundation Prospect Fellow in the UWA Design School.

This article was originally published in The Conversation.

Our PhD Scholarships

Number of scholars 34

38% MALE
62% FEMALE

Distribution across universities

68% UWA
20% CURTIN
6% MURDOCH
6% ECU

Number of scholarship applications in 2021

84

51% MALE
49% FEMALE

SUCCESS RATE

4.8%

FIELDS OF RESEARCH

Archaeology
Bio-engineering
Biological science
Chemistry
Ecology
Economics
Engineering
Epigenetics
Mathematics
Marine science
Medical science
Neuroscience
Oceanography
Physics
Physiology
Plant science
Population health
Radio-astronomy

SUBJECT AREA OF APPLICATIONS

37% Social sciences and humanities
22% Biological science and ecology
13% Engineering and technology
15% Medical and life sciences
13% Natural sciences

RESEARCHER PROFILE

KEVIN THIELE AND TIM HAMMER

Hibbert's flowers and Hitler's beetle – what do we do when species are named after history's monsters?

↗
Spreading Guinea Flower, Hibbertia procumbens. Lake St Clair, Tasmania Australia, January 2012

Photo: John Tann/ Wikimedia Commons, CC BY 2.0

"What's in a name?", asked Juliet of Romeo. "That which we call a rose by any other name would smell as sweet."

But, as with the Montagues and Capulets, names mean a lot, and can cause a great deal of heartache.

We are taxonomists, which means we name living things. While we've never named a rose, we do discover and name new Australian species of plants and animals – and there are a lot of them!

For each new species we discover, we create and publish a Latin scientific name, following a set of international rules and conventions. The name has two parts: the first part is the genus name (such as Eucalyptus), which describes the group of species to which the new species belongs, and the second part is a species name (such as globulus, thereby making the name Eucalyptus globulus) particular to the new species itself. New species are either added to an existing genus, or occasionally, if they're sufficiently novel, are given their own new genus.

Some scientific names are widely known – arguably none more so than our own, Homo sapiens. And gardeners or nature enthusiasts will be familiar with genus names such as Acacia, Callistemon or Banksia. This all sounds pretty uncontroversial. But as with Shakespeare's star-crossed lovers, history and tradition sometimes present problems.

What's in a name?

Take the genus Hibbertia, the Australian guineaflowers. This is one of the largest genera of plants in Australia, and the one we study. There are many new and yet-unnamed species of Hibbertia, which means new species names are regularly added to this genus.

Many scientific names are derived from a feature of the species or genus being named, such as Eucalyptus, from the Greek for "well-covered" (a reference to the operculum or bud-cap that covers unopened eucalypt flowers). Others honour significant people, either living or dead. Hibbertia is named after a wealthy 19th-century English patron of botany, George Hibbert.

And here's where things stop being straightforward, because Hibbert's wealth came almost entirely from the transatlantic slave trade. He profited from taking slaves from Africa to the New World, selling some and using others on his family's extensive plantations, then transporting slave-produced sugar and cotton back to England.

↘
Anophthalmus hitleri. Michael Munich/ Wikimedia Commons, CC BY-SA

Hibbert was also a prominent member of the British parliament and a staunch opponent of abolition. He and his ilk argued that slavery was economically necessary for England, and even that slaves were better off on the plantations than in their homelands. Even at the time, his views were considered abhorrent by many critics. But despite this, he was handsomely recompensed for his "losses" when Britain finally abolished slavery in 1807.

So, should Hibbert be honoured with the name of a genus of plants, to which new species are still being added today – effectively meaning he is honoured afresh with each new publication?

We don't believe so. Just like statues, buildings, and street or suburb names, we think a reckoning is due for scientific species names that honour people who held views or acted in ways that are deeply dishonourable, highly problematic or truly egregious by modern standards.

Just as Western Australia's King Leopold Range was recently renamed to remove the link to the atrocious Leopold II of Belgium, we would like Hibbertia to bear a more appropriate and less troubling name.

The same goes for the Great Barrier Reef coral Catalaphyllia jardinei, named after Frank Jardine, a brutal dispossessor of Aboriginal people in North Queensland. And, perhaps most astoundingly, the rare Slovenian cave beetle Anophthalmus hitleri, which was named in 1933 in honour of Adolf Hitler.

