Issue No. 53

Marsden Fund Update 2017

MARSDEN FUND
TE PŪTEA RANGAHAU A MARSDEN

ROYAL SOCIETY TE APĀRANGI

FROM THE OUTGOING CHAIR

It's been my enormous privilege to serve the research community as Chair of the Marsden Fund Council over the last six years. I'd like to acknowledge my fellow Councillors and the RSNZ staff for their hard work and friendship over this tumultuous time, as we navigated changes at the Royal Society, a National Statement of Science Investment, three Ministers and a change of government. In 2017, we invested more in Marsden research programmes than ever before – some $84 million dollars. This is a very significant increase over the $54 million dollars that was awarded in 2012, my first year as Chair – so I think that the hard work paid off. Thank you.

I'd also like to thank the Marsden applicants for all their robust debate and passionate input into the processes we use to manage the fund, which is so vital to our community. Even with the increase, the success rates still runs below 15%, and it is a testament to the resilience of this community that it continues to support so strongly a Fund that so often disappoints. This passion arises from a collective belief that fundamental, investigator-led research makes a difference. Maybe not an obvious difference, nor a difference that could have been foreseen at the outset, and generally not a fast difference – but a vitally important difference nonetheless. The network of scholars from all disciplines that the Marsden Fund has nurtured for over twenty years is a huge asset to New Zealand and our connectivity with research endeavours globally.

I'm delighted to now pass the baton to Professor David Bilkey, our new Marsden Fund Council Chair. David has three years of experience on the Marsden Fund Council already, having served as the convenor of the Economics and Human and Behavioural Sciences panel, and played a very active role in shaping our investment plan and the current trial we are undertaking on a combined panel approach in the humanities, behavioural and social sciences. I'm absolutely confident that the Fund is in safe hands and I wish him all the best for the challenges ahead.

Professor Juliet A. Gerrard FRSNZ

FROM THE INCOMING CHAIR

I would like to acknowledge the tremendous work that Juliet has done in terms of strengthening the position of the Marsden Fund as the body that supports cutting edge, investigator-instigated research in New Zealand. It is a testament to Juliet's ability and character that she has been able to lead the Council through six years of marked change. She has been guided by a clear vision of how important it is to support high-calibre, blue-sky research, and the research community that makes this happen. Although driving in this direction has sometimes been a difficult and fraught endeavour, she has managed to make great progress, all leavened with good helpings of humour and optimism. As a result of her leadership the Fund is now in a position where it is has a renewed capacity to support the excellent research that is being conducted in our country. For my part, I look forward to being able to continue in this direction, with an ultimate goal to ensuring that all excellent-quality, investigator-led research in New Zealand receives support.

Professor David Bilkey

ABOUT THE MARSDEN FUND

The Marsden Fund Council manages the Marsden Fund on behalf of the Minister of Research, Science and Innovation. It is administered by the Royal Society Te Apārangi and funded by the New Zealand Government.

The Marsden Fund invests in excellent, investigator-led research aimed at generating new knowledge, with long-term benefit to New Zealand. It supports excellent research projects that advance and expand the knowledge base and contributes to the development of people with advanced skills in New Zealand. The research is not subject to government's socio-economic priorities.

The Marsden Fund encourages New Zealand's leading researchers to explore new ideas that may not be funded through other funding streams and fosters creativity and innovation within the research, science and technology system.

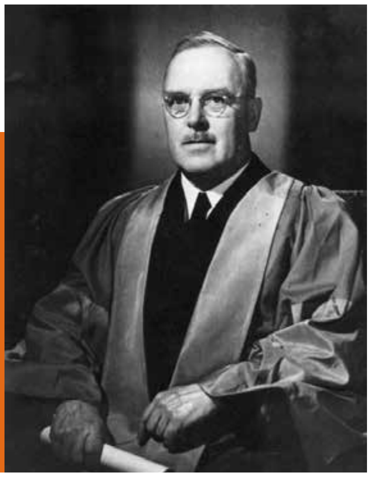
The Marsden Fund Council's mission statement is:

"To drive world-class research in New Zealand by supporting and incentivising excellent researchers to work on their best and boldest ideas and to connect internationally, leading to new knowledge and skills with the potential for significant downstream impact for New Zealand"

Projects are selected annually in a rigorous process by ten panels who are guided by the opinions of world-leading, international researchers. There are two types of grants: Fast-Start grants worth $300K (excl. GST) over three years for early career researchers, and Standard grants that can be worth up to $960K (excl. GST) for three years. Grants pay for salaries and overheads, students and postdoctoral positions, and consumables.

From the 2018 round, a new grant category was introduced, the Marsden Fund Council Award – larger interdisciplinary grants that will be worth up to $3 million (excl. GST) over 3 years. The Marsden Fund Council will assess these applications, rather than the panels.

The Fund is named after physicist Sir Ernest Marsden. It was established by the government in 1994. The Marsden Fund is regarded as a hallmark of excellence, allowing New Zealand's best researchers to explore their best ideas.



MORE PROJECTS FUNDED IN DIVERSE TOPICS IMPORTANT FOR NEW ZEALAND IN 2017 MARSDEN FUNDING ROUND

A total of 133 research projects have been allocated $84.6 million (excl. GST) of funding in this year's Marsden Fund grants, which support New Zealand's best investigator-initiated research in the areas of science, engineering, maths, social sciences and the humanities.

This is an increase on the $65 million (excl. GST) awarded to 117 projects last year, due to the increase of $66 million (excl. GST) over four years foreshadowed in the National Statement of Science Investment and confirmed last year.

The number of grants awarded to established researchers has risen significantly up from 68 last year to 84 in 2017. Subjects under investigation cover a range of topics of great interest to New Zealand, including improving our conservation efforts to protect New Zealand's unique birdlife, developing novel cholesterol lowering therapies, and providing insight on the voyages that first brought humans to Aotearoa New Zealand.

There also continues to be strong support for early career researchers this year with the Fast-Start grants. Researchers will look at topics such as climate change, increasing the accuracy of predicting earthquake damage, the first systematic study of Māori rock art, and developing better disease-resistant crops.

"The Fast-Start grants are designed to allow early career researchers to establish their independent careers research areas and create research momentum for our most talented individuals to work on their best ideas," says outgoing Marsden Fund Council Chair, Professor Juliet Gerrard FRSNZ.

Professor Gerrard says that it is especially pleasing to note that the number of Māori Principal Investigators of successful proposals rose from 5.9% last year to 9.1% this year.

"The continued increase in the number of Māori involved in successful proposals reflects the capacity building that has been under way for several years and, in particular, the emphasis on encouraging Māori to study right through to the PhD level. The proposals involving Māori researchers have been judged by top international referees as highly novel. In many cases, the proposals are multidisciplinary, use Mātauranga Māori, and confidently incorporate scientific and other disciplinary knowledge.

> *"We are also delighted that our awards show no evidence of gender bias, with female Principal Investigators at least as successful as males over the last six years."*

The overall success rate for applicants has jumped from 10.7% last year to 12% in 2017, thanks to the increase of funding. The success rate for Fast-Start grants for early career researchers was 14.8%.

The grants are distributed over three years and are fully costed, paying for salaries, students and postdoctoral positions, institutional overheads and research consumables.

Overall the Marsden Fund is a long term investment in New Zealand, says Professor Gerrard. "It creates a strong research base in New Zealand across the entire academic spectrum and enables fundamental discoveries about how our world and society operate. In the long term, some of these exciting new ideas will help us solve many contemporary issues, for example in conservation, agriculture, social justice, health care and beyond."

The Marsden Fund is managed by the Royal Society Te Apārangi on behalf of the government.

Professor Richard Bedford QSO FRSNZ, President of the Royal Society Te Apārangi, said: "We are delighted to see more research projects funded in the year that the Royal Society Te Apārangi celebrates its 150th Anniversary. The organisation has, from its earliest days, supported New Zealanders to explore, discover and share knowledge. This very much aligns with what the Marsden Fund enables, for the long-term benefit of all New Zealanders."

HE NUI ATU NGĀ KAUPAPA REREKĒ KUA WHIWHI PŪTEA E HIRA ANA MŌ AOTEAROA I TE TAU RAUNA PŪTEA MARSDEN 2017

He 133 te maha o ngā kaupapa rangahau i whakawhiwhia ki te $84.6 miriona (kore GST) mai i ngā pūtea o ngā takuhe Pūtea Marsden o tēnei tau, e tautoko ana i ngā rangahau tūhura pai rawa i roto i ngā wāhanga o te pūtaiao, pūkaha, pāngarau, mātauranga pāpori me ngā mātauranga tangata.

He pikitanga tēnei o te $65 miriona (kore GST) i tukuna ki ngā kaupapa 117 i tērā tau, nā te pikitanga o te $66 (kore GST) i roto i te whā tau i tohua i roto i te National Statement of Science Investment, ā, i whakaūhia i tērā tau.

Kua tino piki te maha o ngā takuhe ki ngā kairangahau matatau mai i te 68 i tērā tau ki te 84 i te tau 2017. He maha ngā kaupapa e kapia ana e pā nui ana ki Aotearoa, tae atu ki te whakapai ake i ngā mahi tiaki taiao hei tiaki i ngā manu ahurei o Aotearoa, te waihanga i ngā tikanga haumanu whakaheke ngakototo, me te whāriki tirohanga mō ngā rerenga moana i tae mai ai ngā tāngata tuatahi ki Aotearoa.

Kei te kaha tonu ngā tautoko mō ngā kairangahau pūhou i tēnei mā ngā takuhe Tīmata-Wawe. Ka tirohia e ngā kairangahau ngā take pērā i te huringa āhuarangi, te whakapiki i te tōtikatanga o te matapae i ngā ngā tūkinotanga rū, te rangahau nahanaha tuatahi i te toi kōhatu Māori, me te waihanga i ngā māra ārai mate pai ake.

"He mea waihanga ngā takuhe Tīmata-Wawe e taea ai ngā kairangahau pūhou te whakaū i ō rātau wāhi rangahau umanga motuhake me te kauneke whakamua i ngā rangahau mō te hunga pūmanawa hei whakapau kaha ki ō rātau huatau pai rawa," te kī a te Tiamana o te Kaunihera Pūtea Marsden kei te mutu mai, a Ahorangi Juliet Gerrard FRSNZ.

E kī ana a Ahorangi Gerrard e tino hari ana ia ki te kite i te maha o ngā Kairangahau Matua Māori i roto i ngā tono i waimarie i piki mai i te 5.9% i tērā tau ki te 9.1% i tēnei tau.

"Ko te piki haeretanga o te maha o ngā Māori i roto i ngā tono i waimarie e whakaata ana i te tipu o te kaha kua mārō nei te haere mō ngā tau maha, otirā, e aro ana ki te whakatenatena i te Māori ki te ako haere atu ki te taumata Kairangi. He tino rerekē ngā tono i roto i ngā kairangahau Māori i whakawāhia e ngā kaitaunaki mātāmua o te ao. I ngā āhuatanga maha, he pūkenga-maha ngā tono, he whakamahi i te Mātauranga Māori, ā, kia angitū te whakauru mai i ngā mōhiotanga pūmātauranga me ētahi atu pūkenga.

