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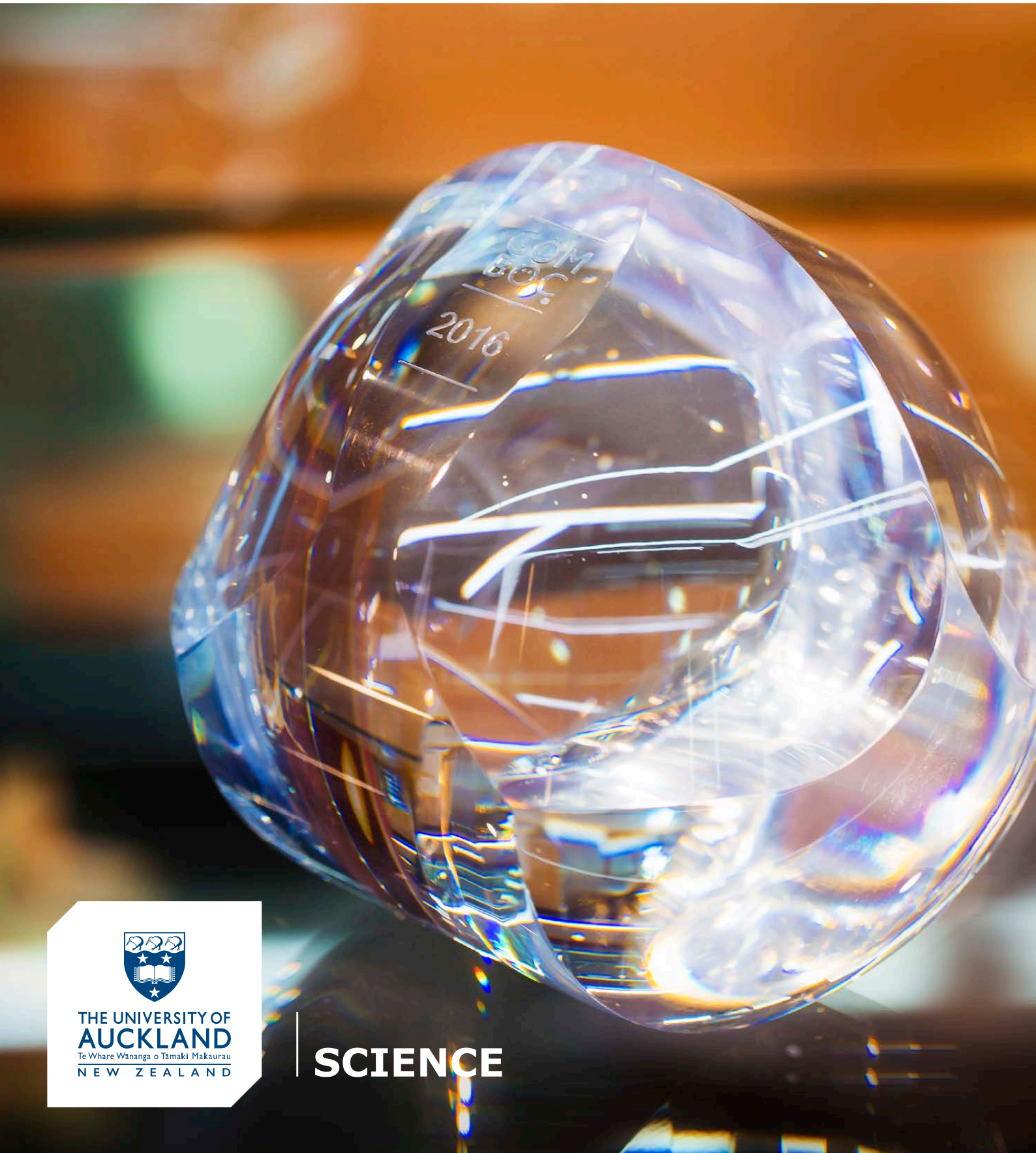
In this issue



THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE

InSCight

The University of Auckland Faculty of Science Alumni Magazine 2017

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If you are a Faculty of Science graduate and have a story to tell about your experiences or achievements, or would simply like to re-establish contact, please get in touch.

We also welcome feedback and suggestions about this publication. If there's something you would like to see in the next issue, don't hesitate to contact us.

InSCIght is available electronically – please email us if you would prefer to receive the magazine in this format.

Contact: science-marketing@auckland.ac.nz

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Cover page photo: The Gömböc, a mathematical shape that retains its unique equilibrium no matter which way it is positioned. See Community links, pages 26-29, for more information about the Gömböc.

A word from the Dean

Another year has gone by. This time last year, we had occupied the new Science Centre and had just put the ink on a new ten-year academic plan. This year has been about starting the implementation of that plan.

A major focus has been an overhaul of our flagship Bachelor of Science (BSc) degree, which has stood the test of time, but now requires some updating. This has included trimming back and simplifying the majors, incorporating new graduate attributes into the majors, and making pathways clearer.

Along the way, this will make it easier to do double majors and conjoint degrees. Like Arts, we have also introduced modules – three paper sequences in specific topic areas, aimed at broadening our students' experience, and adding a capstone course to each major.

The changes reflect much of the feedback I've had from our alumni about the breadth of our BSc being one of its strengths – that is, that it provides more of a 'world view' of science than equivalent qualifications from other universities.

In addition, we are introducing a new four-year integrated honours degree providing a pathway to PhD study for those who are sure of their direction.

These changes will be rolled out from 2019 and will ensure that we continue to have significant global impact by educating close to 8,000 students through modern, fit-for-purpose Science qualifications.

Another focus has been a new research strategy, which aims to break down the barriers between discipline silos within the faculty and beyond – providing more of an emphasis on the sort of multi-disciplinarity needed to solve many of the world's more complex problems.

This approach is exemplified in the launch of three new science research centres in 2017, the George Mason Centre for the Natural Environment, Te Ao Mārama - Centre for Fundamental Inquiry and the Cyber Security Foundry. All three bring together researchers from different disciplines and faculties to solve real challenges – whether it is restoring our unique natural environment, developing more secure and resilient cyber security systems, or asking the big questions about the origins of life.

Along with the focus on strategic direction, we continue to undertake excellence research that has genuine impact. Several examples are highlighted in this edition of InSCight, including Kerry Gibson's work on how young people give and receive support on social media, Renate Meyer's contributions to the discovery of gravitational waves, and Rod Dunbar's work on engineered skin. I hope you will also be intrigued by Andrew Jeffs' novel approach to altering the taste of beer by using sound during fermentation, Laura Domigan's use of proteins from fish eyes to help corneal transplants, Karen Fisher's efforts to restore the Waipā River, and Nick Rattenbury's work in astrophysics.

PROFESSOR JOHN HOSKING
Dean of Science, the University of Auckland

Our campus

The Faculty of Science is undergoing exciting and significant development with the opening of our new Science Centre in 2016 and the ongoing transformation of the City and Newmarket Campuses.

Can we still call our Science Centre new? It's hard to believe it's been over a year since the Faculty of Science welcomed the opening of our flagship building.

The multi-disciplinary space, purpose-built to better connect the set of buildings which make up the main teaching hub for the faculty, has transformed our facilities and created a home for our students and staff alike.

The world-class design not only houses well-appointed undergraduate and postgraduate laboratories, break-out spaces, and teaching and computer labs, but the ground floor plaza, too: a central point for our students to socialise and catch up on work (and the occasional snooze!) while waiting for lectures to begin.

Alongside extensive renovations to the Thomas Building, which houses the School of Biological Sciences, and the creation of the Gateway Building on Symonds Street that will also house the School of Biological Sciences, the transformation of facilities is ongoing with the imminent completion of the Newmarket Campus Building 907.

Since the University's acquisition of the 5.2ha former Lion Breweries site in 2013, the Department of Exercise Sciences has been preparing to relocate from the Tāmaki Campus, currently pegged for early 2018.

Artistic impression of Building 907, Newmarket Campus.

It will be the first time that the whole department will be located in one building at one location.

Head of Department Associate Professor Greg Anson is looking forward to Science sharing the campus with the Faculty of Engineering and contributing to the "development of the campus."

"There is naturally some nostalgia for my time at the Tāmaki Campus," says Greg. "But it is outweighed by the excitement of moving to a new facility that the whole department has had a hand in designing."

Greg has high praise for his colleagues who contributed to the design, alongside external project teams at BECA Engineering, Jazmax Architects and contractors LT McGuinness.

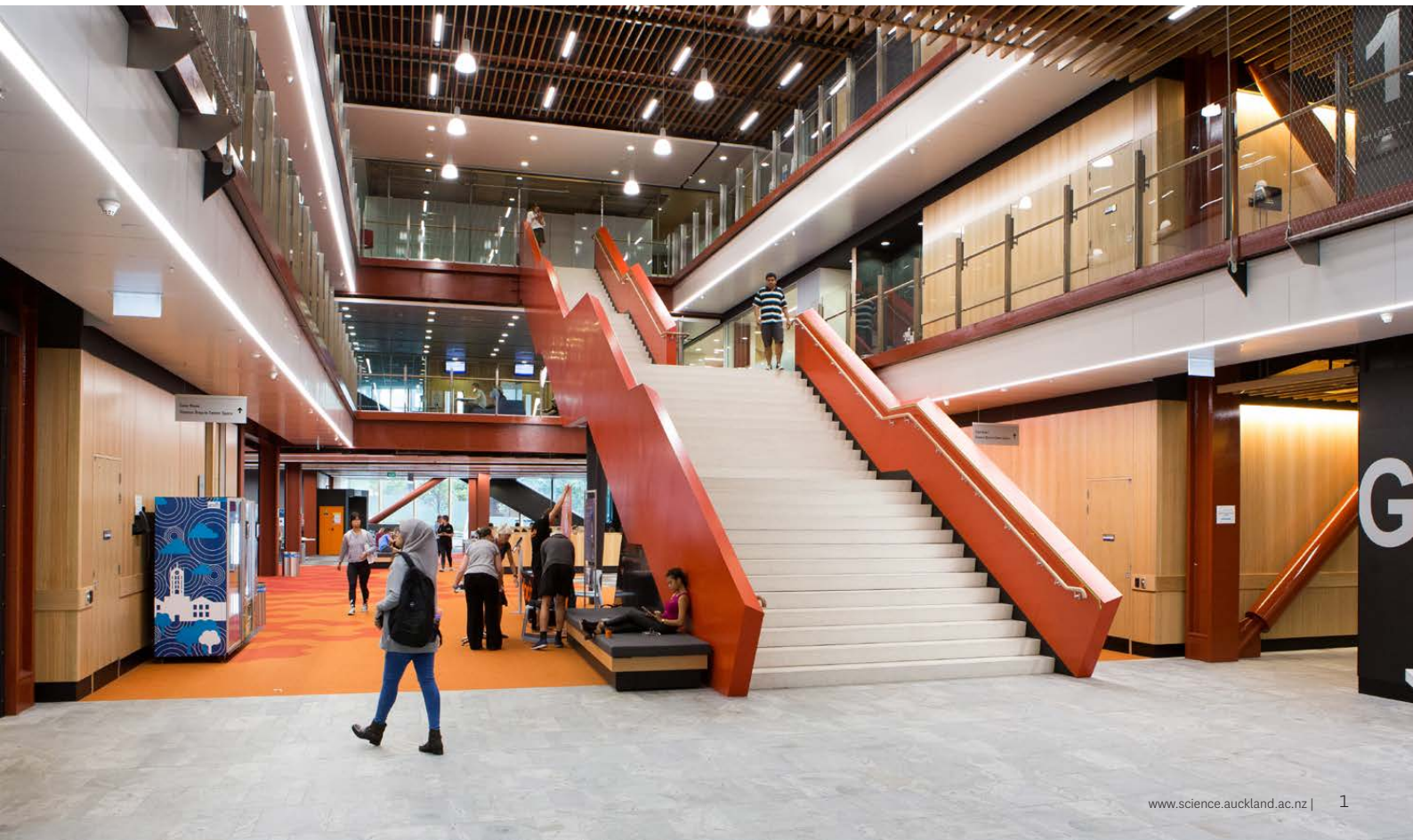
The comprehensive refit of Building 907 includes an administration office, research laboratories, clinic, changing rooms, technical support spaces and a meeting room on the ground floor. A large mezzanine will accommodate the undergraduate teaching laboratory, staff offices, common room, and postgraduate student work stations. Dedicated car parking for clinic clients and bicycle storage (with e-bike charging facility) will be provided on site. Level surfaces to the ground floor will assist clinic clients' access to the building.

As well as the obvious advantages, such as closer proximity to the City Campus, the development of new facilities at the new location has enabled purpose-built laboratories for fundamental, applied and clinical research, including a brand new exercise chamber with temperature and humidity regulation, that can be fitted out with a treadmill or bicycle for aerobic exercise assessment or set up for cognitive testing.

Building 907 has a fascinating and unique history. It started life as the Taupo Totara Timber Company and was fitted out as the stables for the Shire horses that pulled the beer cart, servicing a number of taverns in Auckland. Its future is that of an integrated component of the Newmarket Campus, encompassing a fit-for-purpose, cutting-edge home base for the Department of Exercise Sciences.

With the Science Centre at the helm, New Zealand's leading and largest Faculty of Science* has even more amazing facilities to match its reputation.

***science.auckland.ac.nz/excellence**



Gift launches environment centre

Eighty-six-year-old alumnus Dr George Mason, of Taranaki, who holds a bachelors and masters degree in botany and an honorary doctorate from the University of Auckland, as well as a PhD from the University of California Davis, gifted $5 million towards the launch of a new environment research centre, through the University of Auckland Campaign For All Our Futures.

The George Mason Centre for the Natural Environment officially launched in July and fulfils a lifetime ambition for Dr Mason.

The Centre's focus is on protection and conservation of New Zealand's wildlife and natural land and seascapes. It aims to build connections and collaboration across the University by producing new, independent research on the restoration of species, habitat and ecosystems.

"Dr Mason's gift is transformational. It allows us to address some of the country's significant conservation and environmental issues in a multi-disciplinary manner and do research not previously possible," says Professor John Hosking, Dean of Science.

The initial funding round awarded more than $1 million to three University of Auckland-based environmental research projects, as a first step to providing solutions to the complex problems caused by multiple environmental pressures.

Building public understanding of ecosystems

Reaching communities and individuals with accurate and solution-focused messages about natural ecosystems is challenging. Traditional reporting tends to focus on discrete events, personalities, or on controversy and conflict, which can generate a "spirit of cynicism," turning people away from engagement.

Dr Maria Armoudian, Department of Politics and International Relations, is leading this interdisciplinary project, which combines science with the art of communication to advance research into ecological education and engagement.

"We are reaching a crisis point when it comes to the sustainability and conservation of our rich marine ecosystems," she says.

"This project intends using a broad approach to engage the public in understanding complex marine ecological issues and possible solutions.

"With skills and resources drawn from six University of Auckland research units, we can test different media products, including a documentary, to find the best ways of communicating the realities of our marine ecosystems."

Maria says they plan to publish the results and follow up with workshops for scientists, journalists, community leaders and policy makers. The ultimate goal is to improve the public's understanding of ecosystems and generate support for sustainable environmental policies and solutions, beginning with marine ecosystems.

Plastic pollution and solutions

A growing body of work has shown that plastic pollution is a well recognised threat to marine systems. Much less is known about the impact on freshwater as no one has put the two systems together in a robust way before.