This name is unfortunate for several reasons: despite being a small, somewhat nondescript, blind beetle, in recent years it has been reportedly pushed to the brink of extinction by Nazi memorabilia enthusiasts. Specimens are even being stolen from museum collections for sale into this lucrative market.

This beetle doesn't deserve to be named after the most reviled figure of the 20th century.

Hibbertia may be just a name, but we believe a different name for this lovely genus of Australian flowers would smell much sweeter.

↗
George Hibbert: big fan of flowers and slaver. Photo: Thomas Lawrence/ Stephen C. Dickson/Wikimedia Commons, CC BY-SA

Aye, there's the rub

Unfortunately, the official rules don't allow us to rename Hibbertia or any other species that has a troubling or inappropriate name. To solve this, we propose a change to the international rules for naming species. Our proposal, if adopted, would establish an international expert committee to decide what do about scientific names that honour inappropriate people or are based on culturally offensive words.

An example of the latter is the many names of plants based on the Latin caffra, the origin of which is a word so offensive to Black Africans that its use is banned in South Africa. Some may argue the scholarly naming of species should remain aloof from social change, and that Hibbert's views on slavery are irrelevant to the classification of Australian flowers. We counter that, just like toppling statues in Bristol Harbour or removing Cecil Rhodes' name from public buildings, renaming things is important and necessary if we are to right history's wrongs.

We believe that science, including taxonomy, must be socially responsible and responsive. Science is embedded in culture rather than housed in ivory towers, and scientists should work for the common good rather than blindly follow tradition. Deeply problematic names pervade science just as they pervade our streets, cities and landscapes.

Hibbertia may be just a name, but we believe a different name for this lovely genus of Australian flowers would smell much sweeter.

Dr Tim Hammer was a Forrest Foundation PhD Scholar at UWA and is now a postdoctoral research fellow at the University of Adelaide and the State Herbarium of South Australia.

Kevin Thiele is Director of Taxonomy Australia and an Adjunct Associate Professor at UWA.

This article was originally published in The Conversation.

Our Postdoctoral Fellowships

Number of fellows 15

66% MALE
33% FEMALE

Distribution across universities:

73% UWA
20% CURTIN
7% MURDOCH

Number of fellowship applications in 2021

172

61% MALE
39% FEMALE

SUCCESS RATE

2.3%

FIELDS OF RESEARCH

Chemistry
Computer science
Earth science
Engineering
Evolutionary biology
Marine physics
Materials science
Psychology
Radio-astronomy
Space science

SUBJECT AREA OF APPLICATIONS

35% Social sciences and humanities
27% Engineering and technology
17% Natural sciences
15% Biological science and ecology
6% Medical and life sciences

Our Prospect Fellowships

Our rapid response to the research funding crisis caused by COVID-19

Number of Prospect Fellows **20**

50% MALE
50% FEMALE

Distribution across universities

80% UWA
15% CURTIN
5% MURDOCH

Number of Prospect Fellowship applications in 2020

78

48% MALE
52% FEMALE

SUCCESS RATE

10.3%

FIELDS OF RESEARCH

Bio-medicine
Ecology
Engineering
Evolutionary biology
Health
Linguistics
Mathematics
Philosophy
Physics
Psychology
Sociology
Visual Arts
Veterinary Science

APPLICATIONS BY RESEARCH AREA

29% Physical and mental health
18% Arts and Culture
15% Environment and natural resources
15% Agriculture food and nutrition
13% Frontier technologies
10% Indian Ocean

Governors

MR ROBERT FRENCH
Chair of Governors

PROF MARK CASSIDY
University of Melbourne

PROF ROBYN OWENS

Chair of Selection Committee

DR ANDREW FORREST
Co-Chair
Minderoo Foundation

DR NICOLA FORREST
Co-Chair
Minderoo Foundation

PROF AMIT CHAKMA
Vice-Chancellor
The University of Western Australia

PROF PAUL JOHNSON
Director
Forrest Research Foundation

PROF EEVA LEINONEN
Vice-Chancellor
Murdoch University

PROF HARLENE HAYNE
Vice-Chancellor
Curtin University

PROF STEVE CHAPMAN
Vice-Chancellor
Edith Cowan University

PROF FRANCIS CAMPBELL
Vice-Chancellor
The University of Notre Dame

Financial Update

The following financial statements reflect the financial performance and position of the Forrest Research Foundation for the period ended 31 December 2021.