> ***"E hari anō mātau kāore i te kitea te tītaha ki te taha ira tangata, e āhua rite ana te momoho o ngā Kairangahau Matua wāhine ki ngā mea tāne i roto i te ono tau."***

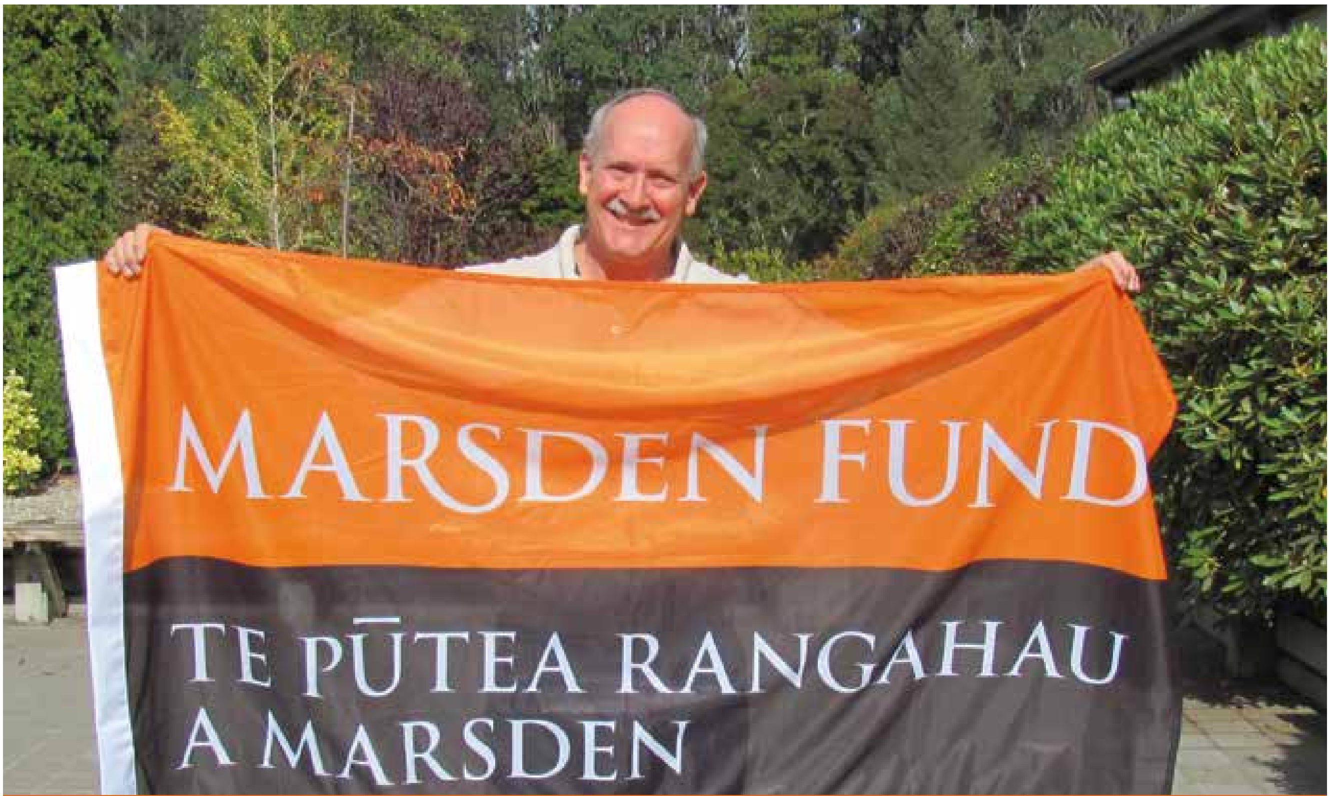
Kua piki anō te ōwehenga momohotanga whānui mai i te 10.7% i tērā tau ki te 12% i te tau 2017, nā te pikitanga o te tahua. Ko te ōwehenga momohotanga mō ngā takuhe Tīmata-Wawe mō ngā kairangahau pūhou he 14.8%.

Ka tohaina ngā takuhe i roto i te toru tau ka mutu e whānui ana te whai pūtea, e utu ana i ngā utu ā-tau, ngā tūranga ākonga me te kairangi, ngā whakapaunga ā-whare wānanga me ngā taonga rangahau.

He kaupapa haumitanga wā roa te Pūtea Marsden i Aotearoa, te kī a Ahorangi Gerrard. "He waihanga i tētahi tūāpapa rangahau kaha i Aotearoa puta noa i te awhe mātauranga whānui me te whakamana i ngā tūhuratanga taketake mō te āhua o te mahi a tō tātau ao, iwi whānui hoki. Mō ngā rā e tū mai, ka āwhina ētahi o ēnei huatau whakaongaonga hou i a tātau ki te rapu rongoā mō ngā raruraru maha onāianei, hei tauira, mō te tiaki taiao, ahuwhenua, tōkeke ā-iwi, manaaki ā-hauora me te maha atu."

E whakahaerehia ana te Pūtea Marsden e Te Apārangi mō te taha ki te kāwanatanga.

I kī a Ahorangi Richard Bedford QSO FRSNZ, Perehetini o Te Apārangi: "Ka nui te hari ki te kite i ngā kaupapa rangahau maha atu e whiwhi pūtea ana i te tau e whakanuia ana e Te Apārangi tana Huritau 150. Kua roa te whakahaere, mai anō i te tīmatanga, e tautoko ana i ngā tāngata o Aotearoa ki te hōpara, tūhura me te tuari i ngā mōhiotanga. E tino hāngai ana tēnei ki ngā mea e whakamanatia ana e te Pūtea Marsden, mō te painga wā roa o ngā tāngata katoa o Aotaearoa."



Dr Ron Ronimus with the Marsden flag.

RESEARCH IN FOCUS

The human body contains just 250 grams of adenosine triphosphate (ATP), the principal product of the break-down of glucose in the body (glycolysis), and the main source of the chemical energy that powers metabolic processes in our cells. However, ATP is also used in the early stages of glycolysis and, between its roles of priming glycolysis and delivering energy, several hundred times each day, the body turns over its own weight of ATP every day. It is a very important molecule.

However, in the 1990s, Dutch investigators discovered two new enzymes in anaerobic archaea from hot environments that used adenosine diphosphate (ADP), rather than ATP, for priming the glycolytic pathway. When genome data for the human genome became available, Dr Ron Ronimus (from AgResearch) and Professor Hugh Morgan (the University of Waikato) discovered an enzyme with shared ancestry to one of the newly-discovered ones from archaea. The enzyme was found to be a glucose-specific ADP-dependent kinase (ADPGK).

This finding represented the first new glycolytic enzyme to be discovered in mammals in nearly four decades, a surprising discovery that raised questions about its role. A team including Dr Ronimus, Professor Bill Wilson and Associate Professor Adam Patterson (both from the University of Auckland), Professor Kathryn Stowell and Associate Professor Andrew Sutherland-Smith (both from Massey University, Palmerston North) studied this further, using a Marsden Fund grant.

In humans, it was thought that ADPGK might be exploited by tumour cells to support their survival in conditions of low oxygen and compromised blood supply (as occurs in tumours), by allowing the energy-producing glycolytic reaction sequence to be primed with ADP when ATP is limiting. However, the PhD studies of Susan Richter at the University of Auckland showed that reducing the expression of ADPGK had little effect on tumour cell glycolytic parameters or in the growth of selected cancer cell lines. So how could a highly-expressed ADP-dependent glucokinase not appreciably contribute to glycolysis? Further investigation indicated that ADPGK affected mitochondrial oxygen metabolism rather than glycolytic rate. Subsequent studies in Germany and Poland built on this observation, and Susan's finding that ADPGK is highly expressed in white blood cells and leukaemia cells demonstrated that ADPGK plays a key role in activation of T-cells through a mechanism dependent on mitochondrial reactive oxygen species.

The structure of ADPGK (from mice) was solved by Massey University PhD student Jan Richter and found to be similar to that of the archaeal enzyme, despite the gene sequences being quite different. The enzyme contains an unexpected disulfide bond near the site that binds to ADP and, in collaboration with Dr Alexander Gorony from Massey University, it was shown to be highly glucose-specific. The latter result is significant as the monitoring of glucose metabolism in humans, such as often used in cancer diagnosis, is based on a technique that fails to pick up ADPGK. This raises the possibility that clinical tests may underestimate glucose turnover in cells.

A full understanding of the role of this newly identified archaeal enzyme in normal human metabolism and disease is yet to be obtained, but there is now growing interest in ADPGK internationally. A group in Toronto has recently uncovered a mechanism by which it helps to limit tumour growth, while a Korean group has reported a mutation that could promote secondary tumours in breast cancer. Thus, the basic research funded through the Marsden grant has stimulated further studies that may in time identify the evolutionary advantage achieved by the acquisition of this ancient gene by the animal kingdom.

FOR MORE INFORMATION

Dr Ron Ronimus
AgResearch, Grasslands Research Centre
Private Bag 11008, Palmerston North 4442
Tel (06) 351 8036
Email: ron.ronimus@agresearch.co.nz

Structure of mouse ADP-dependent glucokinase.

Credit: Jan Richter

FUNDING HIGHLIGHTS FOR 2017

UNDERSTANDING FLUID TURBULENCE IN THE UNIVERSE

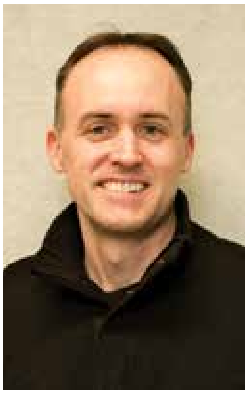
Dr Ashton Bradley from the University of Otago will model the nature of fluid turbulence – the mixing of air or liquids – to better understand varied weather phenomena observed in our solar system.

Fluids are everywhere: the blood pumping through our veins, the seawater washing onto our beaches, the air currents circulating in a tornado. The turbulent mixing of such fluids plays a dominant role in many aspects of life such as in the design of aeroplanes and boats, and the prediction of extreme weather events. Yet the physics of fluid turbulence is incredibly complex and hard to unravel, and so remains poorly understood.

Dr Ashton Bradley from the Department of Physics at the University of Otago has received a Marsden Fund grant to study the nature of fluid turbulence in a system where the fluid is stripped down to its bare essentials. In this system, a cloud of ultra-cold atoms are compressed and trapped into a two-dimensional pancake shape. Here, turbulence takes the form of the chaotic interaction of tiny quantum whirlpools – small point-like holes in the fluid surrounded by circulating fluid – confined to move in only two dimensions.

Dr Bradley will explore the theoretical physics of these two-dimensional quantum whirlpools and their connection to turbulence. He will do this by using a complex equation that he is a world expert at solving, the stochastic projected Gross-Pitaevskii equation. These simulations will illuminate the generic features of fluid turbulence, as well as the exotic behaviour unique to fluids obeying the principles of quantum mechanics. In parallel with these theoretical investigations, Dr Bradley will collaborate with two world leading experimental groups in the USA and Australia to verify the accuracy of his ground-breaking theoretical predictions, and uncover the fundamental nature of turbulence.

This study could led to a better understanding of turbulence phenomena seen in weather systems, for example, those that give rise to Jupiter's Great Red Spot.



BLOOD AND MONEY:

PLAYING THE 'GAME OF THRONES' IN THE ANCIENT MEDITERRANEAN

Dr Jeremy Armstrong from The University of Auckland will investigate and reconstruct ancient Roman armour and weapons to explore the centrality of the military in the ancient Mediterranean economy.

War and weapons are big business. As Game of Thrones fans know, money can buy an army and win wars. In ancient Greek and Roman societies, access to and control of military equipment was similarly important. These weapons were more than just functional; they were also symbols of power, political status, and identity. For example, a bronze shield was closely associated with citizenship for infantrymen in Athens and Sparta. Despite their practical and symbolic importance, we know little about the industries that manufactured and traded military equipment in the ancient world.

In a new Marsden Fund grant, Dr Jeremy Armstrong from the University of Auckland's Department of Classics and Ancient History will investigate the 'military-industrial complex' across ancient Italy and the Mediterranean region. Surviving texts hint at a trans-regional weapons industry, including long-distance exchange of materials, tools, and knowledge. Dr Armstrong will combine this literary evidence with archaeology and innovative reconstruction of weapons and armour in an experimental forge. This will allow him to develop new understanding of the networks and technologies of ancient military production.

Re-creating armour will enable Dr Armstrong to rediscover the metalworking tools, processes, and skills used in this ancient industry. This knowledge has largely been lost in the modern world. More generally, by tracing military equipment from raw materials through production, to trade and sale, this research will illuminate the interconnections between the military, economy and society in the ancient Mediterranean.

Helmet and cuirass from Paestum, Tomb 174 Gaudo, 390-380 BCE

On display in the Museo Archeologico Nazionale di Paestum

Credit: J. Armstrong

Helmet from the 'Lanuvium Warrior Burial', c. 500 BCE

On display in the Museo Nazionale Romano Terme di Diocleziano

Credit: J. Armstrong

OUT OF THE MOUTHS OF BABES: HOW DO CHILDREN UNDERSTAND AND ANSWER QUESTIONS?

Dr Deirdre Brown of Victoria University of Wellington will examine the best approaches to question children in criminal and welfare investigations.

From a young age, children learn that they are expected to answer adults' questions. When children are interviewed about past events, they rarely say when they do not understand a question, or are unsure about an answer. Instead, children will often try to comply by answering in unexpected and sometimes inaccurate ways. In some contexts, such behaviour can have serious ramifications, for instance when police officers or social workers interview children about possible maltreatment.

To help children in such settings, interviewers often teach them 'ground rules'. For example, children are asked to say, "I don't know", "I don't understand", or "that's not right" when needed. However, we don't know how well children of different ages understand these ground rules, what impact these rules have on their behaviour, or how best to teach them.

Dr Deirdre Brown of Victoria University of Wellington's School of Psychology has received a Marsden Fund grant to examine how children understand interview ground rules at different ages, and to determine the most effective teaching method. The findings from this project will help adults prepare children to answer questions about their experiences, and ensure we gain better, more accurate information when making decisions about children's well-being.

COULD LIFE HAVE ORIGINATED ON LAND?

Professor Kathy Campbell from The University of Auckland will drill into the world's oldest land-based hot springs in outback Western Australia for new evidence on some of the earliest life on Earth, and clues to help find remains of past life on Mars.

Determining the origins of life is one of the great scientific challenges of our time. Recognising traces of early life in rocks after billions of years of alteration by natural processes remains difficult. It is therefore not surprising that the time when life began remains unknown. Nevertheless, we do know where life began – or do we? Following the discovery in deep-sea hydrothermal vents of 'extremophiles' – heat loving microbes that constitute Earth's most primitive living things – spawned the popular notion that life originated in the ocean. However, a new discovery in Western Australia challenges this view.