Associate Professor Kevin Simon, School of Environment, and Dr Gavin Lear, School of Biological Sciences, believe there is good reason to do so – rivers deliver waste to the coastline and from there out to sea.

Recent surveys of streams have found an abundance of microplastic pollution and the presence of bacteria able to digest certain kinds of plastics and associated chemicals.

This project will use the inner Hauraki Gulf as a model system to investigate the impact of microplastics and associated chemicals that leach from plastic products and how bacteria interacting with degraded plastics can be tracked as they journey down waterways into the ocean.

"Our goal is to identify sources and pathways of plastic pollution and to develop novel microbiological techniques to reduce microplastic pollution in our waterways and maximise the degradation of plastics and plastic additives in our natural environments," Kevin and Gavin say.

From hilltops to the ocean

Land use intensification, particularly agricultural, is significantly increasing sediment, nutrient, and organic matter loads to freshwater and coastal ecosystems.

Recent research suggests there may be a tipping point where muddiness exceeds a critical level, significantly affecting denitrification (the microbial conversion of bioavailable nitrogen into inert N2 gas) in estuaries.

Dr Luitgard Schwendenmann from the School of Environment says sediment and nutrient input may lead to the loss of marine vegetation, such as seagrasses and kelp forests.

"This decreases the capacity of our coastal ecosystems to act as carbon reservoirs and significantly impacts kai moana, particularly shellfish beds," she says.

"Our project will look at the cascading effects of land use change on carbon and nutrient cycling in freshwater and coastal ecosystems around the Hauraki Gulf, the role of natural ecosystems in mitigating negative effects and the potential for enhancement through restoration of our estuarine and coastal ecosystems."

The goal is to provide practical new research and techniques that communities can use to increase the successful restoration of seagrasses, kelp forests and, ultimately, shellfish beds.

In addition, the George Mason Centre for the Natural Environment has established an important partnership with Foundation North's Gulf Innovation Fund Together (G.I.F.T). The partnership draws on the respective strengths of the two organisations to support positive environmental change.

Foundation North's G.I.F.T. fund has generously provided a grant of $150,000 for the hilltop to oceans ecosystem services and mitigating impacts project. The grant will contribute to the development of techniques for the restoration of shellfish species.

Read more about the George Mason Centre for the Natural Environment
www.science.auckland.ac.nz/gmcne

Watch our video and support the work of the Centre
www.auckland.ac.nz/natural-environment

Te Pūnaha Matatini – 'the meeting place of many faces' – is a Centre of Research Excellence hosted by the University of Auckland that will develop methods and approaches for transforming complex data about New Zealand's environment, economy, and society into knowledge, tools, and insight for making better decisions. The centre is a novel and exciting collaboration that brings together experts from the academic research community, industry, and government to develop the methods and tools that will transform that data into knowledge, providing insight for businesses, government, and communities.

Isabelle Sin and the gender pay gap

Dr Isabelle Sin and her co-authors found that women in New Zealand's workforce are paid 84 cents for every dollar a man earns (on average), despite there being no significant difference in level of productivity between male and female workers.

"This study is different to most previous wage gap studies in that it tests whether men and women are paid different wages for adding the same amount of value to their employer," says Dr Sin.

The researchers analysed New Zealand tax data for 50 percent of the working population from 2001 to 2011, to determine how much of the overall difference between women and men's pay could be attributed to women being employed in industries that pay less.

"We found that women were over-represented in low-paying industries like food and beverage services, but this explains a mere seven percent of the entire gender wage gap," Dr Sin says. "If you add in the fact that women also tend to work in low-paying firms, we can say that 12 percent of the overall gender wage gap is due to the particular industries and firms where women work."

The study then looked at productivity and wages of New Zealand men and women in private, for-profit organisations with five or more employees. Using employee-level data linked to business information, they found that on average, Kiwi women are paid 16 percent less than their male counterparts for making a contribution of the same value to their employer.

"To put it simply, our research suggests sexism is likely to be a major driver of the gender wage gap. What we're going to do about it is another matter."

Overall, the data suggest that sexism is a drag on large segments of New Zealand's economy, with the gender wage-productivity gap as high as 40 percent in some sectors – in finance and insurance, telecommunications, transport equipment manufacturing, water and air transport, electricity, gas and water, and rail.

"It's worth noting that these are all sectors that have the potential for monopoly-created profits and have low competition," says Dr Sin. "To put it simply, our research suggests sexism is likely to be a major driver of the gender wage gap. What we're going to do about it is another matter."

Professor Tava Olsen from the University of Auckland, Director at the New Zealand Centre for Supply Chain Management and Deputy Director, Industry and Stakeholder Engagement at Te Pūnaha Matatini, described the results as "pretty definitive".

"There is a gap and [because the study researchers] were able to get firm-level data on productivity, there's really no explanation for it other than implicit bias or sexism," says Professor Olsen.

She added that the Motu research is a lot harder to ignore than previous studies due to its sheer size and the nature or quality of the data collected.

"It's not until you get a really big study like this that you can say 'Oh yes, there is actually a problem here.' Obviously, this isn't the first study to show gender pay gaps, it's just a very clean one in terms of the data they got access to," she says. "I doubt there are many countries who allow researchers access to their tax data… If you think about it, it's pretty phenomenal.

"So I think this is quite important research in terms of showing there is a real gap. There is a problem here and it's not really okay," says Professor Olsen.

"Hopefully, companies will start putting procedures in place to check themselves and try and start looking at their own gender gaps."

About Isabelle Sin

Dr Isabelle Sin has been a highly valued member of Te Pūnaha Matatini since joining the centre as a founding principal investigator in 2013. She holds a PhD in Economics from Stanford University, California and is a Fellow at Motu Research in Wellington.

"My Te Pūnaha Matatini collaborations challenge me to think more broadly about the questions I might ask in my research, and the methodologies I might use to answer them. Plus it's always an inspiration to be surrounded by a lot of passionate researchers with such diverse ideas."

"It's not until you get a really big study like this that you can say 'Oh yes, there is actually a problem here.' Obviously, this isn't the first study to show gender pay gaps, it's just a very clean one in terms of the data they got access to,"

Reference

Sin I., Stillman S., Fabling R. (August 2017). What drives the gender wage gap? Examining the roles of sorting, productivity differences, and discrimination. Motu Working Paper 17-15 Motu Economic and Public Policy Research.

Since 2002 the Maurice Wilkins Centre for Molecular Biodiscovery, a Centre of Research Excellence hosted by the University of Auckland, has been harnessing New Zealand's biomedical expertise to target serious human disease. The Centre brings together scientists from across New Zealand to research cancer, diabetes and metabolic disease, infectious disease and integrative biomedical technologies. To read about one of the Centre's current innovative researchers, head to page 18.

Promoting connectivity, sustainability and visibility across the faculty: our senior leadership team reflects on a positive 2017

This year, our Kaiārahi and Associate Deans for Equity and Sustainability have been busy developing and implementing some exciting new initiatives, including a smartphone app for our Tuākana students, an innovative interdisciplinary teaching module, and a fund dedicated to small-scale faculty equity projects.

Faculty of Science Sustainability Network – Niki Harré, Associate Dean Sustainability

"Sustainability – the promotion of human and ecological flourishing – is sometimes referred to as a 'wicked' or 'messy' problem. We do not all agree on the solution, let alone how to achieve it. Wicked problems need attention from multiple perspectives.

"So here, in the Faculty of Science, we have a Sustainability Network. Our network is not a 'top down' policy or plan, it is a group of staff who care about 'flourishing people and thriving ecosystems' and the role our University can play in creating these.

"We share the same values, but our approaches and projects are diverse. Our Sustainable Laboratories project includes technical managers from across the faculty who are working towards practices that save water, energy and other resources. We have installed compost bins in all the kitchens in the Science Centre. And we have bought a number of indoor plants to bring a little nature into our work places.

"For the past three semesters, we have been teaching a unit on the global clothing industry that operates across courses in Psychology, Chemistry and Sociology. The students learn about the social and environmental effects of the clothing industry in their primary discipline, and then teach what they have learnt to students from one of the other courses.

"So here, in the Faculty of Science, we have a Sustainability Network. Our network is not a 'top down' policy or plan, it is a group of staff who care about 'flourishing people and thriving ecosystems' and the role our university can play in creating these.

"Twice a year we have a public seminar on a sustainability issue that features Faculty of Science speakers as well as a guest speaker from the community. Staying with the theme of our teaching project, our seminar in October this year was on clothes – their chemistry, the conditions of international workers and workers in New Zealand retail outlets, and the dilemma faced by fashion designers who want to make items that look and feel great, and are ethically produced.

"Our other public seminars have examined waste, water, transport and sustainable systems. We also take our role as a 'critic and conscience' of society seriously – commenting on both public issues, such as climate change policy, and on University issues, such as facilities for cyclists and engaging suppliers with a demonstrable history of care for environmental and social issues.

"Our network has made progress, but we have much further to go. We'd like to develop a partnership with students and help to open up democratic processes that facilitate student involvement in the creation of a more sustainable University.

"There are many clubs such as Fossil Free UoA, Generation Zero, Engineers Without Borders, Plastic Diet and The Sustainability Network, that are full of students who are eager to contribute. We'd like to help nurture them as active, concerned citizens that can help shape our collective future."

Find out more about the Sustainability Network, and watch short videos on their recent work www.science.auckland.ac.nz/sustainability-network

Onwards and upwards: Promoting equity in Science – Virginia Braun, Associate Dean Equity

"If you're a glass-half-empty kind of person, working for equity presents optimism challenges. Progress towards change can be slow, and occasionally you find yourself making the same argument, again and again. So in a context where it won't all happen overnight, it's important to reflect on the 'wins' along the way.

"I'm delighted that, as a faculty, we have established the Equity Initiative Grant fund. We funded our first five projects this year.

There are many factors that contribute to making workplaces and learning environments spaces where people of different identities and backgrounds feel they belong, are supported, and can flourish.

"This year's funded projects are intended to gather information and knowledge that can build towards positive equity change, tackle a key challenge within their area, or build support to foster participation.

"One project, based in the School of Environment, aims to explore the question of conference participation – a key component in academic work-life – asking what factors impede, and what factors can enable, conference participation in minority or marginalised groups. Watch this space for their report.

"Another project addresses the question of gender within Computer Science – one of the departments which has lower than average numbers of academic women staff. Being good empiricists, the people working on this project recognise that sound knowledge around gender and computer science is important, and it seeks information from students and staff. It is primarily a data-gathering and analysis activity, with the subsequent aim of building towards change.

"One factor in 'belonging' is visibility. The classic equity adage 'if you can't see it, you can't be it' captures the importance of visibility for what we imagine is possible, and where we see ourselves as not just belonging, but sometimes even as just entitled to be.

"Women academics remain a minority across the faculty (as are Māori and all other equity groups) and so, this year, we've been working on creating a strong, visible, diverse face of women in science, through our Women in Science webpages.

"Resources like this show potential students that they could belong; they highlight the multiple perspectives we bring to the faculty; and they provide a virtual connection to peers we might never realise we have."

Read more about the Equity Initiative Grant and view the Women in Science webpages www.science.auckland.ac.nz/equity

Tuākana in Science – Michael Steedman, Faculty of Science Kaiārahi

"This year, the development of the Tuākana app was a major step forward in utilising an alternative – yet still familiar – medium to connect with our Māori and Pacific students in the Faculty of Science.

"The main purpose of the Tuākana in Science app is to provide information to the Māori and Pacific Science students about Tuākana tutorial timetables, Tuākana tutor and mentor contact details in each of the departments and schools, as well as updates on relevant events and stories to maximise the student experience.

"We wanted to move into to a space and connect with our students in ways they are familiar with, so an app made absolute sense. We actually had this idea a few years ago but, with the steady increase of smartphone use and other devices, we wanted to find a way of occupying that space and tailor something that meets student needs and those of our programme, too.

"As of September the app had over 400 downloads which, for its pilot year, is really exciting, and puts it in a great position for review at the end of the year.

"Two new apps are being scoped for development in 2018. One will focus on postgraduate Māori and Pacific Science students, and the other will function as Tuākana in Science Outreach.

"The Outreach app will have a core function of connecting with potential students in secondary schools, and will also give Māori and Pacific students an idea of what University life is like, as well as exposing them to the Tuākana in Science Programme."

Learn more about the Tuākana in Science Programme www.science.auckland.ac.nz/tuakana

Keira is focused on her task in this experiment

How do dogs think? Clever canines and comparative psychology

Evolutionary psychologist Dr Alex Taylor reckons he has one of the best jobs in the world. "I mean, who wouldn't want to work with dogs all day?" he laughs.

The director of the School of Psychology's recently established Clever Canine Lab has always been fascinated by animals, but it was during his undergraduate studies at the University of Oxford that Alex realised he could combine his love of animals with his interest in history and evolution.

"I read a paper by a Brazilian biologist who was observing butterflies in the field while running a complicated and intellectually challenging experiment on evolution and I thought, 'That's basically my dream job: to work on big questions in evolution, be mentally stimulated, and at the same time work with animals'," he recalls.

A Brit hailing from Bolton in the north of England, Alex's journey to Auckland begins in the basement of the Biology department at Oxford.

"One of the professors brought over some New Caledonian crows and housed them in the basement. Betty the crow had bent a piece of wire into a hook and I saw the talk where this research was first presented," Alex remembers, "I was really interested in animal behaviour at the time and everyone was excited about it – Richard Dawkins was there, asking a million questions! – there was a real buzz around the research, and the species."

But Alex didn't want to study a smart species in a basement at Oxford. He wanted to work with the Auckland team who had been the first to discover complex tool use in the New Caledonian crows (Professor Russell Gray and Dr Gavin Hunt), so he took up a Commonwealth Scholarship to study for his PhD in Psychology at the University of Auckland.

A keen kiteboarder and surfer, Alex loves Auckland for its proximity to the ocean. "Here, I'm able to have an outdoors lifestyle while also doing cool science in an environment that feels really supportive," he enthuses.

While the New Caledonian crows have been Alex's mainstay, he has also worked with everybody's favourite alpine parrot, the cute 'n' curious kea. "Kea climb all over you, pulling your hair, grabbing your watch and camera. They are adorable, but they are a challenge! I feel really privileged to be working with them," he says.

A step from crows to kea is logical, but a leap from birds to dogs? "I've always wanted to work with dogs – what's going through their brains has always been a big mystery to me," he explains, "and I also wanted to do research based in Auckland, to make it easier to involve undergraduate students."

And so the Clever Canine Lab was born. Alex was honoured as a Rutherford Discovery Fellow in 2014 and, while his fellowship has supported the Lab, it has mostly been "a lot of hard work by my fantastic PhD students Patrick Neilands, Amalia Bastos and Rebecca Hassall, and my honours student Ivy Ren," he says.

The Clever Canine Lab is exploring how dogs think, with a view to gaining a deeper understanding of the evolution of intelligence. The researchers play fun games with the dogs, and focus on the social bonds with their owners.

Compared to his work with birds, Alex's dog research gives him the luxury to spend time refining his methodology. "We had 400 dog owners register within the first three weeks, so we can run much bigger studies with a greater number of subjects," he explains, "and it is a lot less stressful than the crows and kea, where there are a limited number of subjects and a short field season."

Alex says that when he's trying to understand how an animal thinks, he starts with an evolutionary reason why a particular ability might have evolved. "We know that dogs have been co-evolving alongside us for a long time, so we think about what might have given dogs an advantage when interacting with humans."