Investment returns across the 12 months to 31 December 2021 were the main contributor of the positive performance against budget. These returns were influenced by the continued rebound in economic activity.

Expenditure for the year was well within budget. The pandemic led to the Foundation appointing a smaller than planned cohort of scholars and fellows in 2021, and to delays in the commencement of a number of scholars and fellows.

Forrest Hall occupancy rates and revenue were below planned levels, reflecting the COVID-19 impact on inter-state and international mobility.

The total carrying value of the Foundation financial assets as at 31 December 2021 was $75 million, of which 98% is invested in the long-term pool. The total carrying value of property, plant and equipment as at 31 December 2021 was $27 million.

Income Statement
for the period ended 31 December 2021

	2020 Actual	2021 Budget	2021 Actual
	$	$	$
INCOME			
Funds from Minderoo Foundation	6,500,000	6,500,000	6,500,000
Forrest Hall – Student Accommodation Rental **(a)**	651,904	770,595	619,681
Forrest Hall – Short-stay Rental **(a)**	136,942	252,300	66,949
Investments Income **(b)**	3,085,522	4,018,555	10,384,454
Other	219,760	-	75, 578
TOTAL INCOME	**10,594, 127**	**11,541,450**	**17,646,661**
EXPENDITURE			
Forrest Research Scholarships **(c)**	599,202	910,409	569,054
Forrest Foundation Fellowships **(c)**	1,295,462	1,487,468	886,176
Forrest Foundation – Prospect Fellowships **(c)**	-	1,500,000	1,174,020
Salaries	357,889	365,282	353,268
Marketing	10,296	73,000	4,770
Operating Costs	142,180	252,500	236,217
Forrest Hall – Expenses **(d)**	354,980	330,883	308,982
TOTAL EXPENDITURE	**2,760,009**	**4,919,542**	**3,532,487**
OPERATING RESULT BEFORE DEPRECIATION	7,834,119	6,621,908	14,114,175
Depreciation expense	840,870	876,631	832,295
OPERATING RESULT AFTER DEPRECIATION	**6,993,248**	**5,745,277**	**13,281,879**

Notes

a) Forrest Hall occupancy and rental income was below budget owing to WA border closures preventing the arrival of out-of-state scholars, fellows and visitors.
b) Accrued investment income is based on the mark-to-market of investment portfolios as at 31 December 2021. The long-term pool net investment earning rate in 2021 was +16.72%; the short-term pool distribution rate was 1.0%.
c) Scholarship and Fellowship expenditure was below budget owing to WA border closures delaying the commencement of a number of scholars and fellows.
d) The Forrest Hall operating model has adopted a 'whole of life' approach to managing the building. 45 per cent of the income flows to manage the facility and pay all associated operating costs. The residual income available to the Foundation is allocated to a building sinking fund.

Statement of Financial Position
as at 31 December 2021

	2020	2021
	$	**$**
ASSETS		
Current assets		
Cash and cash equivalents	2,515,733	1,458,192
TOTAL CURRENT ASSETS	2,515,733	1,458,192
NON-CURRENT ASSETS		
Other financial assets	60,132,799	74,203,157
Property, plant and equipment **(a)**	28,300,118	27,174,653
TOTAL NON-CURRENT ASSETS	88,432,917	101,377,810
TOTAL ASSETS	**90,948,650**	**102,863,002**
EQUITY		
Reserves **(b)**	1,379,798	2,012,320
Retained earnings	89,568,852	102,218,209
TOTAL EQUITY	**90,948,650**	**104,230,529**

Notes

a) Depreciation is based on a 2% reducing balance for buildings and 5% straight line for fixtures and fittings.

b) The reserves represent 55% of Forrest Hall total revenue set aside to cover future capital maintenance.

FORREST
RESEARCH
FOUNDATION

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