Researchers recently found a 3.5 billion year-old rock formation in Pilbara, Australia, originally thought to be an ancient marine basin. It contains well-preserved mineral, chemical, and textural indicators of ancient life – the earliest convincing evidence to date. However, newly discovered geothermal sediments indicates the formation preserves a remnant of Earth's oldest known land-based hot spring. If proven, this discovery will extend the known geological record of inhabited terrestrial hot springs on Earth by around 3 billion years, and push back the existence of life on land by 580 million years – to a time comparable with some of the earliest known ocean fossils.

Professor Kathy Campbell from The University of Auckland, along with her multinational research team, has been awarded a Marsden Fund grant to examine the Pilbara rock. They will drill down into the ancient hot spring deposit to obtain a core of unweathered rock to sample for geochemical, mineral, and organic analysis to help solve the riddle of how life took hold on Earth.

In a novel approach, they will compare the well preserved drill core with modern-day hot spring deposits, studied previously by the team. This will provide a better understanding of microbial-mineral-fluid relationships, and reveal the ancient environmental and geochemical conditions under which earliest life on land developed.

In addition, results from this project will inform the upcoming NASA Mars 2020 mission as to the best location on Mars to explore for possible signs of extraterrestrial life, in a hot spring setting that also formed over 3 billion years ago; a time on the Red Planet when volcanism was active and water flowed across its surface. Some members of the Marsden team, including Professor Campbell, are helping to present the science case for the rover site selection process currently underway in the USA.

Discussing the comparatively very young New Zealand hot spring samples on a field trip in the Coromandel, North Island, and ~3.5 billion year old Pilbara rocks, Western Australia. Left to right: Steve Ruff (Arizona State University; leader of Columbia Hills, Mars, landing site selection team), Martin Van Kranendonk (Marsden AI, Big Questions Institute and Pilbara expert, UNSW), Kathy Campbell (Marsden PI, microbial sedimentology, UoA), Tara Djokic (PhD student of Van Kranendonk and co-discoverer of the earliest life on land), Diego Guido (Marsden AI, geothermal systems and volcanology, Universidad de La Plata).

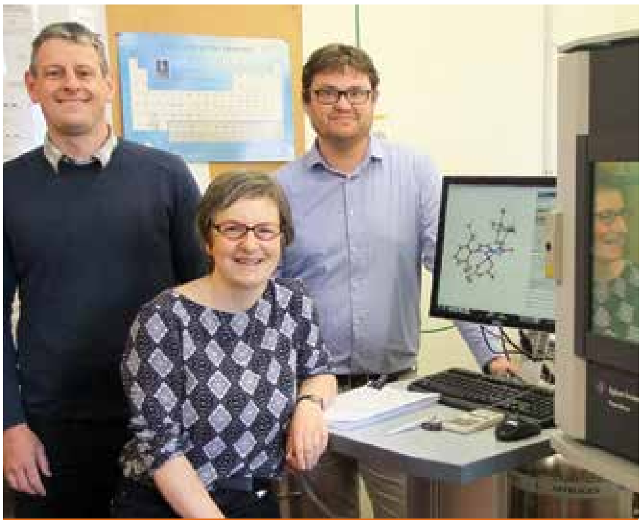
Credit: Bryan Drake

DESIGNER CATALYSTS FOR A SUSTAINABLE FUTURE

Professor Alison Downard and her team from the University of Canterbury will use a novel strategy to more efficiently speed up very slow reactions, such as the splitting of water and the reduction of a common greenhouse gas – carbon dioxide. This could lead to exciting new prospects for renewable energy storage and climate change mitigation.

The challenge of developing sustainable, environmentally-friendly energy sources must be tackled using multiple technologies – each with their own unique hurdles. For example, the generation of energy from intermittent renewable sources such as solar and wind must be coupled with efficient energy storage methods. Batteries and supercapacitors are the direct solutions for energy storage; however, their capacity is limited.

Indirect storage is an alternative method of energy storage, whereby renewable energy is used to produce fuels and other useful chemicals which are then stored. For example, renewable energy can drive the splitting of water into hydrogen and oxygen gases, which are stored and then recombined in fuel cells to produce electricity on-demand. Another exciting example is the conversion of a greenhouse gas – carbon dioxide – into carbon monoxide, a building block for fuels, including methanol and diesel.



Dr Chris Fitchett, Professor Alison Downard and Dr Aaron Marshall.

Professor Alison Downard, PhD student Ting Wu and Dr Chris Fitchett

However, these chemical reactions are inherently slow and thus require electrocatalysts to accelerate their reaction rates. Electrocatalysts are a special type of catalyst that accelerate electrically-driven chemical reactions. However, current electrocatalysts perform poorly or are very costly and are not suitable for commercial use.

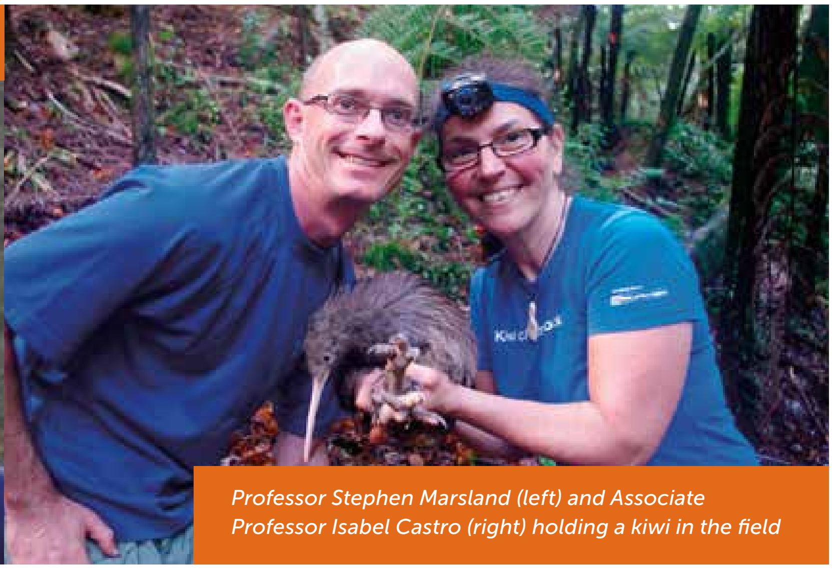
Professor Alison Downard and Dr Chris Fitchett from the School of Physical and Chemical Sciences, and Dr Aaron Marshall from the Department of Chemical and Process Engineering at the University of Canterbury have received a Marsden Fund grant to design more effective and stable electocatalysts. They will study how to tailor the molecular environment of well-known electrocatalysts (such as iron porphyrin) to achieve high reaction rates.

The findings from this study will lead to exciting long-term prospects such as carbon-free energy production and climate change mitigation.

CELLS AND WHISTLES:

SUPERCHARGING OUR BIODIVERSITY MONITORING TOOLKIT

Associate Professor Rachel Fewster



Professor Stephen Marsland (left) and Associate Professor Isabel Castro (right) holding a kiwi in the field

Researchers from The University of Auckland and Massey University will combine sound recordings with statistics, software, and genetic information to better estimate the populations of our endangered, but delightfully noisy, native wildlife.

An incredible conservation movement is unfolding in New Zealand, with thousands of community volunteers driving a groundswell of public effort to protect our native animals and restore our natural habitats. For wildlife conservation to be effective, we need to address whether populations are growing or declining, and which interventions work best. These questions are very hard to answer, especially for species that live in dense forest or the open ocean.

A new Marsden Fund grant will support Associate Professor Rachel Fewster from The University of Auckland's Department of Statistics and her research team to address urgent issues in biodiversity monitoring and management. This team will develop a new statistical framework to improve wildlife monitoring using data already collected in New Zealand by volunteers, researchers, and conservationists.

Dr Fewster and her team plan to develop methods to estimate the number of individual animals from sound recordings such as birdsongs or dolphin calls. This will involve comparing pairs of song bursts to weigh up the chances that they come from the same individual or different individuals. Genetic information from items the birds leave behind (faeces and feathers) will supplement the acoustic records, identifying individual birds and their kinship.

Professor Stephen Marsland from Massey University's School of Engineering and Advanced Technology has also received a Marsden Fund grant for a complementary project to reliably detect and analyse birdsong from these recordings. There are currently no computational methods that can accurately interpret these recordings. He will use mathematical and computational tools to estimate the abundance of bird populations from the number of calls made. The tools that Professor Marsland develops could also be extended to detect and recognise predators and other endangered native species such as bats.

Professor Marsland and Dr Fewster will collaborate to integrate their new methods into the freely available AviaNZ software program (http://avianz.massey.ac.nz). The software can be used by anyone – from the public to the Department of Conversation – to analyse acoustic data for conservation efforts. These projects will improve the monitoring of New Zealand's most vulnerable animal populations, and contribute to better conservation and wildlife management.

UNDERSTANDING THE ORIGINS OF CRISPR IN THE HUMBLE BACTERIA

Associate Professor Peter Fineran from the University of Otago is investigating the regulation of the CRISPR-Cas bacterial immune system, which could have far-reaching implications for bacterial evolution and antibiotic resistance.

CRISPR, the sophisticated technology for editing genes making headlines worldwide, originated in bacteria as a type of immune system. We commonly think of bacteria as the germs that cause disease. However, bacteria themselves are continuously under threat from viruses and other invaders. As a result, many bacteria have developed this sophisticated 'immune system' to recognise and eliminate foreign genetic material. This system also allows bacteria to develop a 'memory' which allows them to recognise and disarm future attacks.

Associate Professor Peter Fineran, from the Department of Microbiology and Immunology at the University of Otago, Associate Professor Paul Gardner and their team, have been awarded a Marsden Fund grant to study how bacteria regulate this immune system. The core of this sophisticated system is CRISPR-Cas. Immunity relies on the bacteria acquiring 'memory' sequences from the invader. These sequences then assist bacterial Cas proteins to recognise and destroy the foreign genetic material.

However, the fundamental biology of the regulation of CRISPR-Cas – in particular, how it is regulated to provide a comprehensive defence against foreign genetic material without causing 'auto-immune' problems – remains poorly understood.

To address this, Associate Professor Fineran's team will work with Associate Professor Paul Gardner to develop and employ state-of-the-art methods to unravel the full network of CRISPR-Cas regulatory genes. These genes allow ramping up of the CRISPR-Cas defence when a bacterium is most vulnerable to attack. They also defuse the inherent danger of "autoimmunity" of this system when the host bacterium is not under threat.

By understanding their regulation, CRISPR-Cas systems could be manipulated for improved outcomes, such as limiting the spread and acquisition of antibiotic resistance genes and developing CRISPR-based antimicrobials. This work will provide new insights into one of the hottest topics of modern molecular biology.

Associate Professor Peter Fineran with his PhD student Hannah Hampton, are looking at data by flow cytometry – one of the methods involved in the project

Credit: Htin Aung

The team is, from left to right, Dr Nick Gant, Associate Professor Michael Hautus and Professor Bryony James

The Magnetic Resonance Imaging (MRI) instrument that is going to be used in neuroimaging.

CRUNCHY, CREAMY, CRISPY... DO WE EAT LESS FOOD IF IT HAS A COMPLEX TEXTURE?

Professor Bryony James, Associate Professor Michael Hautus and Dr Nicholas Gant from The University of Auckland will study how food texture relates to our sense of feeling full. This project will help in planning dietary strategies to combat obesity.

There are many factors contributing to the current obesity epidemic. One part of the puzzle is why people continue to eat, or eat between meals, when they are full.

Feeling full can be heightened by spending more time and effort on chewing food. However, recently it has also been shown that the sense of feeling full can be accelerated by food texture, in particular, complex textures. Complex textures might be a combination of many sensations, such as crunchy, creamy, and crispy like a Ferrero Rocher chocolate.

Alternatively, they may be just a few textures sensed with high intensity, like a tooth-breakingly-hard gingernut biscuit. However, the mechanisms that connect textural complexity with the feeling of fullness are not well understood.

Professor Bryony James, Associate Professor Michael Hautus and Dr Nicholas Gant, all from The University of Auckland, have received a Marsden Fund grant to address this important knowledge gap. They aim to determine if the increased effort required to chew texturally complex foods results in a cascade of sensory inputs to the brain, stimulating signals to the gut.

Their study will use an interdisciplinary approach, using functional MRI to directly investigate the response of the human brain to different food textures, and to link these neural responses to food material properties and to perceptions of texture.

This hallmark study will directly connect the responses of our mouth, brain and gut to the physical properties of the food we eat. Ultimately, the research will contribute to a better understanding of appetite and eating, and enable better insight into how to combat the rising obesity epidemic.

TB OR NOT TB?