One of the most intriguing experiments is the 'detour problem' – that is, whether or not a dog judges an object as something to fear, by questioning why their owner might avoid it. The dogs in this study seem to treat the object as more threatening if they see their owner make a detour around it.

"It's very early days and we still have more data to collect, but if this result continues it'll suggest that dogs view humans as agents that make rational decisions about dangers to avoid," says Alex.

These results also lead on to the 'throwing experiment', where dogs need to assess whether humans are competent at particular actions, such as throwing or kicking a ball: "It's all part of a suite of computations about social agents, which is really underexplored in comparative psychology," he explains.

Alex says that, while some of the results are influencing the direction of the experiments, plans often change and the team are flexible when they observe anecdotal results in their subjects. "I've become really interested in this idea of dog emotions, particularly secondary emotions such as jealousy and guilt.

"I hadn't anticipated how engaged the dogs' owners would be, so I thought it would be really fun to run experiments around things that they really care about – people want to know if their dog really gets jealous, or if it feels guilt, and this area hasn't had a lot of attention so far in the scientific community."

From his work with birds Alex learnt the importance of science communication – that is, engaging people with science that's easy to relate to and generates enthusiasm.

L-R: Dr Alex Taylor, doctoral students Rebecca Hassall, Amalia Bastos and Patrick Neilands, and clever canines Kai and Keira

He believes there is value in finding out how dogs think and communicating this to the public. "We're reminded of the connections we have with our pets – and to nature – and it's great to give people a way to understand how socially sensitive their animals are," Alex explains.

The team are also talking to assistance dog groups about how their research can be applied in those settings, with potential to affect the way guide dogs and mobility dogs are trained. "Right now we're asking dogs to make fairly simple assessments of human competence, but if we give them the right experiences then maybe they can start making more sophisticated inferences about the agents around them – it could help speed up training, take training further, or even train breeds for specific purposes."

The team work with a variety of breeds at the lab and although remaining diplomatic, Alex says that others in this field have told him that Border Collies are where it's at – "I've been joking about making it just a Border Collie lab!" he laughs. "But really, the types of tasks that a Border Collie has to do [when herding stock] require more independent thought than other breeds. It has to make judgements every second, and be able to predict what a sheep might do next, for example. I think there's good reason to expect them to be slightly better than other breeds at a lot of tasks requiring social intelligence."

While he has collaborated with colleagues on previous projects, Alex says the Clever Canine Lab is a chance to flex his independent research muscles: "As a young researcher, once you've shown that you can do good research with others, you have to show that you can do good research on your own. The Lab gives me the opportunity to do just that.

"Having said that, we are planning work with Dr Ian Kirk, and others in the School of Psychology, to use EEG headbands to record the dogs' brain activity while they're doing some of our experiments," he says.

In the future, Alex foresees the owners being more involved in the studies, by giving them homework training tasks to work on with their pets. "We want to involve the community and the owners as much as possible. Getting owners to train their dogs before a study is a great way to do that while also running some really exciting science," he enthuses.

The Clever Canine Lab team are passionate about the future of their field, in terms of the impact and application of their research. "Humans have run a grand, unplanned experiment on dogs since they've been domesticated – we've selected them for various attributes, and there have been lots of other traits that have come in along the way," says Alex, "Over the next 30 years or so we'll begin to see the results of that experiment – it's really exciting."

www.clevercaninelab.auckland.ac.nz

Punk, politics and tipping points: Why don't we take collective action against injustice?

In a world where inequality and injustice are rife, and at a time when politics is the topic on almost everyone's tongue, Dr Danny Osborne is examining why we don't do more – collectively – to redress unfairness. And he's been awarded the inaugural Royal Society Te Apārangi Early Career Research Award in Social Sciences for his efforts.

Social psychologist Dr Osborne has a specific interest in political psychology. By his own admission, Danny's path into academia was non-traditional. He was, however, a bit of a "rabble-rouser" and heavily into the punk music scene. "It was really music that awakened my socio-political consciousness," he says.

"The bands I listen to talk about things like Marxism, police brutality, gender inequality, homophobia, racism, and so on.

"Music showed me that the injustices I saw in my local community were present across the globe."

Dr Osborne was inspired to pick up a pile of books as well as a guitar, and he began to read about the topics his favourite bands were writing about. "When I was applying to do my PhD, I only applied to places where I could get a degree in political psychology. The rest is history!"

In particular, Danny's research is focused on New Zealanders' beliefs about our ability to change social policy or influence contemporary socio-economic conditions, and he is interested in understanding the psychological barriers to collective action; in other words, when a situation is unfair, why don't we protest more?

"Inequality and injustice around the world show no signs of abating and, in fact, it could be argued are actually on the rise," Dr Osborne says.

"Some of my current work indicates that we do not react to injustice as frequently as most models of collective action would suggest."

Danny's research has revealed that collective action to redress inequality actually challenges some of our most basic psychological tendencies. He says that by blaming individuals for their experiences rather than the systems and structures that enable inequalities, we're defending the status quo.

"It feels so natural to blame the individual, but we really have to fight this urge and ask ourselves, 'What kind of society would allow – and even revere – someone who drives a $300,000 car, when there are people starving on the streets?'"

The most surprising thing that Dr Osborne has found is that people's beliefs about their power to change the system can undermine their support for collective action – because by believing they can change things for the better, they are implicitly endorsing the idea that society is fair.

According to Danny, a metaphorical 'suggestion box' is a powerful thing: "Sometimes those in power can provide the illusion that they are listening to our concerns. Just the mere suggestion that we are being listened to – even if we know that we cannot influence the outcome – will decrease our motivation to protest." So much for the fairness of the office feedback box!

Dr Osborne says that his work reveals just how difficult it is for people to get to the point where they think 'enough is enough'. "People do eventually reach a tipping point – sometimes all it takes is for one person to stand up and say they've had enough."

And our emotional reaction to injustice is key: "People can perceive that their group has been mistreated, but if that perception elicits fear instead of anger, people will retreat from social protest," explains Danny. "Once we overcome these barriers, then we can identify the 'tipping point'."

As well as his close collaboration with Professor Chris Sibley on the New Zealand Attitudes and Values Study (a longitudinal study examining changes in New Zealanders' attitudes to a range of social and economic issues over time), Dr Osborne is an advisory board member of the Vote Compass project, an online voter education tool available during the previous two general elections.

New Zealand is no stranger to political protests, and, while some of us may be surprised at the outcome of our recent General Election, no one is taking collective action. Dr Osborne believes that, on the whole, MMP is fair and "allows for an arguably more diverse discourse than is afforded by FPP voting systems" and he is hopeful about the future of New Zealand.

"I'm hopeful that we have a progressive Government who is committed to fighting inequality, has a strong plan for tertiary education and who is on the side of environmental protection."

When asked what individuals can do in the face of injustice, Dr Osborne says that although most of his work focuses on how groups can work together to create change, individual efforts can – and often do – feed into collective action.

"Easy things like voting for the candidate or party who best reflects your own views of what a fair society should look like is one important step we can all make.

"The day-to-day decisions that we, as individuals, make can have a huge impact. In the long run, choosing to take public transport, buying local and so on really can improve our local surroundings and make the world a better place."

From Most Valuable Player in his high school football team (yes, really!) to the New Zealand Attitudes and Values Study and Vote Compass, Dr Osborne's growing list of projects and accolades shows no sign of slowing down.

In 2016, Danny received the Faculty of Science Dean's Award for Sustained Excellence in Teaching and, in 2015, he received the Early Career Research Excellence Award from the University of Auckland. In 2015, he also received the Early Career Research Excellence Award from the Society of Australasian Social Psychologists, and gave a keynote lecture at its 2015 conference – we're sure it was music to the delegates' ears!

While Dr Osborne would advise his younger self against applying to join the US Air Force ("That [advice] would have saved a lot of grief!"), he recommends reading more books on statistics and political psychology: "You can never know enough!" he says.

"I'm delighted and honoured to receive this inaugural award and the support it provides for my work, helping to increase our understanding of how we might make the world a fairer, more equitable place."

Life as it could be

What is life? How did it come to exist and how does its intelligence differ from that of computers? Dr Matthew Egbert's research into Artificial Life lies at the interface between philosophy and science, attempting to address some of our biggest questions.

Matthew is based in the south wing of Building 303 at the Science Centre, situated on Auckland's tree-lined Symonds Street. Nestled amongst the other computational sciences, and across the road from the philosophy department where he can often be found, the locale is most appropriate for Matthew, whose passion is collaborative, interdisciplinary research. "Computer Science is well suited to being a hub in interdisciplinary research because you can build a computer model of just about any system – you just have to figure out *which* model to build."

Rather than focusing on making computers solve problems and 'be smart' like his counterparts in the field of artificial intelligence (AI), Matthew is interested in fundamental questions concerning the mind and life, and the relationship between the two. As such, he affiliates with the artificial life research community. Although connected to artificial intelligence, the goals and motivations are different.

"We look at life and take inspiration from it to create an artificial system that is life-like in some way. We then study the artificial system to learn about the biological phenomenon that inspired it."

Recently, Matthew was awarded a Fast Start Marsden Grant for his research that will explore the role behaviour played in facilitating the very earliest stages of life's evolution. For this body of research, Matthew is thinking about life as a dissipative structure; a concept from physics used to describe systems that use energy to maintain their highly ordered or organised state.

"I use computer simulations and real-world experiments to investigate dissipative structures such as whirlpools or self-propelled oil-droplets," says Matthew. "These systems demonstrate fascinating, life-like forms of primitive self-preservation where they move toward environments that have the energy they need to persist and improve their chances of survival."

Matthew's research aims to find out if this kind of behaviour enabled the actual origins of life. Because these dissipative structures are quite simple, evolution is not required to explain how they came to be. But despite their simplicity, they perform life-like behaviours that prolong their survival. Matthew wonders if this ability will help to explain a gap he sees in most modern explanations of the origin of life.

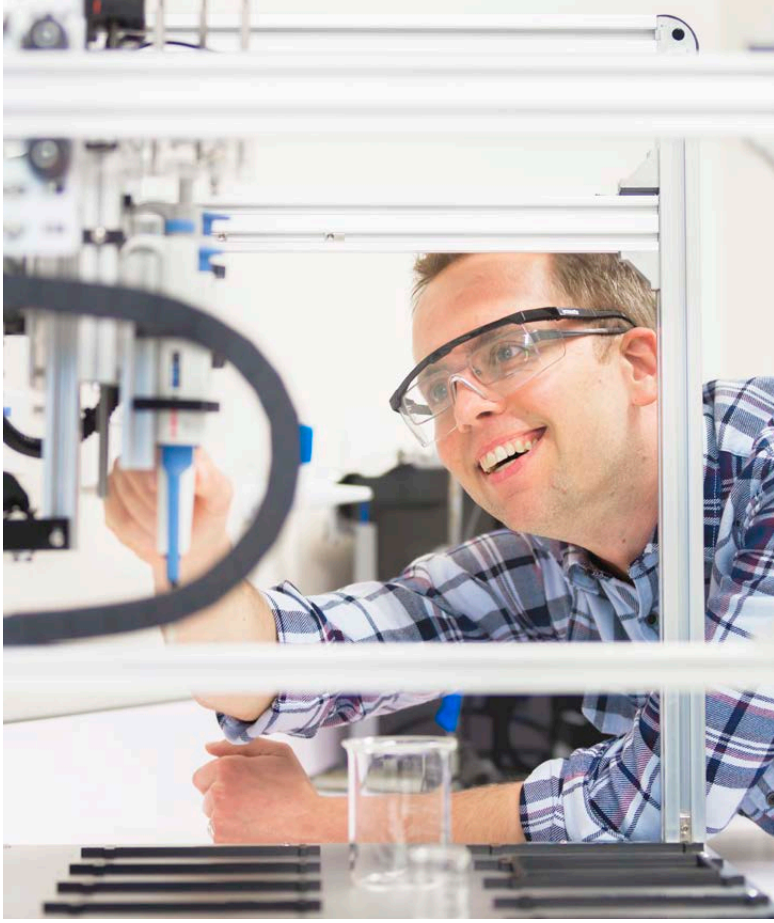
"The common assumption is, to get life going all that you need is some evolving chemistry, molecules that divide, replicate and evolve, and so on, and that Darwinian evolution will create increasingly complex life. Fast forward a few million years and you will then have us!" he says. "But we still don't understand a major transition where evolving *chemistry* developed into integrated, behaving *organisms*."

For this reason, Matthew's approach is to consider dissipative structures as the first proto-organisms, and to investigate ways to make them increasingly evolvable. The explanatory gap between evolving chemistry and evolving organisms is side-stepped by starting with organism-like behaving entities in the first place.

As part of the artificial life community, he is impressed with the breadth of the topics at the conferences and workshops he attends. The diversity of topics include evolution, neural networks, and complex systems of all different kinds. The many different approaches by different disciplines to understand life is, he says, "phenomenal."

In order to be a successful scientist in the world of artificial life, Matthew believes that being a good science communicator is key. "You've got to learn a lot and understand the basics in each different area and be able to communicate your ideas clearly," explains Matthew.

In a second ongoing project, Matthew is collaborating with researchers and students in the Department of Mathematics, who are helping to analyse an artificially evolved neural network in an effort to understand the role of lag or delay in natural nervous systems.



Dr Matthew Egbert uses an OpenTrons robot to investigate the relationship between dissipative structures (such as whirlpools and self-propelled oil-droplets) and the origins of life.

"In the brain, things are going on all at the same time, everything is overlapping everything else, and it is really complicated and messy. In addition there are substantial delays in the amount of time it takes a signal to get from A to B. This is different than in computers, where engineers use synchronizing clock signals and other techniques to eliminate the effects of lag."

To better understand the role of lag in natural nervous systems, Matthew has simulated a "very simple robot" with only one neuron. The neuron has a recurrent and delayed connection to itself, where its output is fed back into the input, but with a delay.

"I used artificial evolution, also known as a genetic algorithm, to tune that one neuron to control a robot to solve a really simple task," says Matthew. "The robot is placed in an environment where there are two stimuli, a target stimulus and distractor stimulus, and it has to move through its environment to find its target stimulus and stay there. And I know, because it only has this very simple, one neuron brain that the only way it's going to be able to solve this problem is to somehow take advantage of its lagged recurrent connection. The artificial evolution has worked – we have the robot solving the problem, and now we are working on understanding *how* the problem is being solved."

Subsequently, Matthew is mindful that people are so "awestruck" by what the brain is, that we use the latest and greatest technology as a metaphor for essentially describing what the brain does. But there is something really different between computers and us and that is our cognitive skills.

"All the time people are comparing brains to computers. For instance people will talk about 'having their wires crossed.' It's ultimately an unfortunate way to perceive ourselves because if you're 'wired wrong,' well then you're just out of luck – there's nothing that can be done. But we are not computers! There are things that we can do well – for instance natural language – that remain essentially impossible for computers," Matthew enthuses. "I hope to find new ways to think about what cognition is – new non-computational ways – to think about what we are and how we work."

In May 2017, the Department of Computer Science held the annual Gibbons Memorial Lecture Series, titled 'Steps towards the singularity: Artificial intelligence and its impact'. The series was a great success, very well attended and drew a significant online audience. Watch the lectures www.cs.auckland.ac.nz/gibbons-lectures

Meet a small selection of our 2017 doctoral graduates

Charlotte Connell – PhD in Exercise Sciences

Charlotte's doctoral research provides new insight into how caffeine affects the brain, and could be useful not just for sport, but also for reducing injury risk in occupational settings involving long-durations of taxing, physical work.