Understanding the spread of tuberculosis in the Pacific

Dr Michael Knapp from the University of Otago will study ancient DNA from seal and human bones to map the arrival and spread of tuberculosis across the Pacific, to better understand how this disease spread and caused past epidemics.

Tuberculosis (TB) is a major global health issue, infecting one-third of the world's population. It is a common and costly infectious disease, also affecting other mammals, including livestock, pests and marine mammals. However, very little is known about how TB spread in the Pacific, and the subject is controversial. Evidence of TB infection in pre-European skeletons across the Pacific challenges the commonly-held view that sailors and settlers brought TB bacteria to the Pacific region, including New Zealand, in the 18th and 19th centuries.

Dr Michael Knapp from the University of Otago's Department of Anatomy has received a Marsden Fund grant to determine the arrival and spread of TB across the Pacific region. Particularly intriguing is the idea that TB was introduced to New Zealand not by humans, but by marine mammals. Humans may have become infected by – for example – consuming seal meat. From there, the seal adapted TB strains may have evolved to "jump ship" to infect Māori well before the introduction of more modern strains of TB by Europeans. Dr Knapp will test this theory. Working with a team of biological anthropologists and microbiologists, he will use modern molecular tools on ancient DNA samples from human and seal bones to discover when and how different forms of TB arrived in New Zealand and infected humans.

This research will resolve a long-standing debate on how TB spread across the Pacific region. It will also lead to better understanding of the ways in which infectious diseases like TB move between animal and human populations, potentially causing significant epidemics.

GOING WILD: SEARCHING FOR GENES TO PROTECT NEW ZEALAND KIWIFRUIT FROM PSA

Dr Honour McCann from Massey University will investigate how Psa, the bacterial disease causing devastation to New Zealand kiwifruit, has evolved and emerged over the past 30 years, and whether wild varieties of kiwifruit are resistant to Psa. This could lead to better disease-resistant crops.

Plant disease is a major threat to agricultural productivity worldwide. Identifying the ways by which crop diseases emerge and 'break-out' from wild sources is of fundamental importance to the global horticultural industry. Recurring outbreaks of Psa (a strain of the common Pseudomonas syringae bacterium) have had devastating effects on one of New Zealand's key exports, the kiwifruit. Yet wild kiwifruit varieties may have some immunity to these bacterial attacks that is lacking in cultivated kiwifruit.

Dr Honour McCann from Massey University has received a Marsden Fund Fast-Start grant to investigate how certain varieties of the Psa bacteria have emerged in parallel with the domestication of kiwifruit. Using Psa samples collected from wild and cultivated kiwifruit across East Asia, Dr McCann and her team will identify how this crop disease has emerged and evolved. They will also perform analyses to understand which wild kiwifruit genes confer resistance to the bacteria.

This research will enable plant breeders to develop better disease-resistant crops, and to help ensure the sustainability of the New Zealand kiwifruit industry. More generally, understanding the emergence and evolution of such crop diseases is key to ensuring global food security and the horticultural industry's ongoing profitability.

Top: Dr Honour McCann examining wild kiwifruit.

Right: Dr Honour McCann on a sampling trip in China with collaborators from the Chinese Academy of Sciences: Li Li (left) and Yifei Liu (right).

Dr Honour McCann and collaborator Yifei Liu (Chinese Academy of Sciences) in search of wild kiwifruit.

Left to right: Antoine Felden, Professor Phil Lester, Dr James Baty and Dr Monica Gruber. Manaaki Whenua Landcare Research scientist Dr Dan Tompkins is not present.

Credit: Gerry Keating.

SILENCING IMMUNITY TO CONTROL THE SPREAD OF ALIEN INVADERS

Professor Phil Lester from Victoria University of Wellington will identify immunity genes in the highly invasive Argentine ant, with the aim of silencing these genes to reduce the ants' abilities to survive disease. This will have implications for pest control and management strategies.

Invasive species often have no natural predators to control their numbers. Many rapidly colonise vast areas, out-competing native species and causing widespread environmental damage. However, some of these alien invaders crash to low numbers only a few years after colonisation. If we can understand why, we can use this knowledge to help control their spread.

One leading theory for this boom and bust cycle in invasive species is that pathogens, tiny disease-causing organisms, are responsible. As an invader accumulates bacteria and viruses in its new habitat, it spends precious resources fighting the infection, thereby reducing its fitness and competitive ability. Professor Phil Lester from Victoria University of Wellington and colleagues have been awarded a Marsden Fund grant to study this theory in a very successful invader – the Argentine ant.

The Argentine ant is one of the world's worst invasive species. Having successfully invaded New Zealand, the ants cost our economy millions of dollars each year in reduced crop production and treatments attempting to control their numbers.

Professor Lester and his team will use the latest genetic techniques to identify and switch off the genes that enable the ant's immune system to fight a variety of pathogens. This innovative immune-silencing treatment can then be administered to ants in the wild through baits specifically designed to only target Argentine ants.

Professor Lester's research will improve our understanding of disease spread, especially in invasive species, and has the potential to effect a major change in traditional invasive species management. Not only could the system control the Argentine ant population in New Zealand, but potentially could be adapted to other highly invasive species around the world.

TE WHAKARUHI ARIĀ MATE HEI WHAKAHAERE I TE HORA O NGĀ KAITOMO TAUHOU

Ka tautuhia e Ahorangi Phil Lester o Te Whare Wānanga o Te Ūpoko o Te Ika i ngā ira ārai mate i roto i te pōpokoriki Aketīna tino urutomo, e whai ana ki te whakaruhi i ēnei ira hei whakaiti i te kaha o ngā pōpokoriki ki te ora. He pānga tō tēnei ki ngā rautaki patu me te whakahaere kīrearea .

I te nuinga o te wā kāore he kaikonihi tūturu o ēnei momo urutomo hei whakahaere i te tokomaha. He maha ka urutomo i ngā wāhi whānui, e poke ana i ngā momo taketake me te tūkino whānui i te taiao. Engari, ka tino ititi rawa ētahi o ēnei kaitomo tauhou i ngā tau ruarua noa i muri i te urutomonga. Mēnā ka kitea he aha i pēnei ai, ka taea ēnei mōhiotanga te whakamahi hei whakaiti i te horanga.

Ko tētahi whakapae matua mō tēnei huringa momoho me te parekura ko ngā tukumate, ngā moroiti pūtake-tahumaero iti rawa, te take i pēnei ai. Ina whakahiato tētahi kaitomo i ngā huakita me ngā wheori i te nohoanga hou, ka pau ngā tino kaha ki te whawhai i te tahumaero, e iti ake te pakari me te kaha tukituki. Kua whakawhiwhia a Ahorangi Phil Lester o Te Whare Wānanga o Te Ūpoko o Te Ika me ana hoa mahi i tētahi takuhe Pūtea Marsden hei rangahau i tēnei ariā i roto i tētahi kaitomo tino toa – te pōpokoriki o Aketīna.

Ko te pōpokoriki Aketīna tētahi o ngā tino momo urutomo kino rawa o te ao. Ina kua urutomotia a Aotearoa, e hia miriona tāra i te tau ka ngaro ki te ōhanga nā ēnei pōpokoriki i roto i ngā whakaputaranga ahumāra me ngā whakamātautau ki te whakaiti i te tokomaha.

Ka whakamahia e Ahorangi Lester me tōna rōpū ngā tikanga iranga hou rawa hei tautuhi me te aukati i ngā ira e taea ai te pūnaha āraiga mate o te pōpokoriki te whawhai i ngā tukumate rerekē. Nō reira ka taea tēnei maimoatanga whakaruhi-ārai mate te whāngai ki ngā pōpokoriki i te koraha mā ngā mounu i hangaia kia hāngai pū ki ngā pōpokoriki Aketīna anake.

Ka whakapai ake ngā rangahau a Ahorangi Lester i tō tātau mōhio ki te horanga tahumaero, otirā ngā momo urutomo, ā, he huringa nui ka taea i roto i ngā mahi whakahaere momo urutomo tūturu. Tērā pea i tua atu i te whakahaere a te pūnaha i te taupori pōpokoriki Aketīna i Aotearoa, ka taea pea te urutau ki ētahi atu momo urutomo kino puta noa i te ao.

Argentine ants raiding a beehive in Northland. Ants steal the honey and kill the juvenile bees, eventually killing the whole hive. They are a major issue for beekeepers in the upper North Island.

Credit: Jess Russell.

PROTEIN RECYCLING COULD HOLD THE KEY TO HEART DISEASE

Professor Sally McCormick at the University of Otago will study how "bad" cholesterol particles are cleared from our blood, which could lead to novel cholesterol-lowering therapies.

It is widely known that high levels of a type of blood cholesterol, called Lp(a), predisposes people to heart disease. Lp(a), or lipoprotein(a), is a low density lipoprotein (dubbed the "bad cholesterol" particle) with a companion protein called apo(a) attached to it. Much is known about how Lp(a) causes heart attacks, but very little is known about its normal function or how it is cleared from the blood.

Professor Sally McCormick, from the Department of Biochemistry at the University of Otago, is leading a team that has been awarded a Marsden Fund grant to begin unlocking these mysteries. The researchers have recently discovered how Lp(a) is removed from the blood by the liver, and that the apo(a) protein is then recycled back into the blood. They will identify which other proteins in cells are involved in the apo(a) recycling process, and uncover its biological purpose. They suspect that the recycling process is used by the body to remove toxic waste products from dead or dying cells, including oxidised lipids (known to cause inflammation) from circulation.

Ultimately, the researchers hope that a better undertanding of the biological processes involved in removing Lp(a) from the blood will lead to improved therapies for lowering blood cholesterol.

EARTHQUAKE ACCOUNTING:

A NEW WAY OF INCLUDING LOCAL SOILS IN THE PREDICTIONS OF GROUND SHAKING

Dr Christopher McGann (University of Canterbury) will develop methods to improve the prediction of ground shaking from earthquakes of different magnitudes, taking into account location-specific factors, such as soil structure. This study will increase the accuracy of predictions, and will inform the design and construction of future structures.

The damage from the 2010 and 2011 Canterbury Earthquakes was worse than you might predict based on the magnitude of the earthquakes. This was in part due to the local geology leading to differences in soil structure at different locations. In Canterbury, the nature of the local geology resulted in severe ground shaking and extensive liquefaction leading to more extensive damage. Earthquake scientists also failed to accurately predict these effects because the current models are too simplistic for most locations and only look at one dimension of the seismic waves.

Dr Christopher McGann from the University of Canterbury's Civil and Natural Resources Engineering Department, together with colleagues from New Zealand and the USA have been awarded a Marsden Fund Fast-Start grant. This team will develop more sophisticated methods to improve the accuracy of ground shaking prediction for specific locations. To accomplish this they will use data from over 5,000 ground shaking measurements from over 100 Japanese earthquakes, considering local geology and ground motions in three dimensions.

This study is extremely timely. Recent earthquakes around the world have generated considerable interest in better understanding these local effects. It is critical that an improved analytical framework is developed, so that the most accurate predictions of ground shaking can be adopted worldwide. More accurate predictions could then be used to inform the design and construction of safer urban structures, such as high-rise buildings, bridges, and other infrastructure.

Images show several pillars within the Carina Nebula, observed and studied with MUSE on ESO's Very Large Telescope. The massive stars within the star formation regions slowly destroy the pillars of dust and gas from which they are born.

Credit: ESO/A McLeod.

MASSIVE STARS:
NEIGHBOURS FROM HEAVEN OR HELL?

Dr Anna McLeod from the University of Canterbury will explore how the largest stars in our universe reshape their surroundings, and even trigger the formation of new stars.

No star is an island. Stars are not isolated systems that live their lives without interacting with their surroundings. This is particularly the case for the most massive stars – which are stars greater than eight times the mass of our own sun. Throughout their life these huge stars 'feedback' into their surroundings by emitting massive amounts of ultraviolet radiation and belching super strong winds, ionizing and heating everything around them. Even in death, they are spectacular; creating a massive explosion called a supernova that can both trigger and suppress the formation of other stars in the neighbourhood.

The physics of massive star formation and the redistribution of mass, energy, and metals throughout the stars' lifecycle, are the missing ingredients required to connect the galaxies that we observe today to models of galaxy evolution.

Dr Anna McLeod, from the University of Canterbury has been awarded a Marsden Fund Fast-Start grant to study the feedback from massive stars. With researchers from Germany and the United Kingdom, she will determine how these stars regulate the formation of other stars, and hence the development and growth of galaxies.

Using some of the newest and largest telescopes in the world, Dr McLeod will describe the features of several massive stars. She will dissect nearby galaxies into tiny regions and obtain high-quality spectra for each, thereby gaining valuable insights into massive star feedback in action.

Findings from this study will provide the observational platform needed to significantly advance our understanding of one of the most important astrophysical processes in the universe.

HOW DO FUNGI LIKE MYRTLE RUST SUCCESSFULLY INVADE THEIR PLANT HOSTS?