Charlotte is passionate about fitness and can list completion of four full marathons by the age of 24 to her achievements.

The next stage of Charlotte's career is an exciting one as she moves to New York to pursue further post-doctoral training in data science. She also has her eye on one of the world's most famous marathons.

"I've always wanted to run the New York marathon and now that I'm moving there it's a real possibility so I'm really excited about that."

Of Ngāti Uenuku descent, Charlotte says the support she received through the University's Tuākana programme, aimed at enhancing academic success for Māori and Pacific students, has been invaluable in helping her achieve her goals.

Charlotte Connell (centre) with her parents

Francesca Casu and husband Davide Zazzaro

Francesca Casu, PhD in Microbiology from the School of Biological Sciences, and husband Davide Zazzaro, PhD in Marine Biology from the Institute of Marine Science

Husband and wife Davide and Francesca joke they do everything together so it's no surprise that today they graduate from the University of Auckland's Faculty of Science with matching doctorates.

The pair left their home in Italy in 2011 to come to New Zealand as international students.

The couple, who are the same age and have birthdays within a few days of each other, raised their four-year-old daughter while studying.

"We had our daughter during our PhDs and shared the experience of working weekends and nights and caring for her as we studied," Francesca says.

Francesca now works as a Hazards and Containment Advisor and Laser Safety Officer at the University of Auckland's School of Biological Sciences while Davide also works for the school, as Plant Facilities Manager.

Both love New Zealand and are happy they have made their life here.

Josie Galbraith – PhD in Ecology

Josie's research involved an investigation into the effects of backyard bird feeding on native and introduced birds including whether our habit of throwing bread on the back lawn helps spread disease.

It was one of the first studies in the world to look at the science of bird feeding. The study findings – including the fact that New Zealanders feed wild birds more than five million loaves of bread each year – were published in top international science journals and generated media coverage around the world.

But the countless hours spent in the field capturing and screening wild birds was particularly tough for Josie, who suffers from a rare form of peripheral neuropathy. The condition means she has difficulty completing everyday tasks, has ongoing loss of motor function and some sensory loss in her hands and feet.

She credits a large support network with helping her get through.

"I was just very lucky to have a huge amount of support from a small army of volunteers, including my fellow postgraduate students and also my research supervisors and disability support services," she says.

When Tom met Malfoy

In his efforts to champion some of our least-loved insects, School of Biological Sciences doctoral student Tom Saunders has scientifically described a species of native wasp and named it after a character from the Harry Potter series.

Malfoy the wasp

"I used the name *Lusius malfoyi* because Malfoy is a character with a bad reputation who is ultimately redeemed and I'm trying to redeem the reputation of our native wasps," he says.

Unlike their introduced cousins, New Zealand's native parasitoid wasps do not sting and do not live in colonies. There are thought to be 3,000 endemic species in New Zealand, of which only around a third are known to science.

Tom worked on improving methods for wasp capture during his masters degree because, he says, we may be unaware that we're losing endemic species in New Zealand.

"The big problem is lack of data; we do not know what species we have, how many there might be or what their host species are, so they can't be included in conservation planning," Tom explains, "If we don't put more resources into their taxonomy, we could be in danger of losing wasp species without even knowing it."

A right royal surprise for Brendon

In June this year Brendon Blue, a doctoral student in the School of Environment, was recognised by the Royal Geographical Society in London as a leading new researcher in the field of geography.

He received the Wiley Publisher's Area Prize for New Research in Geography, for his paper entitled 'But what do you measure? Prospects for a constructive critical physical geography', which explores possibilities for more socially-sensitive river science and management.

"I received the Area Prize with real surprise and delight. I would like to thank my colleagues in Geography for encouraging and supporting my diverse and interdisciplinary interests," Brendon says.

The Society said of Brendon's article: "This is an excellent agenda-setting paper that explores how geomorphic knowledge is manufactured and mobilised. Using the example of river diversity and measurement, it makes the case for a 'constructive critical physical geography' that develops rigorous, place-based and democratic understandings of landscapes."

Eliza's got the Blues

Pole vaulting sensation Eliza McCartney, who is completing a Bachelor of Science majoring in Physiology, won the Sportswoman of the Year Award for her incredible achievement at the 2016 Olympic Games in Rio, claiming a bronze medal for New Zealand. She also won the Most Meritorious Performance (Sport) category at the Blues Awards 2017.

Despite the demands of her sport Eliza is still enrolled part-time at the University, completing one Science course a semester. "It's really important to have something else, outside of your sole focus, because it can get quite intense. A huge congratulations to everybody else, and a huge thank you to the University, especially the Faculty of Science, for all of their help," she says.

While a Blues Award has traditionally been a sporting accolade, there are now three categories of the award at the University of Auckland: Sports, Arts and Cultural, and Service and Leadership. Science students were awarded one Arts and Cultural Blue, six Service and Leadership Blues, and 22 Sports Blues.

Keane for a Curry? The VC certainly was!

Congratulations to the Department of Mathematics' PhD students Sean Curry and Andrew Keane, who won the Vice-Chancellor's Prize for Best Doctoral Thesis 2016.

Sean received the prize for his thesis 'Submanifolds in conformal and CR-manifolds and applications'. Sean resolved many open problems with how to treat submanifold structures in his thesis. In particular, he found a new and very effective way to identify the 'fingerprint' of the geometry.

Andrew was awarded for his thesis entitled 'A dynamical systems approach to understanding the interplay between delayed feedback and seasonal forcing in the El Niño Southern Oscillation'. Andrew introduced advanced mathematical techniques to provide fundamental insights; for example, he demonstrated that the unpredictable nature of El Niño events does not require external stochastic input.

Sean and Andrew received a certificate and a monetary prize at the Celebrating Research Excellence reception in May, and their achievement is recorded on their academic transcripts.

Other Science nominees were Cory Toth and Josie Galbraith from the School of Biological Sciences, and Mozhgan Memari from the Department of Computer Science.

Three minutes to be 'nosey'

Science students were well represented at the annual University of Auckland 3 Minute Thesis competition, held in August.

Akshat Shah from the School of Psychology was named masters winner for his thesis entitled 'Nosey speech: Effectiveness of a workshop to improve community speech language therapists' ability to assess and provide appropriate intervention for children with cleft palate speech disorders.'

Akshat, who is also a speech-language therapist, went on to compete in the inter-university 3 Minute Thesis competition at Victoria University Wellington.

Science students Nina Novikova from the School of Chemical Sciences and Sarah Leadley from the School of Psychology were judged as finalists in the doctoral thesis category.

Congratulations to Akshat, Nina and Sarah!

Supporting our students

Established in 2010, the Science Student Support Fund is intended to ensure a greater number of talented and deserving students who are experiencing financial hardship have the opportunity to fulfil their academic goals.

This year, the Fund is enabling new Faculty of Science Student Support Awards designed to help Science students in financial hardship. Any Science student may apply for an Award – more than once if they need to – and there are two opportunities per year to make an application.

Previously this money provided a single masters scholarship, but the faculty decided to prioritise the support of a larger group of deserving students, rather than one student biennially. The first application round was in August, with the panel receiving over 70 applications for a total of seven awards to be allocated.

The faculty would like an even greater number of students to benefit from the Science Student Support Fund. If you would like to learn more about the Fund, or discuss how you can help to support Science students, please contact Kiri-Ann Olney, Development Manager k.olney@auckland.ac.nz.

Problem-solving, pits of success, and improving the R environment

Sometimes, when he arrives to give a talk and the equipment isn't fit for purpose, Statistics and Computer Science alumnus Hadley Wickham is tempted to write a rider that describes – in minute detail – how he wants everything set up. "It would also demand a bowl of M&Ms with all the brown ones removed, Van Halen-style," jokes Hadley.

This rigorous attention to detail and passion is what makes a data scientist of his calibre acquire the nickname 'the Rock star of R' – for his commitment to bringing an understanding of data science to the masses.

For the uninitiated, R is a statistical programming language developed by Department of Statistics academics Ross Ihaka and Robert Gentleman in the early 1990s, and now used by the majority of the world's practising statisticians.

In his role as Chief Scientist for RStudio (an integrated development environment for R), Hadley works with his team to "make R a better environment for doing data science", and to develop new, open source R packages that solve particular problems. He also helps people learn to use R most effectively, in order to make sense of data.

Data is one of the greatest resources of the 21st century; however, many people are baffled by the volume, variety and complexity of 'big data' that is collected about all aspects of our lives and the world around us, every single day. We're fortunate, then, that Hadley is here to help us out.

"Better than 'big data' I like the term 'too big data'. Too big data is when your data gets big enough that you can no longer handle it with your current tools. For most people, this is not very big: as soon as you have thousands of observations you usually need to learn some new tools (like R) to help work out what's going on.

"It's incredibly important to be data literate so that you can understand what data is being collected about you, and how that's being used to drive important decisions.

"If you read the newspaper or watch TV, you hear a lot about machine learning and AI [artificial intelligence] like they're these magic wands that make problems go away. But the reality is that it's very easy for these tools to amplify existing biases and inequalities," explains Hadley.

As a passionate data science communicator and educator (he teaches in-person workshops at RStudio and speaks at conferences worldwide), Hadley hopes to see the field become more accessible for newcomers, through "better tools and better teaching."

Hadley's own education took a few twists and turns: "In high school I wanted to be a genetic engineer and it seemed like the best way to do that was to become a doctor first!" So he began a Bachelor of Human Biology at the University of Auckland, before switching to a Bachelor of Science majoring in Statistics and Computer Science. "I didn't really enjoy medicine, so I went back to what I enjoyed in high school: statistics and programming."

A love of the problem-solving nature of statistics led Hadley to complete his masters at the University of Auckland before travelling to the United States to take up a PhD at Iowa State University.

"What I particularly enjoyed at the Department of Statistics at the University of Auckland was that it was grounded in real problems – and real problems require programming, which I also enjoyed. I was lucky enough to learn R very early in my statistics career, and it has formed the foundation of pretty much everything I've done since then," says Hadley.

And "since then" quite a bit has happened – following his PhD Hadley worked at Rice University as an assistant professor of statistics for four years, before joining RStudio as its Chief Scientist. This year, he can also add 'Adjunct Professor of Statistics at the University of Auckland' to his admirable list of achievements. A keen foodie, baker and cocktail maker, Hadley is now based in Houston, Texas, but visits New Zealand as often as he can.

"One of the things I love about where I live now is that I'm just a couple of blocks away from a 7500 square metre liquor store where I can get any cocktail ingredient I need.

"The thing I miss most about New Zealand is the food – there is so much good food – and coffee! – everywhere," he says.

Hadley returned to the Faculty of Science for a fleeting visit in March this year, when he was invited to deliver a keynote address at the Department of Statistics' inaugural Ihaka Lecture series.

He is also a generous donor to the Department of Statistics, as part of a wider appeal to extend the reach and impact of the department's work in statistical computing by establishing a Centre for Advanced Data Science. The Centre will lay the foundations for future initiatives that will develop a rich environment of learning, discovery and innovation.

Hadley imagines the future of his field as full of "pits of success". He explains, "It's not like a peak of success, which you have to strive to climb to; rather, it's something that you can fall into – almost by accident."

While the 'Rock star of R' has no immediate plans to ditch the data science for the life of an on-the-road musician, he's no stranger to the (mosh!)pit of creativity and innovation ("I spend most of my time writing, either R code or English prose") and he's a fan of Forrest yoga, an intense, internally focused practice.

"My work is all about trying to dig to that 'pit' by developing new ways of looking at data science problems and then providing code tools to bring ideas to life."

We're hoping Hadley will bring his ideas for data science-themed cocktails with him when he next visits the University – we've been promised a mixology session and expect a Tibbleoni (Negroni + tibbles, a way of storing data in R) to be on the menu.

We're sure, too, that he'll continue to make the mysteries of big data seem surmountable.

IHAKA
LECTURES

In March 2017 the Department of Statistics launched the inaugural Ihaka Lecture Series, titled *Statistical Computing in the Data Age*. Named after Associate Professor Ross Ihaka (co-creator of statistical programming language R) in honour of his contribution to the field of statistical computing, the series was a great success.

For more information about the series, and to watch the 2017 lectures, visit **www.stat.auckland.ac.nz/ihaka-lectures**

A good grounding

When asked how a background in science supports Alanna Simpson's international role in natural disaster protection she is unwavering in her response, "it is key" says the talented scientist, who has been in her role as a Senior Disaster Risk Management Specialist at the World Bank Group for the past six years.

"I might have studied geology (at University) but I now have to be proficient with at least the basics of physics, engineering, meteorology, mathematical modelling, psychology, policy, finance and economics to do my job," she says. "The ability to learn science sets you up to learn anything."

With a Bachelor of Science majoring in Geology (2001) from the University of Auckland and a PhD in Geoscience (2006) from the University of Queensland, Alanna believes science is an excellent foundation for life. However, her journey with science began with humble beginnings.

Born and raised in Levin, Alanna didn't even take any science subjects in Year 11 and 12 at school because, she says, "the science teachers were terrible". However, Alanna realised she could "do science" while originally exploring an arts degree majoring in physical geography and choosing an elective course in geology.

"University science isn't like school science. I caught up on all the chemistry I'd missed in school and I fell in love with the scientific approach of asking questions and finding answers to those questions," she enthuses. "Just because you don't do well in science at school doesn't mean you can't do it at University."

Alanna remembers her time at the University of Auckland fondly, mostly because of her lecturers' obvious passion for what they were teaching. In particular, Associate Professor Ian Smith and esteemed Professor Warwick Prebble (1975-2011), whose old school methods and "hair-raising" field trips are legendary to Alanna and her fellow students.

"A few of us were doing field work around the Orakei Korako geothermal park, and to understand the origin of the cave there, we went off the tourist routes. At one point the 'crust' of ground above the geothermal springs was so thin, Warwick had us climbing from one tree to another tree to get around. He was doing it too – lecturers leading from the front!"

Another fond memory of her time at University, being taught by Warwick, is from Alanna's first job at Geotek Services. She was asked to explore a clay seam on a new subdivision near Auckland to assess the possibly of future landslides.

"My manager had organised an excavator on site and asked me if I knew what to do. I said sure, because I remember Warwick explaining in class how he had done it in the past with photos. My manager came to visit me on site and saw me going up and down the giant hole in the excavator basket to check the walls of the hole for clay. Well, suffice to say he almost had a heart attack – apparently the typical process is to check the soil as it comes out – not to get into the basket. But I was following Warwick's photos and, besides, I definitely had the best view of the problem."

The support from the University of Auckland didn't end when she left to pursue her PhD, as "I often bumped into Ian at scientific conferences and he always introduced me to well-known academics and helped me network."

Although Alanna isn't so hands on in terms of actual geology anymore, she is very proud of the job she loves and the ability to use her science skill set to enable citizens and governments to take the necessary actions to safeguard people's lives.

"University science isn't like school science. I caught up on all the chemistry I'd missed in school and I fell in love with the scientific approach of asking questions and finding answers to those questions," she says. "Just because you don't do well in science at school doesn't mean you can't do it at University."

Nowadays based in America at the World Bank Group's Washington DC office, Alanna, who has three young daughters, spends a large chunk of her time calculating risk through disaster risk modelling. She ensures that there is the right scientific and engineering evidence at the right time for the right person to convince them to invest precious resources in safe earthquake resistant schools for children, or early warning systems for flood management. But she still loves science, just last weekend she had a blast making chemical volcanoes with her seven-year-old daughter... just for fun.