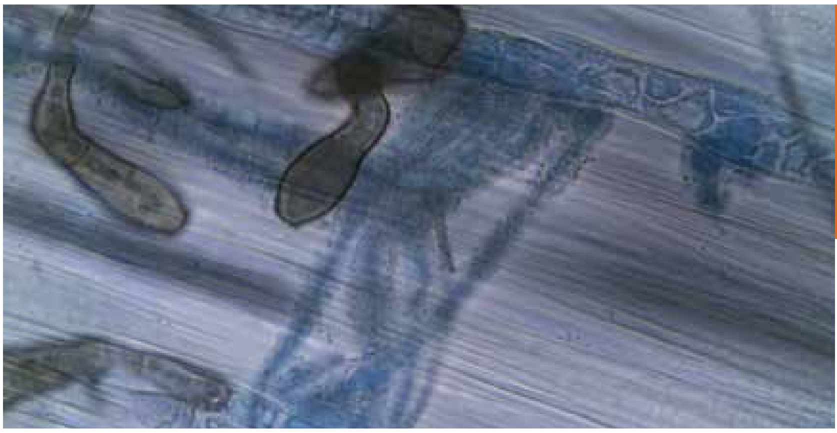
Dr Carl Mesarich from Massey University will study a common fungus that affects apples, to work out how some fungi are so successful at infecting plants. His work will provide new insights into how these types of fungi cause disease, and will create new opportunities for plant disease resistance breeding and pathogen control.

Fungi are a major cause of diseases in plants. They are among the most destructive disease-causing agents in economically-valuable plants worldwide. A notable example is myrtle rust, a recent invader to New Zealand that is threatening our native trees and thriving mānuka honey industry.

Fungi are very successful at invading their hosts, despite plants possessing a wide array of defences against infection. Many disease-causing fungi have the ability to modify their surface biochemistry and structure. This allows them to invade plant tissue and manipulate the plant's immune system to facilitate colonisation. However, very little is known about the cell surface changes involved, and how these lead to the maintenance of specialised infection structures that can survive in a hostile host environment.

Dr Carl Mesarich from the Institute of Agriculture and Environment at Massey University, Palmerston North, has been awarded a Marsden Fund Fast-Start grant to examine how changes to the fungal cell surface facilitate plant invasion. He will use a common fungus that infects apples (apple scab fungus) as a system to investigate this. He will characterise differences between the structure, cell surface biochemistry, protein composition, and gene expression of different fungal structures formed in cultures, plant host tissue, and cellophane membranes (an artificial host environment). Dr Mesarich will then use this information to identify specific genes that play a role in the differentiation and maintenance of infection-related structures.

This research will provide a framework for understanding infection-related cell surface modifications in other plant-invading fungi. It will offer important new insights into how these organisms cause disease and will open up new opportunities for plant disease-resistance breeding and pathogen control. This important work will help to ensure our horticulture industry continues to thrive.



Infection structures of the apple scab fungus, Venturia inaequalis, formed in an apple hypocotyl at seven days post-inoculation. Infection structures are stained blue.

Credit: Dr Carl Mesarich

YOUTH-QUAKE: HOW NEW ZEALAND YOUTH ARE PUTTING HOPE INTO ACTION

Associate Professor Karen Nairn from the University of Otago will explore the ways that hope for a better future motivates young New Zealanders to engage with politics and new social movements, and their visions for the future of our nation.

Faced with climate change, growing economic inequality, and political instablity, the future of the world may seem bleak. Young people will live the longest with these challenges and their consequences, and recent elections and social movements have seen a resurgence of youth engagement and activism globally. The so-called 'youth-quake' behind the recent metoric rise of Jacinda Ardern is a striking example. In this context, hope for social change can be a powerful catalyst for political action.

Associate Professor Karen Nairn of the University of Otago's College of Education will explore how young people in Aotearoa New Zealand put their hopes for social change into action in a new Marsden Fund grant. In particular, she will examine what inspires young people to join collectives and social movements, and what sustains their engagement. Working with politically-engaged 18 to 29 year old New Zealanders through interviews, observation and social media, Associate Professor Nairn will investigate what issues these young people perceive as the most urgent, their visions for the future, and their views on the most effective ways to make change.

There is extensive research on the threats and challenges facing the current generation, and on youth resilience in the face of adversity. Yet few people have looked at the importance of hope as a powerful motivator towards social and political action. In doing so, this project will challenge stereotypes of youth as disaffected, apathetic and self-interested. It will highlight the hope and visions for the future that young people in Aotearoa – our future leaders – are actively working towards.

TE HARURU RANGATAHI: TE ĀHUA O TE WHAKATINANA A NGĀ RANGATAHI O AOTEAROA I NGĀ TŪMANAKO

Ka hōpara a Ahorangi Tuarua Karen Nairn o Te Whare Wānanga o Otāgo i ngā āhuatanga o te tūmanako mō tētahi anamata pai ake e whakahihiri ana i ngā rangatahi o Aotearoa ki te uru atu ki ngā tōrangapū me ngā kaupapa pāpori hou, me ō rātau matakitenga mō te anamata o tō tātau motu.

E pā mai ana te huringa āhuarangi, te tipu o te rerekētanga ā-ōhanga, me te pāhekeheke o te tōrangapū, ko te āhua nei he kapua pōuri e iri ana ki te anamata. He roa ake te pānga mai o ēnei whakapātaritari ki te hunga rangatahi me ngā pānga, ā, kua kitea i ēnei pōtitanga nei me ngā kaupapa pāpori te aranga ake anō o te urunga mai o te rangatahi me ngā mahi werowero kaupapa puta noa i te ao. E kīia ana ko te 'haruru rangatahi' te kaupapa i tere ara ake a Jacinda Ardern, koinei tētahi tauira hira. I tēnei horopaki, he mana nui tonu te tūmanako mō ngā huringa pāpori hei whakakipakipa i ngā mahinga tōrangapū.

Ka hōpara a Ahorangi Tuarua Karen Nairn o Te Kura Akau Taitoka o Te Whare Wānanga o Otāgo i te āhua o te whakatinana a ngā rangatahi o Aotearoa i te tūmanako mō ngā huringa pāpori mā tētahi Pūtea Marsden hou. Otirā, ka hōpara ia i ngā mea e whakahihiri ana i te hunga rangatahi ki te whakauru ki ngā rōpū me ngā kaupapa pāpori, ā, he aha ngā mea e pupuri ana i a rātau. Mā te mahi tahi me te hunga 18 ki te 29 tau o Aotearoa e aro ana ki te tōrangapū mā ngā uiui, mātakitaki me te pāpāho pāpori, ka tūhura a Ahorangi Tuarua Nairn i ngā take e ai ki ngā rangatahi he tino kōhukihuki, ō rātau matakitenga anamata, me ō rātau whakaaro mō ngā āhuatanga whaitake rawa e puta ai ngā huringa.

He whānui ngā rangahau mō ngā whakaraerae me ngā whakapātaritari e pā mai ana ki te reanga onāianei, me te pakari o te rangatahi ki te tūtaki i ngā uauatanga. Heoi, he tokoiti noa te hunga kua tirotiro ki te hiranga o te tūmanako hei take tino whakahihiri i ngā mahi mahinga pāpori me te tōrangapū. Mā tēnei, ka werowero tēnei kaupapa i ngā whakapae mō te rangatahi he muhumuhua, ngākau-kore, kaiapa hoki. Ka whakaaturia te tūmanako me ngā matakitenga mō te anamata e āta whāia ana e te hunga rangatahi i Aotearoa – ō tātau rangatira o āpōpō.

Dr Gerard O'Regan pointing out a face carved in a cliff in the Central North Island. Sometimes the tupuna (ancestor) faces are made up from a pair of curved eyes over a mouth – sometimes only a pair of 'eyebrows' staring out at us from the cliffs.

A NEW ARCHAEOLOGY OF OUR THREATENED MĀORI ROCK ART

Dr Gerard O'Regan from The University of Auckland will undertake the first systematic study of Māori rock art across the North Island, to document and protect this increasingly threatened aspect of our cultural heritage.

Rock art is a crucial medium to understand the worldview of past peoples. Within New Zealand, however, rock art remains amongst the least understood and most at-risk form of Māori heritage. This is particularly true in the North Island. Until recently, there were only 30 recorded rock art sites in the North Island but we now know that there may as many as 120 sites.

Dr Gerard O'Regan from the University of Auckland's James Henare Māori Research Centre has received a Marsden Fund Fast-Start grant to initiate a Māori archaeological study of threatened North Island rock art. Working with local iwi and kaitiaki (guardians), Dr O'Regan will undertake a systematic archaeological survey and analysis of North Island rock art sites. This is the first time such work has been undertaken in the North Island of Aotearoa New Zealand. The planned survey encompasses sites across Auckland-Northland, Hauraki-Coromandel, Waikato, Bay of Plenty, King Country, Tokoroa, Taupō, Rotorua, Taranaki, and the East Coast. Dr O'Regan will also investigate the different ways that Māori used rock art, whether rock art was a common practice shared across North Island iwi, or whether it originated as a series of unrelated innovations.

Mātauranga Māori (Māori knowledge) about rock art is currently limited, a consequence of colonial actions that disrupted connections between Māori and their lands. In addition, weathering, erosion, and land development for forestry or farming threatens the continued survival of these cultural treasures. Documenting the nature and location of rock art across the North Island will enable Māori to better protect and generate awareness of Aotearoa New Zealand's heritage. It will also provide a new window into the worlds of our ancestors.

HE HUAKANGA HOU O Ā TĀTAU TOI KŌHATU MĀORI WHAKARAERAE

Kei te whakahaerehia e Tākuta Gerard O'Regan o Te Whare Wānanga o Tāmaki Makaurau he rangahau nahanaha o ngā toi kōhatu Māori puta noa i Te Ika-a-Māui, hei tuhi me te tiaki i tēnei wāhanga whakaraerae o tō tātau ahurea tuku iho.

He tūāhuatanga taketake te toi kōhatu e mārama ai ki te tirohanga o ngā iwi o mua. Engari i Aotearoa nei, kāore tonu i te tino mōhiotia te toi kōhatu, ka mutu kei te noho whakararerae nei te āhuatanga tuku iho Māori. Kei te tino pēnei i Te Ika-a-Māui. Nō nā noa nei, 30 anake ngā wāhi toi kōhatu i tuhia i Te Ika-a-Māui engari e mōhio ana tātau ināianei he maha atu i te 120 ngā wāhi.

Kua whakawhiwhia a Tākuta Gerard O'Regan o Te Whare Rangahau Māori o Hēmi Hēnare ki tētahi takuhe Pūtea Marsden Tīmata-Wawe hei tīmata i tētahi rangahau huakanga Māori o ngā toi kōhatu whakaraerae o Te Ika-a-Māui. Mā te mahi tahi me ngā iwi me ngā kaitiaki, ka whakahaere rangahau huakanga nahanaha a Tākuta O'Regan me te tātari hoki i ngā wāhi toi kōhatu i Te Ika-a-Māui. Koinei te wā tuatahi ka whakahaerehia he kaupapa pēnei i Te Ika-a-Māui o Aotearoa. Ka rangahautia ngā wāhi puta noa i Tāmaki Makaurau-Te Taitokerau, Hauraki, Waikato, Toi Moana, Te Nehenehe Nui, Tokoroa, Taupō, Rotorua, Taranaki me Te Tai Rāwhiti. Ka tūhura anō a Tākuta O'Regan i ngā tikanga rerekē a te Māori mō te toi kōhatu, mēnā i hōrapa whānui tēnei tikanga toi puta noa i ngā iwi o Te Ika-a-Māui, mēnā rānei i puta noa mai, ā, kāore he hononga.

He whāiti ngā mātauranga Māori mō te toi kōhatu, i runga i ngā mahi pēhi a Tauiwi i te hononga o te Māori ki ōna whenua. I tua i tēnei, nā te huarere, horonga, me te whanaketanga whenua mō ngā mahi ngahere, pāmu rānei kei te noho whakaraerae ēnei taonga ahurea. Mā te tuhi i te āhua me te wāhi o ngā toi kohatu puta noa i Te Ika-a-Māui ka taea e te Māori te tiaki pai ake i te me te whakatipu mōhiotanga mō te āhuatanga tuku iho o Aotearoa. Mā te whakapukapuka i te āhua me te wāhi o ngā toi kōhatu puta noa i Te Ika-a-Māui ka tipu te mōhio o te iwi whānui me te tiaki hoki i tēnei āhuatanga tuku iho o Aotearoa. He whai tirohanga hou hoki ki te ao o ō tātau tīpuna.