"If you ask my eldest daughter what I do when I go to work (she came once to a 'bring your child to work day'), she will say I talk A LOT!" says Alanna.

Family is a huge motivation for Alanna, who grew up listening to her grandparents' memories of surviving the devastating 1931 Napier earthquake. At Alanna's twelfth birthday party, the look of terror on her grandfather's face as he ran from the house during the 1990 Dannevirke earthquake has stayed with Alanna throughout her career.

"I really believe in what we are doing at the World Bank Group. Disasters cause immediate trauma and hardship, but also cause long-term psychological impacts, as I saw with my grandfather. And in the poorest and most vulnerable countries, too often we see children are taken out of school, nutrition is cut, selling of scarce assets and so on, to cope with disaster losses."

Although it may look like Alanna's academic and career trajectory has been very well planned and smooth sailing, it is her passion for science that has led the way.

"When I did my PhD I worried about a focus on pure research, and my brother told me that I could always come and milk cows with him, even with my fancy degree," she jokes. "My advice to students is: consider how your undergraduate degree could lead to a career, follow your passion and interest and be open enough to consider that you might end up with a career that you never dreamed of."

Even though Alanna's day job means her focus is on disaster risk prevention, geology is a strong foundation for how she views the world.

"The best part of geology is that no matter where I travel, I am endlessly entertained by the landscapes out the window of the plane, car, or train. With geology, my mind is always trying to figure out what the rocks are, what the geological process was – classic 'armchair geology' –, but I am certainly never bored."

Staff awards and distinctions

Marsden funding

Professor Richard Easther (Department of Physics)
Ultralight dark matter: Dynamics and astrophysics
$910,000

Associate Professor Rachel Fewster (Department of Statistics)
Cells and whistles: Supercharging our biodiversity monitoring toolkit using genetic and acoustic records
$680,000

Associate Professor Nickola Overall (School of Psychology)
Conflict recovery in families: Why inevitable conflict does not have to be detrimental
$840,000

Professor Anthony Poole (School of Biological Sciences)
Rewiring life: Using synthetic biology and experimental evolution to unravel the evolutionary origins of DNA
$850,000

Dr Matthew Egbert (Department of Computer Science)
Behaviour before evolution? A transdisciplinary investigation into the role of self-preserving behaviour at the origin of life
$300,000

Professor Christian Hartinger (School of Chemical Sciences)
Blossoming of bioinspired supramolecular architectures: Towards applications in catalysis, drug delivery and materials science
$910,000

Associate Professor Igor Klep (Department of Mathematics)
Free analysis and its applications
$455,000

Associate Professor Claire Postlethwaite (Department of Mathematics)
Noisy networks: Understanding how stochasticity affects mathematical models of cognitive systems
$545,000

Dr Kristal Cain (School of Biological Sciences)
The heart of song: Understanding the origins of vocal learning using New Zealand's missing link, the titipounamu or rifleman
$300,000

Professor Joanna Putterill (School of Biological Sciences)
Functional analysis of MtING2 – Uncovering an independent mechanism for control of flowering by winter cold
$895,000

Associate Professor Quentin Atkinson (School of Psychology)
Political gaming: Using economic games to explore the foundations of political ideology
$835,000

Pedram Hekmati (Department of Mathematics)
Exploiting gauge theory and duality in geometry
$300,000

Professor Kathleen Campbell (School of Environment)
Some liked it hot: Searching for early life in terrestrial hot springs
$958,000

Ministry of Business, Innovation and Employment (MBIE) funding

- Research led by Photon Factory founder **Professor Cather Simpson** from the University's School of Chemical Sciences and Department of Physics attracted funding of more than $12,802,791 for two projects.
- Research led by **Professor Andrew Jeffs** from the Institute of Marine Science received $999,998.
- $1 million for research led by **Senior Lecturer Geoff Willmott** from the Department of Physics who will explore improving the process for producing milk powder.
- School of Biological Sciences Research Fellow **Dr Kim Handley** will investigate how microbial processes influence groundwater quality.
- **Professor Joel Baker** from the School of Environment has been awarded $999,823 to develop a new tool for detecting and dating earthquakes in New Zealand's distant past.
- School of Biological Sciences Research Fellow **Dr Laura Domigan's** project to develop a new surgical adhesive formulated from proteins received funding of $977,236.
- **Professor Jadranka Travas-Sejdic** and Professor David Williams from the School of Chemistry received $869,315 to develop a new method to selectively extract metastatic cancer cells from blood.

Royal Society Fellows

- **Professor Margaret Wetherell** (School of Psychology)
- **Professor Jadranka Travas-Sejdic** (School of Chemical Sciences)

Rutherford Discovery Fellowship

- **Dr Emma Carroll,** a PhD graduate and post-doctoral fellow from the School of Biological Sciences, has been awarded a 2017 Rutherford Discovery Fellowship.

Royal Society inaugural award

Dr Danny Osborne has won the inaugural Royal Society Te Apārangi Early Career Research Award in Social Sciences.

Royal Society James Cook Fellowship

Associate Professor Stéphane Coen from the Department of Physics and optical physics group has been awarded the James Cook Fellowship from the Royal Society Te Apārangi.

New Zealand Association of Scientists medal

This year's New Zealand Association of Scientists Beatrice Hill Tinsley Medal is awarded to **Professor Christian Hartinger** ffrom the School of Chemical Sciences and the Maurice Wilkins Centre for Molecular Biodiscovery.

New professors

- **Suzanne Barker-Collo** (School of Psychology)
- **Virginia Braun** (School of Psychology)
- **Sebastian Link** (Department of Computer Science)
- **Christopher Sibley** (School of Psychology)
- **Cather Simpson** (School of Chemical Sciences and Department of Physics)
- **Mary Sewell** (School of Biological Sciences)

New heads of department

- **Professor Suzanne Purdy** (School of Psychology)
- **Professor James Curran** (Department of Statistics)

Marine Science Lifetime Achievement Award

Associate Professor Mark Costello from the Institute of Marine Science has been awarded the highly prestigious New Zealand Marine Science Lifetime Achievement Award.

Templeton Religion Trust grant

Professor Chris Sibley from the School of Psychology has been awarded a $4.6 million grant from the Templeton Religion Trust to support and expand the New Zealand Attitudes and Values Study (NZAVS). The grant is shared with Chris' long-time collaborator and co-PI Professor Joseph Bulbulia from the Faculty of Humanities and Social Sciences at Victoria University of Wellington.

Research Excellence Awards

- **Professor Cather Simpson** (School of Chemical Sciences and Department of Physics)
- **Dr Danny Osborne** (School of Psychology)
- **Dr Gabriel Verret** (Department of Mathematics)

Vice-Chancellor's Excellence Awards

Alistair Mead, Pooja Yadav, Roger van Ryn, Tony Chen, Stuart Morrow, Tasdeeq Mohammed, Radesh Singh, Sreeni Pathirana, Jan Robertson and Tim Layt, School of Chemical Sciences' Technical Staff Relocation Team, won the Professional Staff Excellence Delivering Results Award for relocating complex lab operations from multiple locations to the Science Centre.

The Faculty of Science Sustainability Network, chaired by Associate Dean for Sustainability, **Associate Professor Niki Harré**, won the Environmental Sustainability Award for a large number of initiatives to make the faculty more sustainable; ranging from multi-disciplinary teaching modules to providing composting options for waste disposal.

Exploring new frontiers in e-therapy

It seems rather ironic that the source of so much angst for young people could also provide a platform for front-line support in the battle against psychological distress, but Associate Professor Kerry Gibson's research into peer-to-peer support online aims to do just that.

The two-year research project will explore how young people give and receive support for psychological stress through social media and, as the principal investigator, Kerry is the first to admit that the internet remains something of "a dark continent" for researchers because so little is known about how support works in online environments.

Funded by the Faculty of Science Research Development Fund, the research will also have an interdisciplinary focus with Associate Professor Susanna Tranka from the Faculty of Arts engaged as associate investigator. "Anthropologists are really good at understanding cultures and how people operate in culture, psychologists can join with them quite well to get interventions that fit culturally with people," says Kerry.

In recognising that there is real potential for difficulties like trolling, cyber bullying, grooming and "other awful stuff", Kerry says "the internet's not going away anytime soon, so we might as well look at what can work in that environment." After all, she says that all social relationships have risks. "They can be cruel, they can be unkind, but people can also be loving and kind and supportive."

The motivation for the research came from the observation that while young people have the highest rates of mental health problems and suicide, they actually make the least use of formal psychological support. Indeed, one Australian study found that only about 20 percent of young people with mental health problems actually accessed mental health care.

"I came from the perspective of thinking that if they're not using these services, what are they doing," says Kerry. "How does it work for young people, do they look after themselves, do they look after each other?"

Previous research into help seeking has identified several barriers to youth engagement with mental health services. These include the potential stigma associated with having problems, worries about being judged by adults and fears about the loss of autonomy when engaging with adult professionals.

Given that the majority of young people prefer to rely on their friends and their own networks, Kerry says "if we can learn what they're doing it might put us in a better position to set up mutual peer support networks for young people, to engage better with them in online environments, to offer them support – because it's clearly where they're going."

Existing research literature has tended to focus on the negative effects of digital communication, whether it be through texting or engagement with social media. However Kerry believes that there is not enough realisation of how much connection and sense of belonging people get in those environments and how it has become an important way of feeling connected in the world.

While there is still a need to develop professional resources which psychologists and psychiatrists and counsellors need to provide, she reasons that if young people are already providing a lot of mutual support in their own networks, "is there some way we could understand how it's working and build on that because it's a great resource."

The overall aim of the research is to gain a clearer understanding of how young people understand the process of giving and receiving support for psychological distress through social media, however engaging with them for research purposes is easier said than done.

Past experience has taught Kerry about the challenges of simply getting to talk to young people face-to-face. "A lot of people are anxious, they're not that comfortable speaking to an adult about personal stuff," she says. They also operate in a "fluid environment" in which making an appointment to meet at a specific place and time is fraught with difficulty because in their world everything changes all the time.

"If we can learn what they're doing it might put us in a better position to set up mutual peer support networks for young people, to engage better with them in online environments, to offer them support – because it's clearly where they're going."

As a result, a two-phase study has been designed which will use fluid, online and immediately available media that young people feel comfortable with. In addition to a targeted online survey of around 200 people which will be advertised through Facebook, there will be an anonymous online interview with 30 participants which will provide an opportunity to explore different ways of gathering data like emoji and other distinctively online expressions.

To avoid the ethical challenges of conducting research with young people without parental consent, the target age of participants is 16-21 years. "If you have to start getting parental permission it takes on a different feel," says Kerry. "I feel like I won't be able to get access to their own accounts, I'll get more carefully worded responses and so on." While slightly younger people might face more risks, she says those 16 and over have experience and a bit of distance and might reflect on what it was like when they were younger as well as what they are doing now.

Another challenge is data analysis which would normally involve a standard thematic analysis technique to capture the meanings. However the presence of 'idiosyncratic text speak' such as shortened words and messages, plus the use of visuals, memes and songs might encourage a new analytical approach. "In a way the method is partly educating me about how people talk online," says Kerry. "I'm going to be pushing myself to try and find helpful ways of looking at that."

One solution has been the engagement of a 'cultural translator' in the form of summer scholar, Katie Smith, who will sit alongside Kerry to help her decipher what's going on in the online environment. "It is like entering another culture. We talk a lot about working at cross cultures and the need to understand the rules and the way things work there."

In terms of impact, the research is expected to contribute to new knowledge around youth social media use and it has the potential to influence policy and practice by providing the foundation for targeted peer-to-peer online support networks that can be used in first-line interventions in the community.

In that regard, Kerry acknowledges the role of organisations like Youthline and Rainbow Youth and says that her findings could be used to train online support people and also help educate and support young people in schools. "Maybe we can teach them about recognising when somebody's in distress online, and maybe we can teach them about the best way to respond when you see that."

Part of her interest is also in making it safer for young people. "I'm not oblivious and I'm not romanticising all the good that can happen, but we've got to know more and we've got to come at it from inside – not from outside."

As a clinical psychologist and a former President of the New Zealand Psychological Society, Kerry says that youth mental health is a priority and that reaching young people is a complex problem. In a broader sense, she says that core problems such as child poverty need to be addressed as well as the 'gap' between what young people are told they should be achieving in their lives and how hard it is for them to get that.

"There's a lot of pressure on young people," she says, "and we've got poorly equipped services in the District Health Boards. People there are really struggling to meet the need. Part of the problem is that we haven't got enough community-based services."

Another key issue is accessibility to support networks and e-therapy that doesn't involve talking to parents or doctors or mental health professionals. "It's about accessibility on their own terms and not having to step into a big system that's going to carry them away and in which they'll lose control," says Kerry. That means having access to e-therapy at any time including the middle of the night when someone is isolated and alone. "They're now operating in a world where all of their contacts are available 24/7 and that's what they're used to."

With her bookcase crammed with tomes written by Sigmund Freud and Carl Jung, Kerry says that the great psychoanalysts grappled with the context in which they lived just as she does now. "That's the thing with psychology and therapy, it's got to stay alive. We can't just go with what's always been, it has to change with the times and we have to change." ■

Engineered skin offers new hope

Having some skin in the game has added significance for Faculty of Science Professor Rod Dunbar who is the Chief Scientific Officer and a shareholder in Upside Biotechnologies, the highly promising start-up company that he co-founded to develop a world-class skin replacement treatment for burn victims.

Like most scientific start-ups, the long and winding road to commercialisation started with a great idea followed by years of painstaking research and innovation. "At this stage we have a product that looks exciting but I can't guarantee that it's really going to work," says Rod, referring to the importance of yet-to-be-conducted Phase I clinical trials.

Burns are recognised as a leading cause of childhood injury in New Zealand and the treatment for major injuries is slow and painful because it involves gruelling rounds of skin graft surgery. It was a conversation with plastic surgeon Michelle Locke about the limitations of existing skin replacement products that Rod says led to the ground-breaking engineered skin research at the Maurice Wilkins Centre, which is headquartered in the School of Biological Sciences.

The research has been a true collaboration with Vaughan Feisst, Rod's former PhD student and post-doctoral research fellow, who carried out all the initial experimental work and is now also a co-founder and minority shareholder in the company. "Vaughan and I designed the product from the ground up around what the surgeons needed."

Existing products consist of the thin upper layer of epidermal cells which are often too fragile to be useful, so the aim was to create multiple layers of the epidermis and lower dermis cells to better resemble full thickness human skin. Using skin donated for human cell research, single cells were placed into a liquid and nutrient filled culture chamber where they divided and grew on a frame covered with a dissolvable synthetic mesh.

"Our trick," says Rod, "is to turn the whole thing upside down," – hence the company name Upside Biotechnologies. As a result, the upper cell layer migrates toward a gas permeable interface in the chamber floor, while the lower layer moves away to form separate layers sandwiched over the dissolvable mesh.

The concept is simple and convenient which reduces the chances of things going wrong, but Rod says the seven-year long project has required a series of innovations to overcome a host of technical barriers. "At last count it was almost 20 different innovations that we've added on top of each other to get to a final system for growing skin that is substantially different from anything anywhere else in the world."

One such innovation is the specially designed culture chamber made by the Auckland product development company, Adept, whose major challenge was to engineer a device capable of allowing gas in through the base of the container without any fluid leaking out.

Previous techniques were limited to growing seven-centimetre square sheets of skin, however Rod says they've already grown ten-centimetre square sheets and expect to achieve much larger sizes. Indeed, starting with a sample of just 10 by 20 centimetres, enough skin can theoretically be grown to cover an entire body within 16 days.