REWRITING THE TREE OF LIFE WITH MATHEMATICS

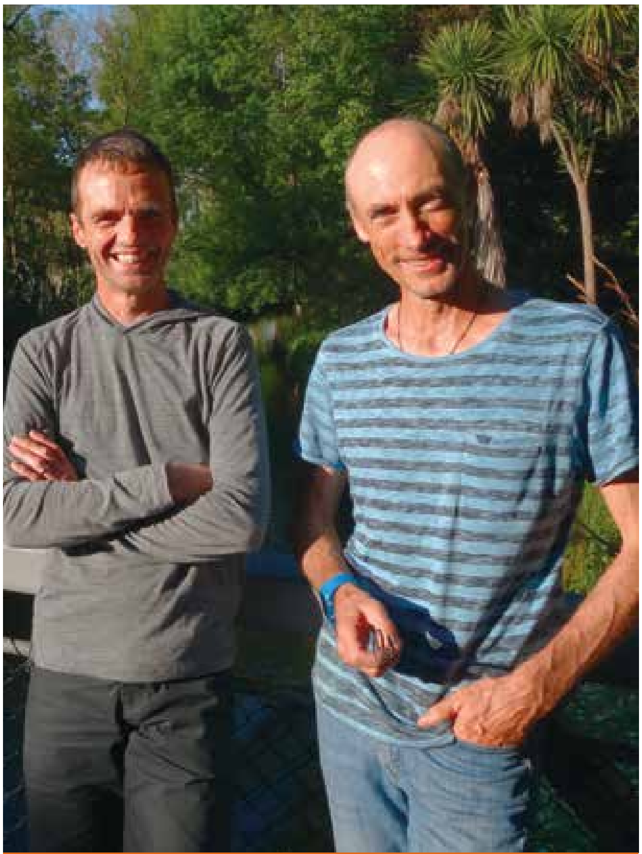
Professor Charles Semple and Professor Mike Steel of the University of Canterbury will apply mathematical models to the complex evolutionary tree of life, in order to understand how species evolve by combining and sharing genes, as well as branching away from each other.

Charles Darwin viewed evolution as a branching treelike process, which gave rise to all the diversity of life on earth. This can be thought of as forks in the tree of life, with a branch of the tree representing where a single species splits to form several new species.

More recently, it has been discovered that non-treelike processes, such as hybridisation (combining the genes of two organisms) and lateral gene transfer (direct gene transfer from one organism to another, especially common in bacteria) also play a role in evolution. As a result, the simple notion of a tree is insufficient to understand the course of evolution.

A major challenge in evolutionary biology is to unravel these complicated historical relationships. This area is called phylogenetics, and mathematics is an essential tool.

Professors Charles Semple and Mike Steel, both from the School of Mathematics and Statistics at the University of Canterbury, have received a Marsden Fund grant to study the mathematics of evolutionary networks. This project will develop and apply new mathematical, statistical, and computational techniques to study evolutionary processes. These world-leading researchers will develop a new mathematical theory that can be used to tease out the tangled ancestral relationships buried within genetic data. They will explore how certain evolutionary processes behave, which will add to our understanding of how life on earth evolved.



Professor Charles Semple (L) and Professor Mike Steel (R)

MAKING INTERNATIONAL ECONOMIC LAW IN UNCERTAIN TIMES

Dr Guy Fiti Sinclair from Victoria University of Wellington will study how the laws and institutions governing the global economy have functioned since World War II for insight into how international economic law can be adapted to respond to the current crisis in the liberal world order.

International economic law helps govern economic relationships between states, organisations and people across national borders. It has been a key aspect of trade and international integration since the mid-20th century. However, the strength of international economic law has recently been tested by the global financial crisis, Brexit, and Trump's withdrawal from the Trans-Pacific Partnership. Such events signal growing disillusionment with neoliberalism and the global institutions that underpin it.

Dr Guy Fiti Sinclair of Victoria University of Wellington's Faculty of Law is interested in how the international economic law governing global trade and investment can respond to these challenges. He has been awarded a Marsden Fund Fast-Start grant to explain the origins of the international economic legal system from World War II until the present moment of crisis. His research will explore the development of key global institutions such as the World Trade Organisation, the International Monetary Fund and the World Bank.

Despite the global importance of these organisations, there is currently no comprehensive history of their role in shaping the modern legal and economic order. Focusing on how these organisations dealt with past economic and political challenges, this research will explore the adaptability of international law and institutions. Dr Sinclair believes we can learn from this complex history in order to better respond to the challenges facing international economic law today.

TAKU ARA RĀ:
WALKING IN OUR ANCESTORS' FOOTSTEPS

Dr Naomi Simmonds from the University of Waikato will lead a hīkoi to rediscover the journey of the ancestress Māhinaarangi, in order to reconnect descendants with the knowledges, stories and land along her journeys.

Māhinaarangi, of Ngāti Kahungunu, is a prominent ancestress for many iwi in Aotearoa. Perhaps her most famous act was to journey, whilst heavily pregnant, some 500kms from the lands of her people in Kahungunu (near Te Aute in the East) to those of her husband, Tūrongo, at Rangiātea (near Te Awamutu). Māhinaarangi purposefully made the journey across ridges and ranges, lakes and rivers. Her hīkoi (walk) was an impressive feat and it provides both a physical and conceptual map as significant as those of more celebrated European cartographers. Yet her legacy is largely hidden today, as these lands have been renamed, surveyed and privatised. Māhinaarangi was a cartographer in her own right – mapping her stories, histories, language and knowledge onto the land upon which her footsteps fell.

Dr Naomi Simmonds (Raukawa) from the University of Waikato has been awarded a Marsden Fund Fast-Start grant to explore the tribal geographies encapsulated in Māhinaarangi's journey. Alongside other descendants, she will use indigenous research methods of hīkoi (walking) and pūrākau (storytelling) to rediscover, travel, and map Māhinaarangi's trail. While hīkoi has been more widely used as a means of protest and resistance in recent decades, this research will extend the practice to affirm and celebrate Māori identity and history.

Through this process, Dr Simmonds will work with iwi to help reconnect tribal stories about Māhinaarangi to physical places, learn from the land, and restore relationships to place as a central aspect of Māori identity. She says that this project has at its heart an assumption that reconnecting to the lands, environments and knowledges of our ancestors through pūrākau and hīkoi can provide positive pathways for descendants of Māhinaarangi in contemporary Aotearoa.

Dr Naomi Simmonds

TAKU ARA RĀ:
TE WHAI I NGĀ TAPUWAE O Ō TĀTAU TĪPUNA

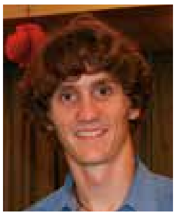
Ka ārahina e Tākuta Naomi Simmonds o Te Whare Wānanga o Waikato tētahi hīkoi ki te tūhura anō i te haerenga a te tipuna a Māhinaarangi, hei tūhono anō i ngā uri ki te whenua, ngā mātauranga, me ngā kōrero, e hāngai ana ki tana haerenga.

He tino tupuna wahine a Māhinaarangi, nō Ngāti Kahungunu, mō ētahi iwi puta noa i Aotearoa nei. I a ia e hapū ana, āhua 500 km te haere a te tipuna o Ngāti Kahungungu a Māhinaarangi mai i tōna kāinga (e tūtata ana ki Te Aute) ki ngā whenua, o tōna hoa a Tūrongo i Rangiātea (e tūtata ana ki Te Awamutu). He tino haerenga tēnei hīkoi, ā, nā āna mahi pēnei i hua ake ai tētahi momo mapi ā whenua, ā, ariā hoki,e rite ana tōna hira ki ērā o ngā tohunga tuhi mapi o Tauiwi. Heoi, kāore i te tino mōhiotia ēnei mahi āna, ina kua whiwhi ingoa hōu ēnei whenua, kua rūritia, ā, kua riro tūmataiti hoki. Waihoki, nā Māhinaarangi anō āna kōrero, āna kupu tuku iho, tōna reo me ōna mātauranga i tā ki runga i te whenua i a ia e takahi haere ana.

Kua whakawhiwhia a Tākuta Naomi Simmonds (nō Raukawa) o Te Whare Wānanga o Waikato ki tētahi takuhe Pūtea Marsden Tīmata-Wawe hei hōpara i ngā whenua ā-iwi i roto i te haerenga a Māhinaarangi. I te taha o ētahi atu o ngā uri, ka whakamahia e ia ngā tikanga rangahau iwi taketake o te hīkoi me te pūrākau hei tūhura anō, hei haere, me te whai i te ara o Māhinaarangi. Ahakoa kua nui te whakamahi i te kupu hīkoi mō ngā kaupapa porotū me te whakahē i roto i ngā tau maha kua hori, ka whakawhānui tēnei rangahau i tēnei tikanga hei whakaū me te whakanui i te tuakiri me te hītori Māori.

Mā tēnei whakahaere, ka mahi tahi a Tākuta Simmonds me ngā iwi ki te āwhina, ki te tūhono anō i ngā kōrero ā-iwi mō Māhinaarangi ki ngā wāhi, te ako mai i te whenua, me te whakaora anō i ngā hononga ki ngā wāhi hei tino āhuatanga o te tuakiri Māori. Ki tāna, ko te tino whakapae o te mahi rangahau nei, mā te hīkoi whenua me ngā pūrākau e tūhonohono anō ai tātou ki tō tātou whenua, te taiao, me ngā mātauranga, ā, mā aua mea anō e whakatakoto ai i ētahi ara whai oranga hei hīkoinga mā ngā uri o Māhinaarangi i Aotearoa o muri nei.

THE HOTTEST STUFF IN THE UNIVERSE



Dr Jonathan Squire from the University of Otago will study the behaviour of plasma – the fourth state of matter, which makes up stars – under extremely hot conditions. This will improve our understanding of this vital cosmic fluid and help to answer several key question in astrophysics, such as the formation of galaxies.

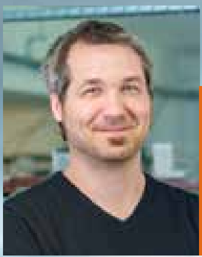
Virtually all of the ordinary matter in the universe is plasma: a fluid that is spread so thin that its ions and electrons cannot recombine into atoms. Despite having weak magnetic fields and particles that hardly ever bump into each other, very hot and diffuse plasmas are extremely sensitive to tiny changes in the magnetic field. Microinstabilities (tiny wobbles in the plasma) can abruptly grow and violently mix the plasma. These microinstabilities are very small in scale compared with the motions that caused them in the first place; however, they strongly influence the plasma's large-scale behaviour.

Dr Jonathan Squire from the Department of Physics at the University of Otago has been awarded a Marsden Fund Fast-Start grant to investigate the effects of microinstabilities in plasma. Together with an American collaborator, Dr Squire will develop a new theory for the large-scale behaviour of plasmas under very hot conditions. This theory will measure the creation of microinstabilities and how they affect large-scale plasma motions and magnetic fields.

This study will critically improve our fundamental knowledge of this exotic but widespread form of matter. It will lay the foundation for understanding its turbulent behaviour, and yield the first practical techniques for simulating such plasmas. These in turn, are crucial for unravelling key astrophysical processes such as galaxy formation, the interaction of the Earth with the sun, and the magnetisation of the universe itself.

IS THE MISSING CO_2 HIDING IN FIORDLAND?

Dr Peter Sperlich from NIWA will examine the amount of carbon dioxide entering and leaving the atmosphere around Fiordland to understand the possible impacts of our largest forest on climate change.



Native bush in Manapouri, Fiordland National Park, at the South-Western tip of New Zealand's South Island.

Credit: Dave Allen, NIWA.

To predict the impacts of climate change on New Zealand we need to be able to estimate future levels of carbon dioxide (CO_2) in the atmosphere. This requires a good understanding of the amount of CO_2 that is both entering and leaving the atmosphere (CO_2 flux) today. Yet, there is currently large disagreement in the estimates of land-based CO_2 fluxes. In particular, the CO_2 flux for Fiordland, one of the largest indigenous forests in New Zealand, has recently been contested.

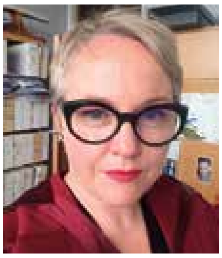
A recent study indicates that the amount of CO_2 absorbed from Fiordland's atmosphere may be underestimated. Forests play an important role in the flux of carbon. They release CO_2 during plant and soil respiration, and uptake CO_2 during plant photosynthesis. Dr Peter Sperlich from the National Institute of Water and Atmospheric Research (NIWA), in collaboration with a multinational team of researchers, has been awarded a Marsden Fund Fast-Start grant to determine if Fiordland's forest is more productive than previously thought and can account for the missing CO_2.

Dr Sperlich will make extensive use of isotopic analyses to probe the processes that affect CO_2 flux, and how these processes are affected by different environmental conditions. In particular, he will measure CO_2 and related trace gases in coastal background air, before and after it has passed over Fiordland. This will lead to an in-depth understanding of the CO_2 flux in Fiordland, and whether it can account for the difference in current atmospheric estimates in this region.

Findings from this study will improve current methods for estimating regional carbon fluxes. This will increase our certainty in New Zealand's inventory of greenhouse gas emissions that are reported to the United Nations Framework Convention on Climate Change.

WHAKAARAHIA ANŌ TE RĀ KAIHAU!

RAISE UP AGAIN THE BILLOWING SAIL! REVITALISING CULTURAL KNOWLEDGE THROUGH ANALYSIS OF TE RĀ, THE MĀORI SAIL



Dr Catherine Smith of the University of Otago, Ms Donna Campbell of University of Waikato and Mrs Ranui Ngarimu will study the only remaining Māori sail. They will combine Māori weaving knowledge with innovative materials identification to provide insights into this unique object and the voyages that first brought people to Aotearoa New Zealand.

Sailing is central to our national history, yet little is known of the customary Māori sails that first brought people to Aotearoa New Zealand. Te Rā is the last known remaining Māori sail in existence. This sail is thought to have been collected by Captain Cook, and it has since largely remained hidden from public view in storage at the British Museum in London. Te Rā provides physical evidence of Māori voyaging traditions and navigation skills, and can contribute to our understanding of their historical and cultural importance. Yet the sail's construction and materials have never been studied systematically.

In a new Marsden Fund grant, a multi-disciplinary team of scientists, weavers, and artists led by Dr Catherine Smith of the University of Otago, Ms Donna Campbell of the University of Waikato and Mrs Ranui Ngarimu will examine the sail using both innovative technology and customary methods. Interdisciplinary analysis of feathers, plants and skin used in making the sail (polarised light microscopy, DNA, light microscopy), as well as cutting-edge imaging and modelling technologies (photogrammetry, Reflectance Transformation Imaging, Computational Fluid Dynamics) will provide new insights into Te Rā's origins and function. At the same time, customary weavers and artists will document and replicate the weave stucture of Te Rā, revitalising cultural practice and rediscovering Māori technologies in the process.

The project is a unique collaboration between Mātauranga Māori (Māori knowledge) and Western science, which will generate new cultural, scientific, and historical understanding of Māori voyaging. The researchers plan to share these findings to engage New Zealanders with the story of an unparalleled journey that brought people to the world's last unexplored landmass, Aotearoa New Zealand.

Mrs Ranui Ngarimu at the Museum of Archaeology and Anthropology, University of Cambridge, 2017.

TE WHAKAARAHIA ANŌ TE RĀ KAIHAU!

E WHAKAORA ANŌ I NGĀ MŌHIOTANGA AHUREA MĀ TE TĀTARI I TE RĀ

Ka rangahau a Tākuta Catherine Smith o Te Whare o Otago, a Ms Donna Cambell o Te Whare Wānanga o Waikato me Mrs Rānui Ngārimu i te kōmaru Māori whakamutunga kei te toe. Ka whakakotahitia ngā mōhiotanga whatu Māori me te tautuhinga papanga auaha hei tuku tirohanga ki tēnei āhuatanga ahurei me ngā rerenga i tae mai ai ngā tāngata tuatahi ki Aotearoa.

He wāhanga nui tō te whakatere moana ki te hītori o tō tātau motu, heoi he iti noa ngā kōrero mō ngā kōmaru Māori tuku iho i kawe mai i ngā tāngata tuatahi ki Aotearoa. Ko Te Rā te kōmaru Māori kei te toe e mōhiotia ana. E ai ki te kōrero he mea riro i a Kāpene Kuki, ā, kāore anō kia tino kitea e te iwi whānui i te mea e rokirokitia ana i te Whare Taonga o Piritana i Rānana. He whakaaturanga kikokiko a Te Rā o ngā tikanga rerenga tuku iho me ngā pūkenga whakaterenga, ā, he tautoko i tō tātau mōhio ki te hiranga tuku iho, ahurea hoki. Heoi, kāore anō kia āta rangahautia te hanganga o te kōmaru.

Mā tētahi takuhe Pūtea Marsden hou, ko te mahi a tētahi rōpū tohunga pūtaiao pūkenga-maha, kaiwhatu, tohunga toi hoki e ārahina e Tākuta Catherine Smith o Te Whare Wānanga o Otāgo, Ms Donna Cambell o Te Whare o Waikato me Mrs Rānui Ngārimu ka āta tirotiro i te kōmaru mā ngā hangarau auaha me ngā tikanga tūturu. Mā ngā pekanga mātauranga maha hei tātari i ngā huruhuru, tipu me ngā kiri i whakamahia hei waihanga kōmaru (karu whakarahi tūrama whakapitorua, pītauira, karu whakarahi tūrama), tae atu ki ngā atahanga hou rawa me ngā hangarau whakatauira (whakaahua mahere rūri, Atahanga Hurihanga Whakaatatanga, Akiakitanga Kūtere ā-Rorohiko), ka whai tirohanga hou ki te ahunga mai me te mahi a te kōmaru I te taua wā anō, ka tuhia, ka tāruatia anō e ngā kaiwhatu tūturu me ngā tohunga toi te hanganga whatu o Te Rā, e whakaora nei i ngā tikanga ahurea me te tūhura anō i ngā utauta me ngā hangarau Māori i roto i ngā mahi.

He kaupapa mahi tahi ahurei tēnei i waenga i te Mātauranga Māori me te pūtaiao Tauiwi, ā, ka whakaputa mōhiotanga ā-ahurea hou, ā-pūtaiao, ā-hītori hoki o te rerenga Māori. Ko te whakarite a ngā kairangahau kia tuaritia ēnei kitenga hei tūhono i te iwi o Aotearoa ki ngā kōrero o tētahi haerenga whakaharahara i tae mai ai he iwi ki te whenua huna whakamutunga o te ao katoa, a Aotearoa.

Donna Campbell and Stephanie Aroha Mitchell at the British Museum, London, 2014.

BRINGING 3D
TO HOME VIDEOS

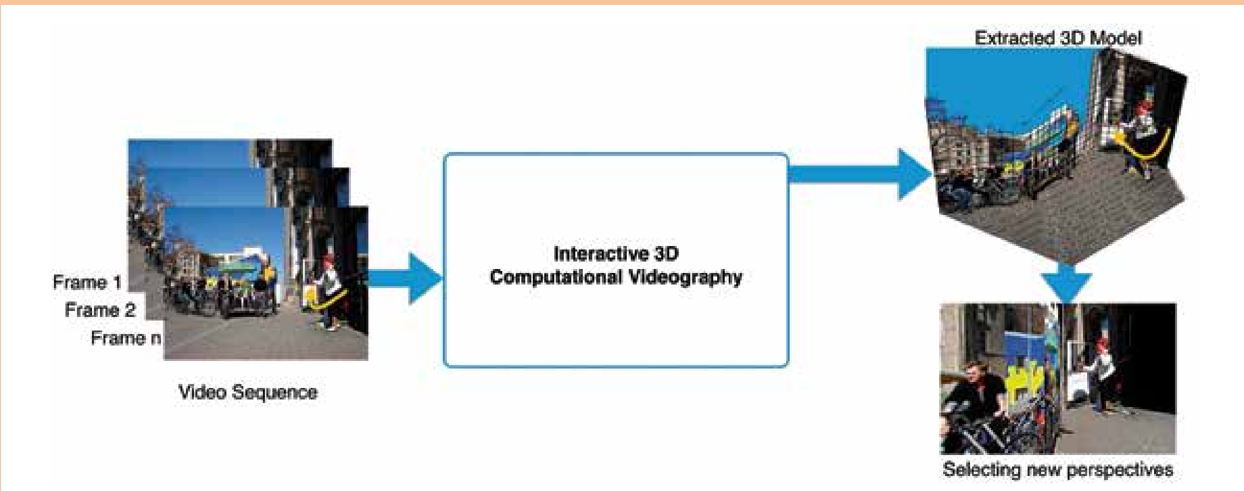
Dr Stefanie Zollmann of the University of Otago will combine novel videography and computational techniques to enable us to 'virtually walk through' a 3D scene created from our home videos.

Imagine being able to experience a family gathering, captured on a single video, as a fully explorable 3D scene, where your choices about how to move and where to look are different from those of the camera operator. Dr Stefanie Zollmann from the Department of Computer Science at the University of Otago will use a Marsden Fund Fast-Start grant to make this technology a reality.

An emerging area of research called 3D computational videography uses recently developed image-processing techniques to extract 3D data from videos. However, existing techniques in this area require multiple cameras, or intensive computer processing, or time-consuming human manipulation. Dr Zollmann aims to construct a 3D scene from a single video file, with minimal human manipulation and in near real time. After the 3D scene is reconstructed, a user will be able to explore the scene freely, selecting new viewpoints and perspectives.

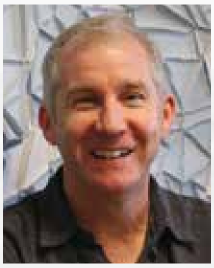
Dr Zollmann will create novel interactive 3D computational videography by combining for the first time, techniques from two existing areas: computational photography techniques which go beyond the boundaries of traditional photography and allow 3D structure to be extracted from a single photograph; and techniques recently developed in augmented reality that emphasise real-time computer vision and computer graphics.

Successful combination of these techniques will improve interactivity and quality, and could ultimately be used in interactive video editing applications.



Overview of Interactive 3D computational videography: From a sequence of video frames (Left), the proposed approach creates a dynamic 3D model (Top Right). The created dynamic 3D model includes static scene elements as well as dynamic scene elements. Based on this dynamic 3D model, the user can select new viewpoints and can experience the video content from different perspectives (Bottom Right).

UNDERSTANDING OCEAN TURBULENCE USING COOKIE MONSTERS AND FLOATING ROBOTS



Associate Professor Craig Stevens from NIWA will explore how heat and energy are transported through the turbulent waters of Cook Strait, to help understand how our planet's oceans are warming.

Ninety percent of the solar heat captured by the planet is stored in the oceans. Understanding the processes that transport and mix this heat is vital for predicting its transfer around the globe, and thus our climate. The efficiency of ocean mixing has been determined for areas with low-to-moderate turbulence. However, we are yet to understand and describe the efficiency of mixing in regions with extreme turbulence.

The Marsden Fund has awarded Associate Professor Craig Stevens, of the National Institute of Water and Atmospheric Research (NIWA) and the University of Auckland, a grant to quantify the efficiency of mixing in the Cook Strait under a spring tide – ocean conditions that are amongst the most turbulent in the world. This project has been dubbed Project Cookie-Monster (Cook Strait Internal Energetics Monitoring and Synthesis), a name that alludes to the monstrous conditions in which sampling will take place.

Associate Professor Stevens, colleague Dr Joe O'Callaghan and researchers from Australia and USA will use the latest technology, including ocean gliders and autonomous profilers, to develop a better way to represent mixing in the ocean. Drifting turbulence-measuring robots will then be deployed into the massive Antarctic Circumpolar Current to look at how this understanding holds up in the largest ocean current on the planet.

In demystifying the processes involved in ocean mixing in highly turbulent areas, Project Cookie-Monster will help to quantify a fundamental parameter in modelling ocean fluids and thus improving our ability to estimate the distribution of heat around the globe.

Deploying ocean turbulence instruments in Cook Strait

Credit: Craig Stevens

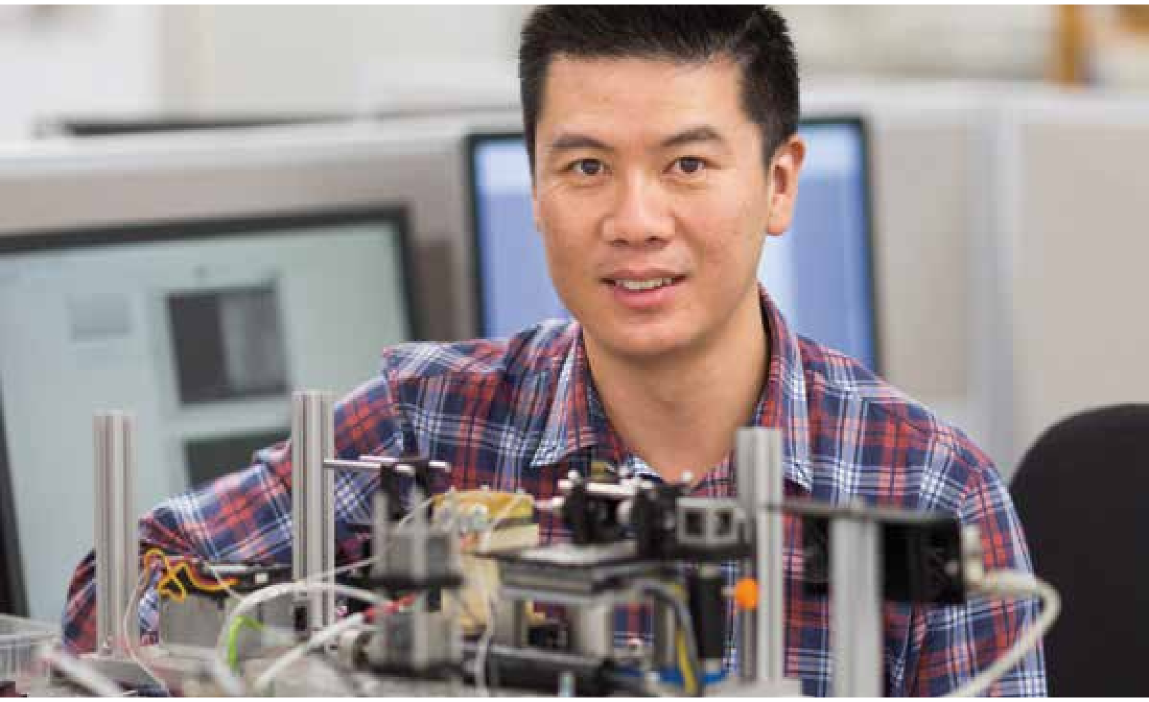
WRITING THE MODERN WORLD ACROSS THE PACIFIC

Associate Professor Alice Te Punga Somerville of the University of Waikato will examine the diverse history of 20th century indigenous writing across New Zealand and the Pacific to explore how Māori and Pacific Island communities engaged with the changing modern world.