As well as producing skin faster than any competitive pipeline product, the culture chamber also doubles as the shipping device. "The surgeons in the theatre can open the box, pull out the skin and put it on the patient – that's the idea."

Auckland nanofibre production company, Revolution Fibres, was another external provider who supplied the dissolvable electrospun PLGA mesh for the skin to grow on. Producing mesh at just the right thickness and porosity for the cells to move into took a lot of experimentation, and Rod says the technical challenges included developing new ways of coating the material to make cells stick to it.

The project also drew on the skills of Rod's materials colleagues in the School of Chemical Sciences, as well as the broader scientific ecosystem within the Maurice Wilkins Centre, which he leads. "This is one of the things that we're focused on, getting people used to working in an interdisciplinary environment with people from other disciplines like the chemists and the engineers to build more complicated things and enable our research."

Protecting the intellectual property around the project was also critical. "If you're going to form a company and get investment then you have to be able to protect the inventions you've got," says Rod. "If we're serious about clinical translation then patenting has to be part of that, otherwise there's no economic return evidence and no investment in technology. That's the reality."

In addition to arranging patents, the University of Auckland's commercial arm (Auckland UniServices Limited) also incorporated Upside Biotechnologies and became a cornerstone investor along with Cure Kids Ventures and the Government-owned New Zealand Venture

Investment Fund. Cure Kids funded some of the research following on from an initial grant from the Sir William and Lois Manchester Trust.

University funding was provided by the recently established University of Auckland Inventors Fund which has $10 million available to help transform good research into good businesses and exciting new products. That investment, says Rod, signals to people that all the University's processes are behind it. "It's putting skin in the game, and that gives other people confidence that the University is not just doing it at a distance but is directly involved."

Upside Biotechnologies was one of more than a dozen companies spun out of the University in 2016, something Rod says is a good thing because it brings in new sources of research funding. "It's opening up University research to people outside who want to invest in new technologies."

To that end, the company successfully raised $2.3 million in March 2017 through a Series A funding round for early stage venture capital which attracted high profile investors including Sir Stephen Tindall's K One W One (No 3) Limited. "The shareholder register is fantastic," says Rod, "It's a dream list, really, in many senses."

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The largest external investor is ICE Angels Nominees, New Zealand's leading angel network that supports exceptional teams that are exploiting global opportunities. Pitching to high net worth investors for vital research funding is not part of his skill set, but Rod found himself doing just that at an ICE Angels fund raiser. "It was brilliant. It is gladiatorial, it's like *Dragons Den* but with 100 dragons sitting there," he says of the five-minute presentation and Q&A session, which raised a substantial amount of money on the spot.

One of the keys to successful capital raising has been the relatively simple business case, which investors get straight away because of the need for successful skin grafts in a global regenerative medicines market that's projected to reach US$30 billion by 2022.

The appointment of Dr Robert Feldman as chief executive officer was also strategic. As an experienced biotechnology executive with a background in start-ups, he has helped position the company for success by creating investment structures that build value for investors.

What's really exciting, says Rod, is the fact that people want to put their money into things that are going to be good for New Zealand. "These are highly successful, highly motivated people. They don't need to be doing this. They've all got this idea that it's important to take their success and enable the next generation of successful people in New Zealand and I think that's a fabulous thing."

The outside world is also taking notice. The Miami-based Biofuels Digest – which claims to be the world's most widely read biofuels daily with an online readership of 650,000 – has described Upside Biotechnologies as a 'brilliant start-up' and 'an outstanding example of the use of cell-culturing technology to address a major medical challenge.'

As an academic, Rod says that the University's support for the venture has been incredibly enabling because "there are people who care about what I've got to offer in terms of translational ideas." In addition to having a small shareholding in the company, Rod says he's motivated by the potential to provide well paid jobs for graduates.

"Through this kind of activity the people that I'm training now get to participate in these new businesses and see how their science can translate, and how they can generate their own ideas that can build businesses to employ their future students."

The next critical step will be Phase I clinical trials at the National Burn Centre at Middlemore Hospital. As Rod puts it, the proof is in the clinical trial, so "the real heart-stopping moment" will be when the first skin product goes on the patient and then the bandages come off a couple of weeks later "and we see whether it's worked or not."

Phase II clinical trials are likely to be conducted overseas, however Rod says that the route to market is potentially quite quick because there is no product currently available that really fits the need. "So, it's not many years away before we hope to see success." ■

Science's resident shape-shifter

Dr Laura Domigan, Research Fellow in the School of Biological Sciences, discusses masquerading as a biochemist, encouraging proteins to use their transferable skills, and avoiding camels in Marrakesh.

For Dr Laura Domigan, "working with people from different disciplines, backgrounds and cultures", along with the opportunity to travel and the excitement of solving a puzzle, are some of the things she enjoys most about her research.

Laura describes her work as "repurposing proteins to forget their day job and work for me". Specifically, Laura uses proteins from the eye lenses of hoki fish, and turns them into high tech materials.

"I use proteins that would otherwise be wasted. At the moment my focus is using these proteins to make useful materials and glue for eye surgery," she explains.

The variety of her day-to-day activities is also something that Laura enjoys. Some days she and her team extract the lenses from hundreds of fish heads – and other days they might make precise molecular measurements on how to attach useful things to their materials. "And then there is the mechanical testing of the final prototypes. We ask ourselves, 'Are they as good as the commercially available materials that are not made from sustainable sources?'," she adds.

A recent recipient of a Ministry for Business, Innovation and Employment (MBIE) Endeavour Smart Ideas grant, Laura says she happily switches disciplines to suit her investigative needs:

"I'm not really a biochemist at all, but don't tell anyone! While my PhD was a cross-faculty project in Biochemistry and Electrical Engineering, my post-doc was in a Biomedical Engineering team.

"I like using the discipline I need to answer the question I'm asking, without identifying with a particular science tribe," she says.

Laura's own "science tribe" includes students and colleagues from across the University, as well as external collaborators. "Half of my students are engineers! I collaborate with academics in the MacDiarmid Institute [for Advanced Materials and Nanotechnology], the Faculty of Medical and Health Sciences, as well as people in industry," she says.

Laura is enthusiastic about the diversity of her collaborations as they provide her with the breadth of experience her research needs: "It's been great having students wandering around campus because lots of new ideas spark at the boundaries, and they learn from each other.

"As a new researcher the main challenge is building a team. It's quite frustrating training a really keen and talented student, only to watch them leave, and then having to start again with a new one! But that's the advantage of working in a university rather than a Crown Research Institute or biotech company – you have a constant source of young people with fresh ideas," she says.

The other "constant source" Laura has had to secure is a regular supply of fish eye lenses so she can continue with her work in the future.

"I recently connected with the fisheries industry, which was quite daunting, but actually, the marketing manager of the company I liaised with was quite excited about this new use for his catch. He said, 'It's nice to think about something other than fish fingers for a change!'", laughs Laura.

Long term, Laura hopes to create new materials for ocular surgery that are better, safer and more sustainable than current options. It's even possible that her work will mean that sutures for the eye can be replaced with transparent glue.

"It took me a long time to decide that science was for me. I also thought about law and business. In the end I chose science because it has the most variety. It gives me the freedom and creativity to explore ideas. And, as it turns out, my research direction has commercial application, so I get to do some law and business too."

When asked about the piece of advice she'd give to her younger, less experienced research self, Laura is clear: never go to Morocco with your supervisor.

"My PhD supervisor was once offered several hundred camels in exchange for leaving me in Marrakesh!"

We're glad the trade didn't work out, because the Faculty of Science would sorely miss its resident discipline shape-shifter. ■

Eight months to Mars

Dr Nicholas Rattenbury remembers visiting Cambridge University, while living briefly in the UK as a 10-year-old, and coming away certain that he wanted to go to University.

"I didn't have a firm idea what I wanted to learn about, but I was keen on science," he says. "Then I received a small telescope as a gift, which nurtured my passion for astronomy."

It wasn't until Nick was engaged in postgraduate research that he realised his knowledge of computing, mathematics and physics combined to create a powerful skill set for discovering alien worlds.

As a 2012 Royal Society Te Apārangi Rutherford Discovery Fellow, Nick is now based in the Department of Physics. He works as part of a team of University researchers fostering the New Zealand space industry, and is fully absorbed in detecting extra solar planets – where alien life might exist.

"Everything in our galaxy is moving. Occasionally a star passes between us here on Earth and a background star," he explains.

"When this happens, the light from the background star gets bent by the gravity of the star between us and it, in a manner very similar to light being bent by a magnifying glass.

"By looking carefully at how the light from the background star appears to be affected by the gravity of the foreground object, we can detect any planets going around the foreground star."

Nick doesn't work alone. He's part of a collegial, international network of scientists sharing information about their projects and supporting each other to solve research challenges.

"One challenge is developing a new methodology to speed up discovering faint planetary signals in the data we are going to get from a new space telescope that will launch in the mid-2020s."

If he's not teaching or communicating with colleagues you'll find Nick writing, adapting, running and debugging computer code that models the planetary systems he is analysing.

He's currently working on machine learning computer algorithms to analyse planetary system data, which he hopes will ease the challenges in modelling data coming from our new space and ground telescopes.

"As we create experiments that generate ever larger and richer datasets, we will have to guide our computer codes to make discoveries without human intervention," he says.

"It's the start of an era of computer-human co-discovery, as we expand our knowledge of the sort of extra-solar planetary systems that are out there."

With plans to put people on Mars looming within the next decade, we asked Nick where he'd like to go should faster-than-light space travel become possible.

"I'd like to explore one of the Earth-like planets discovered by the Kepler space telescope. Kepler 452b, perhaps," he says.

Not a bad ambition for a lad from the North Shore of Auckland with a talent for astrophysics. ■

The sweet sound of fermentation

The role of underwater sound in fermentation, with a focus on beer yeast as a model organism, is Professor Andrew Jeffs' latest research.

And yes, at this time of year you can be forgiven for imagining the light hiss and fizz of a cold bottle of beer being opened against the backdrop of a hot New Zealand summer. However, the importance of sound in liquids is often overlooked because we cannot hear it with our ears. Organisms living in liquids, however, commonly respond to sound."

The aim of the research, that has received $1 million from the Ministry of Business, Innovation and Employment's (MBIE) Endeavour Fund, is not only to produce better beer but to improve other industrial fermentation processes.

"Fermenting beer is a tiny fraction of the fermentation industry that is worth US$127 billion annually," says Andrew of the industry that makes everything from beer to medicines and floor cleaners.

Holding joint appointments with the Institute of Marine Science and the School of Biological Sciences, Andrew and his colleagues Associate Professor Silas Villas-Boas and Dr Austen Ganley, are relishing the challenge of their multi-faceted research.

"Our aim is to untangle the complexity of sound energy, so it can be used in a highly effective manner to influence the production efficiency and profile of the fermentation end products in a commercially advantageous manner," says Andrew. "Whether for industrial fermentation for making biofuels, or to deliver novel world beating-beers from New Zealand."

As a marine biologist, one of Andrew's many varied research interests is the biology of sound, and his previous research has seen him work with marine larvae whose metabolic functioning can be altered by sound. However, aside from having to breed, fertilise, incubate and hatch the eggs, the larvae are, as Andrew says "very fussy", whereas yeast can be transferred and raised in otherwise sterile conditions and there is evidence that some sounds may alter the way they ferment – speeding up fermentation and altering the end products they produce, such as alcohol and other chemical by-products.

Working with yeast in this way also has other perks, and Andrew is not at all ashamed to say that sampling the end product of research is an enjoyable aspect to this body of work. But that's not the only reason he is enjoying this research project.

The significance of being awarded the MBIE funding is not lost on Andrew, Silas and Austen, who know all too well about the "endless applications for funding that can be drudgery at times," says Andrew. "We can actually do the research in a professional and sustained manner rather than cobbling it together with student projects."

A highlight to his research is the collaboration with brewer Garage Project in conjunction with the NZ Symphony Orchestra that has created a fine symphonic Viennese lager by using underwater sound equipment; literally by lowering the sound system into the fermenter. There is also a dark ale brewed to the beat of death metal which produced an unusually high alcohol content of well over 10%. Andrew and his team monitor the beer to see if the music makes the beer ferment faster or impart better flavours and aromas.

We're glad you're enjoying your work Andrew. It's a tough job, but someone's got to do it. ■

Water, water everywhere

Dr Karen Fisher from the School of Environment is contributing towards her iwi's vision with research that is supported by a Marsden Grant.

As a human geographer, Karen's interest in society-environment interactions means she travels as far as the Philippines to research sustainable development and environmental management. But, it is back at home in New Zealand that has seen Karen receive $615,000 in funding to work on a project that is very close to her heart.

Alongside colleague Dr Meg Parsons, the two are principal investigators on their project that involves working with Ngāti Maniapoto, local councils and the regional farming community to examine efforts to restore the fresh water management of the Waipā River.

The Waipā River flows from the Pekepeke spring at the foot of Rangitoto mountain through the Waipā valley and along where it unites with the mighty Waikato River at Ngāruawāhia. The Waipā is, says Karen, "similar to a lot of other rivers around New Zealand where there has been a lot of land clearing that results in sediment clogging our rivers, alongside agricultural intensification that pollutes our waterways."

For this reason, the two researchers are not only looking at ways of managing the environment in relation to the environmental health of the Waipā, but they are interested in looking at this in relation to a Māori perspective or Kaitiakitanga (stewardship).

"It is important for the project to include different people's aspirations toward a better river future," says Karen. "Sustainability isn't just environmental, it's the social aspect too, and ensuring that all parties have their needs met in some sort of way," she says.

In 2012 the Ngā Wai o Maniapoto (Waipā River) Act was enacted following the 2010 Deed of Relation to a co-management framework for the Waipā River. The act formalises the 'eternal' relationship of Ngāti Maniapoto with the Waipā River, which means Ngāti Manipoto and the Crown are Treaty partners working together to protect the health and wellbeing of the Waipā River. Since 2009, Karen has been more involved in different sorts of Iwi-based hui (meetings) that looked at the management of the Waipā River in relation to the process related to the deed, her current research was born from her involvement with the greater iwi's decision making that contributed to the bill being passed.

For Ngāti Maniapoto, an important aspect of the on-going enhancement of the Waipā River is the restoration of Waiwaiā (essence and wellbeing of the Waipā River). For Karen as a human geographer and a Ngāti Maniapoto descendant, it is very clear that her dual identity goes hand in hand with the project.

Karen and Meg are committed to bringing Māori Knowledge and Māori practises such as Kaitiakitanga to promote a 'just' and sustainable future for water management. For this reason, Karen and Meg are first looking at the history of the Waipā River, to see 'how we got to where we are' and what that means for the future. ■

Unlocking the secrets of the universe

Humankind's ability to unlock some of the innermost secrets of the universe has taken a dramatic leap forward with the recent detection of gravitational waves from a neutron star merger that took place 130 million light years from Earth.

Albert Einstein predicted the possibility more than a century ago, however the measurement of such a cosmic event by the Laser Interferometer Gravitational-Wave Observatory (LIGO) in the United States and Italy's Virgo detector has sent an understandable ripple of excitement through the global scientific community.

"Einstein always said that it's very unlikely that these gravitational waves will ever be detected because they're so tiny, so it was quite high risk but it paid off eventually," says Associate Professor Renate Meyer from the Department of Statistics, who has been part of a huge collaborative effort spearheaded by LIGO.

"My contribution was more on the theoretical side at the beginning," she says of the initial work using Markov Chain Monte Carlo techniques to create prototype algorithms and develop the computational techniques that are now used to estimate the parameters of gravitational waves.

Over the years, around fifty data scientists in the parameter estimation group have played a crucial role in extracting the parameters from the gravitational wave signal. Being part of a global collaboration that includes some 1,500 scientists and engineers worldwide, Renate says that she is "in awe" of the engineers who have built the incredibly sensitive L-shaped detectors in the states of Washington and Louisiana.

Using huge mirrors, the four kilometer-long LIGO interferometers can measure the distance to Proxima Centauri with an accuracy that's smaller than the width of a human hair. However their initial failure to detect any waves led to a hardware upgrade and an Advanced LIGO with much increased sensitivity.

The first breakthrough came in late 2015 with the detection of waves from the collision of two black holes that took place nearly 1.3 billion years ago. In addition to being able to estimate the parameters of the coalescing black hole merger waveform, the statistical techniques provided the means to infer important characteristics such as the individual masses of the black holes and the final mass, the distance to the Earth and the energy radiated in gravitational waves.

Renate's involvement in the ground-breaking project dates back to 1998 and a chance conversation about the challenges of identifying gravitational waves with physics lecturer Nelson Christensen. Now a Professor of Physics at Carleton College in Minnesota, and a member of the LIGO Scientific Collaboration, Nelson and Renate have collaborated ever since and co-wrote a paper (published by the Royal Statistical Society in April 2016) entitled 'Gravitational waves: A statistical autopsy of a black hole merger'.

Describing the discovery as 'a landmark moment for science', they also presciently observed;

"This is only the beginning of the story of gravitational waves. Soon, the Virgo detector (near Pisa, Italy) will be operating in concert with LIGO, and with more than two detectors, located in different parts of the world, it will be possible to estimate the sky location of future events even more accurately."

Sixteen months later, in August 2017, that possibility became reality when a gravitational signal code-named GW170817 helped to pinpoint the location of the neutron star merger within a cluster of 50-100 galaxies – and enabled electromagnetic telescopes at 70 observatories to witness the moment. "What is so exciting about it is that these Markov Chain Monte Carlo techniques have been used and they're now put to good use for all these exciting discoveries," says Renate.

It had always been theorised that gravitational waves traveled at the speed of light, and that theory was confirmed by the measurement of light-emitting gamma rays which arrived almost simultaneously. Describing it as a "rich event", Renate says that observations from different telescopes of the kilonova (the afterglow that followed the initial gamma ray burst) have also enabled physicists to analyse what happens to the inner core of neutron stars when they merge.

"It has enormous consequences for fundamental physics. They have much better estimates of the expansion rate and the age of the universe now, and they know that these neutron stars produce heavy elements such as gold and platinum. It's immensely important."

Looking ahead, Renate is working on the development of more robust models for 'noise characterisation' that will further increase the accuracy of gravitational wave parameter estimates. "It's one new research direction where maybe in the future we could make an impact and it might have a direct impact on the accuracy of the credible interval for the parameters of the gravitational wave forms."

In particular, she's extremely excited about LISA – the Laser Interferometer Space Antenna project being developed by the European Space Agency. Expected to be operational by 2034, LISA will consist of a constellation of three Pathfinder spacecraft arranged in an equilateral triangle with sides 2.5 million kilometres long. Flying along an Earth-like orbit, the distance between the satellites will be precisely monitored to detect a passing gravitational wave.

"It has enormous consequences for fundamental physics. They have much better estimates of the expansion rate and the age of the universe now, and they know that these neutron stars produce heavy elements such as gold and platinum. It's immensely important."

With the advancement of new technology comes new challenges for statisticians. While space-based interferometers are no longer subject to the underlying noise on Earth, Renate says that data analysis will face other problems associated with 'source confusion' in space. "We've got all these waves coming in from various sources at the same time, so it's a big problem filtering out signals from different sources."

As always, the work starts with a rough algorithm prototype. If something works, she says you need to make it faster which might require transferring from one programming language, like R, to a faster one such as C++. The work conducted by PhD students and collaborators involves simulations using parallel computers that make the process faster, and Renate is grateful to the New Zealand eScience Infrastructure (NeSI) for their high performance computing facilities and for the technical support from the University's Centre for eResearch.

"One of our challenges is to make them fast enough so that they can be used in real time so you don't have to wait for a day or so to get results back, so very computer intensive."

To facilitate collaboration, and demonstrate the feasibility of LISA data analysis, LISA organised global data analysis challenges which involve hypothetical observations with signals embedded in the noise for groups to analyse and try to extract the signal from the noise. "So groups were challenging each other and seeing how their particular algorithms work out."

The addition of Japan's KAGRA detector in 2019 and a third LIGO detector in India in 2023 will also ensure that the analysis of all the data will provide ample opportunities for statisticians to make significant contributions within the field of astrostatistics.

From a statistical viewpoint, the research essentially involves time series analysis which is transferable to other disciplines. For instance, Renate has been analysing asthma attacks in children as well as the recurrence of tumours in cancer patients. "If a person has recurrent events we need to model the dependence structure between these events in order to estimate the time until a certain event reoccurs. We need to look at the dependence in these events."

Likewise, the same noise characterisation methods that were developed and applied to LIGO will be also used in future research to analyse temperature data gathered in New Zealand since 1907 to help determine the potential effects of climate change. "We're trying to use our methods and see whether we can either validate the temperature increase that other statisticians have obtained, or maybe we'll get a different estimate. We'll see."

Current research is being funded from various sources including a two-year post-doctoral fellowship from the University of Auckland and three years of funding for a theoretical time series project from the German Research Foundation (DFG).

However Renate is especially proud of an initial Marsden Fund grant in 2002 for two PhD students, one of whom went on to conduct post-doctoral work at the California Institute of Technology jet-propulsion lab and the other who completed their post-doctoral at Germany's prestigious Max Plank Institute. "I quite enjoy seeing the careers of my PhD students flourish. A lot of them have gone on to good positions overseas."

What's more, her present PhDs are now basking in the reflected glory of the 2017 Nobel Prize for Physics which was jointly awarded to Professor of Physics, Emeritus Rainer Weiss who is best-known for devising the laser interferometric technique for gravitational wave measurements – AND who supervised the PhD of Renate's original collaborator, Nelson Christensen.

Having co-supervised four students with Nelson on various aspects of gravitational wave parameter estimation, Renate says "it's quite exciting for my PhDs because they now have a direct line to a Nobel Prize winner in Physics, that's quite cool." ■

FOUNDATIONS FOR ALL OUR FUTURES

An evening of Science celebration

The great and good of politics and philanthropy gathered in late July to celebrate the official opening of Building 302 – the newest addition to the Faculty of Science's state-of-the-art Science Centre.

Distinguished guests arrived to a red carpet, welcome celebratory drinks, and the names of donors and researchers projected onto the raw concrete wall of Building 302, all to honour those who have made a significant contribution to Science at the University of Auckland, and to formally open Building 302 to students, scholars, supporters, alumni and friends.

The evening's celebration also included the official launch of the Science-specific segment of the University of Auckland's Campaign For All Our Futures: four featured questions we have set ourselves the challenge of answering, with support from esteemed friends and alumni of the University:

- Can we uncover the mysteries of the human brain?
- Can we build an economy based on what we know, not just what we grow?
- Can we reveal the secrets of our world using modern instruments?
- Can we bring back the dawn chorus?

This final question is one the faculty is a step closer to answering thanks to a landmark donation by alumnus Dr George Mason, which has allowed the establishment of a new environment research centre, also formally opened during the evening. The George Mason Centre for the Natural Environment (GMCNE) aims to build research connections and collaboration across the University, and will focus on protection and conservation of New Zealand's wildlife and natural land and seascapes by producing independent research on the restoration of species, habitat and ecosystems.

In a fitting echo of the disciplines they house, the world-class Science offices, break-out areas and laboratories blend manmade materials and elements of the natural environment to create spaces that foster human interaction. Though undoubtedly cutting-edge in design and construction, the building holds light and open space at its heart through the use of large windows, skylights and multiple atria.

With the addition of Building 302, the new Science Centre is a catalyst for collaboration across the Science disciplines, and will be a cornerstone for our students and staff, allowing them to easily engage in interdisciplinary research that will transform lives, and answer the key questions for all our futures.

Following a formal welcome by faculty kaiārahi Michael Steedman, Dr Erin Leitao from the School of Chemical Sciences acted as MC for the evening and welcomed speeches by Dean of Science Professor John Hosking, Vice-Chancellor Professor Stuart McCutcheon, Science Scholar Jessica Patterson and Tuākana Science programme member Leilani Ioelu.

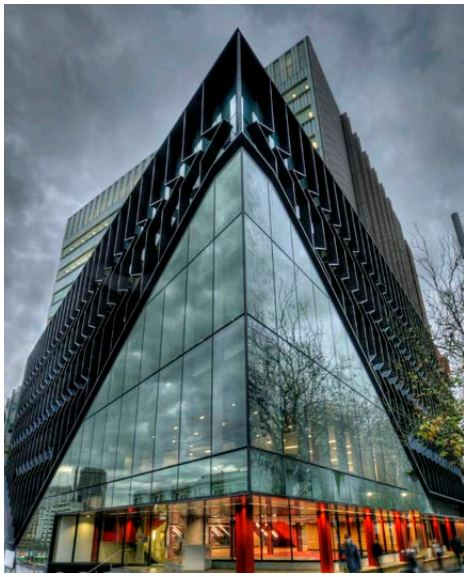
"Science is at the heart of our lives and science is what's required to solve the world's most challenging problems. This building is the perfect place for us to do just that," said Professor John Hosking in his opening speech.

The audience also watched a video timeline of the history of the Faculty of Science, reflecting on significant scientific achievements as well as announcing the faculty's goals and priorities for the future.

Inadvertently bumping the VC up the order of proceedings and taking his place as the penultimate speaker, Prime Minister Bill English echoed the words of Her Majesty Queen Elizabeth, the Queen Mother (who, in 1966, opened Stage A of the Science building, what is now Building 301) when he had "the pleasure of officially declaring the building open", before making a swift exit to catch his plane back to Wellington.

A flying visit it may have been, it was no less exciting for some of our students – passing the foyer windows on their way home, they spotted the PM on stage and saw fit to snap a few selfies for posterity.

And the new Science facilities, too, are for posterity; they are the foundations for all our futures.



We invite all alumni to come and explore the new building, and learn more about the ground-breaking work happening inside the Science Centre. If you would like to arrange a visit to Building 302, or you would like more information about supporting the University of Auckland Campaign For All Our Futures – or any of our researchers – please contact Kiri-Ann Olney, Faculty of Science Development Manager k.olney@auckland.ac.nz.

Watch the video of the history of Science at the University of Auckland
www.science.auckland.ac.nz/foundation-of-science

Exercising muscles and minds

Did you know you get the same benefit from taking a mouthful of sports drink, swishing it around your mouth, then spitting it out, as you do from swallowing it? Or that coffee relieves brain fatigue during prolonged exercise?

These were some of the nuggets of information shared with participants at the Department of Exercise Sciences' inaugural Teachers Day.

The programme combined a tour of the research laboratories and Health and Performance Clinic with short presentations from leading Exercise Sciences researchers. Teachers could make links with the units they teach, understand the options available to science and physical education students, and come away with ideas for classroom activities.

Keith Taylor, a physical education teacher at Saint Kentigern College, enjoyed hearing about the directions of current and future research within exercise sciences.

"I studied sports and exercise sciences at university in the UK and although in my current role I'm responsible for teaching biomechanics, my personal interest lies with exercise physiology [how the body responds to exercise]," he says.

"I appreciated the opportunity to chat to Associate Professor Jim Stinear about the connection between the brain and muscle development. My question to Jim was 'does the brain have to be switched on and fully engaged in physical activity for peak performanced?' Jim explained that research is being conducted, but results are not yet conclusive."

Keith also noticed how passionate the department's scientists are about their work.

"They have a genuine interest in their research and conveyed that in their presentations," he says. "From a teacher's perspective it meant that we got a feel for what their lectures would be like, which means we can better advise our students."

Keith intends ensuring Saint Kentigern College's careers office has all the relevant information to recommend Exercise Sciences as a tertiary option for Year 12 and 13 students.

Making science even sexier

It's safe to say the excitement around Dr Neil deGrasse Tyson's first visit to New Zealand in July was at fever pitch. And rightly so.

The world-renowned expert on star formation, exploding stars, dwarf galaxies and the make-up of the Milky Way is passionate about bringing science to the masses. His New Zealand tour was part of his tireless efforts to educate people about the wonders of science and our universe.

At a time when terms like 'fake news', 'post-truth' and 'alternative facts' have crept in to common parlance, Dr Tyson's mission to develop a more rational society equipped to deal with the problems of the future has never been more important.

"The most dangerous people in a free society are those who don't know," he has been quoted as saying. "It's okay to not know. But if you don't know and think you do know, that is dangerous. Those are the signs of the end of an informed democracy."

Our very own theoretical cosmologist and head of Physics, Professor Richard Easther, proclaimed *A Cosmic Perspective* "a masterclass in science communication."

"The most exciting part of the Spark Arena event was getting to watch Tyson create a personal connection with his audience," he enthuses.

"As an astrophysicist it was a great reminder that, while my discipline is a small part of the overall scientific community, it has an outsize role to play in fostering public engagement with science."

Professor Cather Simpson, of the School of Chemical Sciences and the Department of Physics, agrees.

"Tyson has a captivating presence, especially for his target audience of young people. We sat behind a row of University of Auckland students who spent the time waiting for the show to start by engaging in a rousing argument about what the fifth root of i would be. I had no idea there were so many optimistic, happy nerds in New Zealand!"

Following his presentation, Dr Tyson held a personal science chat, and shared his perception on diversity in science.

Dr Tyson summed up the importance of representation in science with the simple – and often overlooked – statement: "You can't be what you can't see."

In New Zealand we're lucky we can often see the stars. Because, you know, we're all stars. We're all made of stardust.

Wowed by the magic of science

Curiosity and a thirst for knowledge drew more than 370 students and 55 teachers from 13 schools all over Auckland to the faculty's Incredible Science day in July.

Held in this format for the first time since 2014, the event is designed for students in years 7-8 and aims to encourage them to think about future study in a field of science, and to think about science as a career.

Teachers and students alike relished the opportunity to get stuck into the activities being offered throughout the day.

They learned what happens in an archaeological dig, the magic of mathematical patterns using origami and flexagons, saw a miniature tornado, as well as volcanoes and earthquakes, and practiced making slime and analysing fingerprints.

Drones, robots, a real-time analysis of Auckland Transport buses and glowing fluorescent proteins were also included in the science extravaganza.

The school groups were guided through the experience by the faculty's Science students, many of whom had their interest in science piqued at one of these days when they were at school.

The ever popular Magic Show hosted by 'Fred Dagg' aka Gordon Miskelly, Head of the School of Chemical Sciences, drew 'oohs' and 'aahs' from his young audience.

'Fred' and his sidekick, Nina, turned clear liquid into rainbows, exploded hydrogen balloons and demonstrated Oobleck – a non-Newtonian fluid – among many other 'tricks'.

Schools reported that children were "buzzing afterwards", sharing what they were going to study at university and what they had learned.

For some students, who do not have a family member who has attended a tertiary institution, the day opened their eyes to the opportunities available to them in science.

The response was so positive we can rest assured that 'Fred Dagg' and friends will be back next year demonstrating the wonder and diversity of science.

Find more information and activities at **www.incrediblescience.co.nz**

Presenting the Gömböc

When NASA's Curiosity sent home stunning images of rounded pebbles on Mars in 2012, few people could have predicted those photos would lead to the confirmation of a theory that explains the evolution of shapes in non-living nature, such as sand grains, pebbles or asteroids.

The supposition was these Martian pebbles acquired their rounded shape after being exposed to water, most likely an ancient river.

The theory was difficult to prove until Professor Gábor Domokos from Budapest University of Technology and Economics solved a long-standing mathematical problem, one he had worked on for more than 10 years.

In his quest to find a solution, Professor Domokos once collected thousands of pebbles on a beach and checked every one but no such shape could be found.

The problem was to find a convex, homogenous solid object with only two points of static balance – one stable and one unstable – an object that was generally believed not to exist.

Finally, its existence was proved in a 2006 collaboration with colleague P L Várkonyi and the pair created and subsequently manufactured such an object, which they named the Gömböc ('sphere-like' in Hungarian and pronounced Gombok).

The Gömböc behaves like a weeble or roly-poly toy: no matter which way it is pushed or moved,

L to R: Professor Gábor Domokos, Professor John Hosking, Dean of Science; Professor Bernd Krauskopf, Head of the Department of Mathematics; His Excellency László Zsolt Szabó, Hungarian Ambassador to New Zealand. Photo: Amanda Gordon

it always rights itself on a flat surface coming back to its single – stable – point of equilibrium.

Initially the Gömböc appeared to be nothing more than a mathematical curiosity, as its shape is almost never found in nature. Instead of remaining an oddity, however, the Gömböc emerged as the key to understanding shape evolution in non-living nature.

As rocks, pebbles and sand grains abrade by collisions and friction, the number of their static balance points is being reduced and so the ultimate (though unattainable) goal of their evolution is the Gömböc shape.

The underlying mathematical models confirmed by Professor Domokos's work allow scientists to trace back the provenance of abraded river pebbles, sand grains or asteroids based solely on their current shapes.

This turned out to be the key to understanding the origin of those Martian pebbles and confirming they were indeed rounded while they were carried by ancient rivers on Mars.

Following his public lecture at the University of Auckland in March, Professor Gábor Domokos was present at the placing of a large Gömböc the Faculty of Science acquired to be exhibited in its new Science Centre.

Bringing science to the streets of MOTAT

Science is all about collaboration and one of the bigger community collaborations the faculty is involved with is the MOTAT Science Street Fair.

Held in April, this family-focused fair brings the wonders of science out of the University and into people's everyday lives.

Dr Nicolette Rattenbury from the Department of Mathematics, who co-coordinates the event alongside Julie Baker from MOTAT, says audiences almost doubled in 2017.

"The first Science Street Fair was in 2014, in 2016 we had 1,300 visitors and this year it leapt to 2,200," she says. "We had people queuing along the road and around the corner well in advance of gates opening."

This popular and highly anticipated occasion allows families to interact with Kiwi scientists who are innovators and leaders in their field. Far from being staid, our scientists are experts in engaging audiences in interesting activities that have children, in particular, broadening their minds.

"It's all about getting people enthusiastic about science by making it fun and accessible," Nicolette says.

Photo: MOTAT (The Museum of Transport and Technology)

Lego robotics is always a winner, but the Mentos and Coke volcano stall was a huge hit and the hovercraft propelled by a leaf-blower (finally a decent reason to own a leaf-blower!) was also a crowd pleaser.

Nicolette worked on the Association of Women in Science's soap boat station. "You cut craft foam into a boat shape, add liquid detergent to it and drop it into a tub of water. The detergent changes the surface tension of the water, which propels the boat forward.

"What fascinated me was how committed all the kids were to working out the science behind the activity. They tested different alternatives to see what worked best. More or less detergent, cutting a bigger or smaller size, or trying a different shape – their dedication to producing the speediest boat was impressive!"

Nicolette is already planning for the April 2018 Fair – Mentos, Coke and leaf-blowers included.

The Faculty of Science was represented by scientists from the School for Environment, Department of Mathematics, Department of Physics, Department of Computer Science, School of Psychology and Anthropological Science.

BASF Kids' Lab goes off with a bang

"Safety first – don't blow your hand off!" Dr Peter Swedlund says to the students of Henderson Primary School as he swings an empty metal can around on a wire at the front of the lecture theatre.

The can has been emptied of its contents and filled instead with a mixture of air and butane. He stops to ignite the can, but nothing happens.

"Second time lucky!" he says, adding more gas and swinging the can once more. He pauses. "Say the magic word," he instructs the students before raising the BBQ lighter again.

This time there is an enormous explosion and the lecture room erupts with impressed exclamations. "You guys are maniacs!" Peter tells the kids.

The demonstration is the students' introduction to a global initiative, BASF Kids' Lab. The programme allows school children to discover the world of chemistry through simple, safe and fun-filled experiments and highlights how chemistry plays a role in enriching our daily lives.

This year's event involved more than 300 students from five primary and intermediate schools keen to experience chemistry first hand. They conducted colourful experiments under the supervision of experienced chemists in the Faculty of Science's new state-of-the-art laboratories.

Donned in essential safety gear – latex-free gloves, safety glasses and a BASF Kids' Lab apron – students tested a variety of fruit and vegetables for their vitamin C content, were introduced to heat sensitive worms (an alginate gel that changes colour in response to a change in temperature), became UV detectives working with UV-sensitive beads, and used super absorber polymers which hold many times their weight in water.

Laboratory manager Katrina Graaf says the BASF Kids' Lab is a wonderful space where students have hands on access to basic science in a safe and controlled lab environment.

"We want them to realise that chemistry is already all around them," Peter adds. "And that university is a place where people can have fun and try new things [safely, of course!]."

There is the likelihood more than one student went home on that sunny day in November nurturing a tiny spark that will blossom into an enduring fascination with the wonderful world of science.

Global chemical company BASF and the School of Chemical Sciences collaborate on Kids' Lab so children will gain an early interest in chemistry and become the scientists and industry leaders of the future.

Sharing the beauty of maths

It is confirmed. According to Facebook, the 2017 Maths Craft Festival settled at least one long standing argument between friends – the best way to lace your shoes.

World-renowned mathematician and shoelace charmer, Burkard Polster, revealed the mysteries of shoelaces in his free public lecture during the festival. Visitors could also find out about the shortest, strongest and silliest ways to lace your shoes, why your shoelaces come undone all the time and what this has to do with mathematics, monkeys and salesmen.

This was one of many seminars and activity stations where more than 3,000 children and adults discovered the maths behind craft and the craft behind maths.

Dr Nicolette Rattenbury from the University of Auckland's Department of Mathematics, and Dr Jeanette McLeod, Dr Phil Wilson and Sarah Mark from the University of Canterbury's School of Mathematics and Statistics, were thrilled to return to the Auckland War Memorial Museum in September to host the second annual Maths Craft Festival thanks to sponsorship from Curious Minds and support from Te Pūnaha Matatini.

A full team of volunteers from the Department of Mathematics – staff, students and science scholars – supported the two-day festival.

"The event is for those who love maths, those who find maths challenging and those interested in craft – basically everyone from the age of two to 102," Nicolette says. "From the symmetry of a sari and the chaos in crochet, to origami and string art, it is an opportunity to show people how beautiful and useful maths can be."

Parents were especially appreciative, with some delighted to see their children continuing with the activities at home. One mum ventured the festival was responsible for a family miracle or two: "Not only did you get me to pay attention to maths for more than seven minutes, you also got my kids to work collaboratively!"

Nicolette says the Maths Craft Festival shows people how maths underpins almost every aspect of today's society. "Whether it's used in crafts, technology, business, science, social science or education, maths is vital."

So next time you bend down to lace your shoelaces, here's a thought to ponder... this simple, familiar task is actually maths in action.

For more information and resources please visit www.mathscraftnz.org

Once there was a duck

The journey begins with bath toys. Twenty-eight thousand yellow plastic ducks to be exact. That's how the Catherine Wheels Theatre Company from Scotland starts their award winning play about the biggest subject on Earth – the ocean.

The Scottish-based company brought *Lost at Sea* to the Auckland Arts Festival in March, with support from the Faculty of Science.

The play was inspired by the true story of thousands of plastic toys that spilled from a container ship in the Pacific Ocean in 1992, and, over many years, gradually found their way around the world.

What began as a headline grabbing, funny story began to capture the imagination of scientists as they realised they could follow the journeys of these resilient toys to map the movement of the ocean currents and discover more of the underwater world they traversed.

Lost at Sea's Auckland season included three school visits facilitated by faculty researchers Dr Melissa Bowen and Dr Mark Costello. Coincidentally, Melissa happens to have been born in Sitka, Alaska, the town where the plastic ducks first came ashore!

The two colleagues used the tale of adventurous toys flung into the unrelenting currents of the Pacific Ocean to teach several hundred students about how the ocean moves, how fast different kinds of animals move in the ocean and how these movements are important to us.

The post-play presentations were interactive with students mimicking the speed and movement of ocean currents on a roll out floor printed with a map of the ocean. Fast currents are like a fast walk (one metre per second), slower ocean currents are ten centimetres per second (a very slow walk). With artistic props, students enjoyed taking turns playing the roles of drifting plankton and cruising tuna to demonstrate the relative speed of different kinds of animals in the ocean.

"The play conveys the image of swirling vortices of rubbish in the middle of the ocean, and we follow that up by providing a deeper layer of learning with local examples on the importance of marine conservation," Melissa and Mark say.

"We want students to get a real sense of the ocean being one huge, living body of water connecting all land and species, and were really impressed by the range of questions the students had afterwards – we talked about waves, sharks and the colour of the ocean."

Kalman legacy supports maths

The Department of Mathematics former Head, Professor John Kalman (1930-2007), was well known for his caring attitude to students and colleagues in the mathematics community and his commitment to furthering maths education and research.

His dedication to mathematics continues beyond his passing in the work of the Margaret and John Kalman Charitable Trust. Established in 2008, the trust has been responsible for promoting mathematical studies at educational institutions and bringing world-class mathematicians to New Zealand's shores through a number of grants.

The Kalman Visiting Fellowship is offered to "rising stars" in mathematical sciences for an extended research visit. Professor David Conlon from Oxford University is the 2018 fellow and welcomes the opportunity to visit the Department of Mathematics.

Professor Conlon's principal research interests are in combinatorics and number theory, particularly Ramsey theory, extremal graph theory, additive combinatorics, pseudorandomness and random graphs.

Previous recipients are Dr Tim Burness (University of Bristol), Professor Jiawang Nie (University of California, San Diego), and Dr Andy Hammerlindl (Monash University).

The Michael Erceg Senior Visiting Fellowship, launched this year, is awarded to enable a visit to the University of Auckland by an internationally renowned academic.

This Fellowship is named after the late Michael Erceg, who was an alumnus of the Department of Mathematics. The successful applicant is invited to present the annual public Michael Erceg Lecture and participate in research activity, give other seminars and lectures, and engage in informal discussions with staff and students at the University of Auckland.

In November, inaugural recipient Professor Nick Trefethen from Oxford University took his audience on a tour of our mathematical and scientific world, past and present, through the lens of discrete versus continuous mathematics. This distinction is perhaps the biggest, and most fundamental in mathematics and many other disciplines.

For those who knew him, Professor Kalman's legacy only adds to their treasured memories of a world-class mathematician, with an amazing memory and the fastest writing they'd ever seen.

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

SCIENCE

Faculty of Science
The University of Auckland
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New Zealand

2018

Alumni and friends events

International Alumni and Friends Receptions

16 February – Whangarei
28 February – Samoa
1 May – Melbourne
3 May – Sydney
22 May – San Francisco (Date TBC)
6 June – Christchurch
27 June – Singapore
28 June – Kuala Lumpur
8 August – Wellington
2 October – London
22 October – Tokyo
25 October – Hong Kong

Special events in Auckland

8 March – Bright Lights
9 March – DAA Dinner
28 August – Raising the Bar
13 September – Golden Graduates Luncheon
6 October – FMHS 50th Anniversary Dinner

Please note: Event dates are subject to change. Before booking travel to an event, please check with the Alumni Office alumni@auckland.ac.nz

Don't miss out on an invitation to network

To ensure you receive invitations to events in your area, make sure your details are up to date
www.alumni.auckland.ac.nz/update

twitter.com/ScienceUoA

www.facebook.com/science.uoa

Connect with our researchers on Twitter....

***@Anson1G** – Associate Professor Greg Anson, Department of Exercise Sciences*

***@DrQueue** – Associate Professor Quentin Atkinson, School of Psychology and Centre for Computational Evolution*

***@JacquelineBeggs** – Associate Professor Jacqueline Beggs, School of Biological Sciences*

***@ginnybraun** – Professor Virginia Braun, School of Psychology*

***@BrimbleM** – Distinguished Professor Margaret Brimble, School of Chemical Sciences*

***@MyPlasticBrain** – Professor Winston Byblow, Department of Exercise Sciences*

***@stonehistorian** – Professor Kathleen Campbell, School of Environment*

***@alexeidrummond** – Professor Alexei Drummond, Department of Computer Science and Centre for Computational Evolution*

***@REasther** – Professor Richard Easther, Department of Physics*

***@astro_jje** – Dr JJ Eldridge, Department of Physics*

***@MErkintalo** – Dr Miro Erkintalo, Department of Physics*

***@DrTanyaEvans** – Dr Tanya Evans, Department of Mathematics*

***@EllipticKiwi** – Professor Steven Galbraith, Department of Mathematics*

***@nickgantnz** – Dr Nicholas Gant, Department of Exercise Sciences*

***@nicgaston** – Associate Professor Nicola Gaston, Department of Physics*

***@NicolaGavey** – Professor Nicola Gavey, School of Psychology*

***@chartinger** – Professor Christian Hartinger, School of Chemical Sciences and Maurice Wilkins Centre for Molecular Biodiscovery*

***@hendysh** – Professor Shaun Hendy, Department of Physics and Te Pūnaha Matatini*

***@DanHikuroa** – Dr Daniel Hikuroa, Te Pūnaha Matatini*

***@tslumley** – Professor Thomas Lumley, Department of Statistics*

***@LoraxCate** – Dr Cate Macinnis-Ng, School of Biological Sciences*

***@eileenamcl** – Professor Eileen McLaughlin, School of Biological Sciences*

***@droneale** – Dr Dion O'Neale, Department of Physics and Te Pūnaha Matatini*

***@cpaintingnz** – Dr Chrissie Painting, School of Biological Sciences*

***@MathmoClaire** – Associate Professor Claire Postlethwaite, Department of Mathematics*

***@DrPaulRalph** – Dr Paul Ralph, Department of Computer Science*

***@NJRattenbury** – Dr Nicholas Rattenbury, Department of Physics*

***@TectonoFluids** – Associate Professor Julie Rowland, School of Environment*

***@IsldJames** – Dr James Russell, School of Biological Sciences*

***@ptolemytortoise** – Professor Cather Simpson, Department of Physics, School of Chemical Sciences and The Photon Factory*

***@mc_stanley1** – Dr Margaret Stanley, School of Biological Sciences*

***@FredVanH** – Dr Frédérique Vanholsbeeck, Department of Physics*

***@SiouxsieW** – Dr Siouxsie Wiles, Faculty of Science and Faculty of Medical and Health Sciences*