Māori and other indigenous groups are often thought to lack a literary history. A new Marsden Fund study will challenge this perception. While indigenous literature has flourished since the 1970s, little is known of the rich history of writing that precedes this period. Yet Māori, like their counterparts across the Pacific, have been publishing throughout the 20th century and before.

Associate Professor Alice Te Punga Somerville (Te Āti Awa and Taranaki) from the University of Waikato's Faculty of Māori and Indigenous Studies will explore indigenous literature, written in both English and native languages, across newspapers, magazines, poetry and novels from Aotearoa New Zealand, Australia, Fiji and Hawai'i between 1900 and 1975. She will also examine the dynamic interactions between indigenous authors and publishers across national borders during this period, highlighting longstanding global connections amongst indigenous writers.

This research will show how indigenous peoples around the Pacific made use of the global expansion in publishing during the 20th century to discuss the dramatic social changes affecting their communities: urban migration, cultural renaissance, assimilation pressures, and activist movements. This work will bring forgotten writing back into public view, and highlight the ways that indigenous peoples helped to create the new world through the 20th century.



Dr Kenneth Tran working with one of the bioinstruments that he is using to understand how diabetes leads to heart failure.

Credit: T. P. Babarenda Gamage

WHY IS DIABETES A RISK FACTOR FOR HEART DISEASE?

Dr Kenneth Tran from The University of Auckland will develop a computer model to study how diabetes can lead to heart failure. The findings will help to develop new therapeutic strategies for diabetic patients.

The human heart is an elegant yet complex machine that continuously beats throughout our lifetime. The healthy functioning of our heart depends on a delicate balance of interacting cellular processes. However, disease can disturb this balance, often with catastrophic consequences. One key example is 'diabetic heart failure' which arises from complications of diabetes. However, uncovering the mechanisms that link diabetes and heart failure remains an ongoing challenge.

Dr Kenneth Tran, and Associate Professor Andrew Taberner from the University of Auckland's Bioengineering Institute, with Professor Edmund Crampin from the University of Melbourne, have received a Marsden Fast-Start award to address this important question. Every cell in our bodies contains mitochondria, which are the powerhouses essential for energy production. Dr Tran proposes that the primary driver of diabetic heart failure is defects in mitochondrial function. These defects cause a decline in energy supply within heart cells, leading to a reduction in the heart's ability to pump properly.

To test this, Dr Tran will take an interdisciplinary approach to characterise how diabetes leads to the development of heart failure at the cellular level. To do this, he will develop a novel instrument, purpose-built at the Auckland Bioengineering Institute, which enables experimental measurements to be made under very specific conditions. With the data, he will build a novel computational model of how diabetic cells function, and use the model to unravel the complex interactions responsible for diabetic heart disease. He will also use the model to simulate potential treatments to identify critical time points at which treatment could improve heart function.

The findings of this study will raise the prospects for the development of new therapeutic strategies for diabetic patients. With diabetes affecting 6% of our population, this research has the potential to lead to better health outcomes and improved well-being of New Zealanders.

Filter feeding adults of a Botrylloides leachii colony.

Credit: Lisa Zondag

WHOLE BODY MAKEOVER, LITERALLY

Dr Megan Wilson of the University of Otago will investigate how certain animals can completely regenerate their bodies, which could revolutionise human medicine if we could regrow human limbs and organs.

In humans, our body's ability to repair itself following injury is limited. However, some animals have the amazing ability to regenerate complex anatomy, and even completely new bodies, from as little as a few hundred cells.

Dr Megan Wilson from the Department of Anatomy at the University of Otago, together with scientists from Department of Marine Science (Otago), Israel and Switzerland, have received a Marsden Fund grant to address this, by investigating the underlying cellular mechanisms of such whole body restoration. Their work will focus on how a common marine animal, known as the sea squirt (*Botrylloides leachi*), can regenerate an entire new adult version of itself in under two weeks, from only a minute piece of tissue.

Currently, very little is known about how the sea squirt is able to regenerate, and why this capacity does not exist in humans. Dr Wilson and her team will characterise the cellular and molecular mechanisms underlying the regeneration in the sea squirt. To do this they will use state-of-the-art techniques such as cell-tracing, gene editing and genomic analysis to discover the molecular pathways involved in regulating minor injury repair, and compare these to pathways involved in whole body regeneration. They will also determine the role that stem cells play in this regeneration process.

The researchers aim to address the mystery of why some animals repair or scar, whilst others regenerate whole tissues or organs, or even bodies. A deeper understanding of the nature of the signals that instigate whole body regeneration could have important implications for humans. Imagine the impact on human medicine, if we could regrow human limbs and organs.

THE SECRET LIFE OF TRAUMATIC MEMORIES

Associate Professor Rachel Zajac of the University of Otago and Professor Maryanne Garry at the University of Waikato will delve into how people recall and process traumatic memories.

Both the general public and practising clinicians often believe that memories of traumatic experiences are fragmented, causing them to emerge jumbled with pieces missing. In this view, trauma is remembered by special mechanisms that only allow the brain to record shallow aspects without deeper conceptual processing. Many people also believe that with the right therapy, traumatic memories can be reassembled and traumatic amnesia reversed to regenerate coherent memories of such events.

While this view might seem reasonable, it rests entirely on the underlying idea that traumatic memories behave differently from non-traumatic memories. Is this really true? Surprisingly, there is no scientific evidence that memory fragmentation is harmful, encoded by a special mechanism, or even that traumatic amnesia exists.

Associate Professor Rachel Zajac at the University of Otago's Department of Psychology and Professor Maryanne Garry at the University of Waikato's Psychology Department have received a Marsden Fund grant to explore the secret life of traumatic memories. They will apply rigorous experimental methods to examine and compare how people recall traumatic and non-traumatic memories. They suggest that fragmentation occurs for most memories, but that people appraise traumatic memories differently. This sets in motion a chain of behaviours that shape memories, psychological wellbeing, and even willingness to question events.

This research will have important implications for how we understand memory and help to guide clinicians as they address the traumatic memories of their patients.

Associate Professor Rachel Zajac (L) and Professor Maryanne Garry (R)

2017 MARSDEN FUND RECIPIENTS

Contract	Title	Principal Investigators	Funds
Fast-Start Grants			
GNS1701	Probing the crust with zircon; a new pathfinder for mineral deposition?	Dr RE Turnbull (GNS Science)	$300,000
GNS1702	Shaken not stirred: What triggers slip in shallow subduction zones?	Dr JM Carey (GNS Science)	$300,000
LCR1703	Friends on the forest floor: do facilitative interactions dominate in New Zealand's unique bryoflora?	Dr AJ Brandt (Landcare Research)	$300,000
MAU1701	Making the switch: cell surface modifications that enable plant-pathogenic fungi to differentiate and maintain infection-related cellular morphotypes during host colonization	Dr CH Mesarich (Massey University Manawatu)	$300,000
MAU1705	Sea-level is not level: unraveling the drivers of spatial and temporal variations in past sea-level changes around the New Zealand coast	Dr AJH Clement (Massey University Manawatu)	$300,000
MAU1709	Population Genomics of an Emergent Plant Infectious Disease	Dr HC McCann (Massey University Auckland)	$300,000
MAU1712	Understanding friction in granular mixtures: an experimental and modelling study	Dr LA Fullard (Massey University)	$300,000
MAU1713	Encapsulation of an aqueous liquid in a drop of aqueous liquid	Dr E Nowak (Massey University Auckland)	$300,000
MAU1714	Optical Nano-Machines to Study Single-Molecules	Dr E Avci (Massey University Manawatu)	$300,000
MAU1720	Subgraph Matching: Theory and Practice	Dr M Qiao (Massey University Manawatu)	$300,000
MAU1721	Pattern Discovery from Big Medical Data	Dr X Zhu (Massey University Auckland)	$300,000
MAU1724	Māori, Catastrophic Events, and Collective Development of Culture-based Disaster Management Theory and Practice	Dr CM Kenney (Massey University Wellington)	$300,000
MAU1725	Multiple coincidences: Cuban medical cooperation in the Pacific	Dr SJ McLennan (Massey University Manawatu)	$300,000
NIW1701	Southern Ocean fronts – Still an un(re)solved mystery!	Dr E Behrens (NIWA)	$300,000
NIW1704	Where is the missing CO2? A novel multi-species approach to trace the fate of atmospheric CO2.	Dr P Sperlich (NIWA)	$300,000
UOA1702	Does ATP release contribute to perinatal brain injury after ischaemia?	Dr JO Davidson (The University of Auckland)	$300,000
UOA1703	Diagnosing the diabetic heart	Dr K Tran (The University of Auckland)	$300,000
UOA1707	The heart of song; understanding the origins of vocal learning using New Zealand's missing link, the titipounamu or rifleman	Dr KE Cain (The University of Auckland)	$300,000
UOA1708	Behaviour Before Evolution? A transdisciplinary investigation into the role of self-preserving behaviour at the origin of life	Dr MD Egbert (The University of Auckland)	$300,000
UOA1710	Initiating a Māori archaeology of threatened North Island rock art.	Dr G O'Regan (The University of Auckland)	$300,000
UOA1713	Self-adaptive vibration energy harvesting based on nonlinear energy sink	Dr L Tang (The University of Auckland)	$300,000
UOA1718	The Young Māori Party: Leading Iwi into Modernity	Dr H Kaa (The University of Auckland)	$300,000
UOA1721	Exploiting gauge theory and duality in geometry	Dr P Hekmati (The University of Auckland)	$300,000
UOA1724	Versatile and Efficient Anomaly Detection for Fog Computing Applications	Dr XZ Zhang (The University of Auckland)	$300,000
UOA1728	Consuming kids: The impact of marketing 'health' to children	Dr DA Powell (The University of Auckland)	$300,000

Contract	Title	Principal Investigators	Funds
UOC1701	The impact of massive stars on the lifecycle of galaxies: tracing massive star formation feedback in the nearby Universe	Dr AF McLeod (University of Canterbury)	$300,000
UOC1702	The solution to the Southern Ocean's sea ice mystery – its thickness	Dr DDF Price (University of Canterbury)	$300,000
UOC1704	Using synthetic communities to visualise bacterial plant leaf community development and pathogen invasion processes at the single-cell resolution	Dr MNP Remus-Emsermann (University of Canterbury)	$300,000
UOC1707	A hybrid 3D-1D framework for site-specific seismic response analysis	Dr CR McGann (University of Canterbury)	$300,000
UOC1710	Brauer groups, degrees and rational points on algebraic varieties	Dr BM Creutz (University of Canterbury)	$300,000
UOO1708	The neurobiology of maternal behaviour – dissecting the role of prolactin in the medial preoptic area	Dr RSE Brown (University of Otago)	$300,000
UOO1709	Challenging the gene silencing dogma: DNA methylation as a mechanism for gene activation	Dr A Chatterjee (University of Otago)	$300,000
UOO1714	Capturing the growth of a destructive ubiquitin chain	Dr AJ Middleton (University of Otago)	$300,000
UOO1715	CRISPR-Cas immunity in cyanobacteria	Dr RD Fagerlund (University of Otago)	$300,000
UOO1720	Searching for a human sensory 'fingerprint' – a personalised index of hedonic eating	Dr M Peng (University of Otago)	$300,000
UOO1721	Planting the Soil and Panning for Gold: Exploring the dynamics of colonial life in Otago	Dr CL King (University of Otago)	$300,000
UOO1724	Interactive 3D computational videography	Dr SE Zollmann (University of Otago)	$300,000
UOO1727	The small scales call the shots: the effect of microinstabilities on collisionless cosmic fluids	Dr J Squire (California Institute of Technology)	$300,000
UOO1729	Single photon control of optical phase using ultracold Rydberg atoms	Dr AB Deb (University of Otago)	$300,000
UOW1704	Taku ara rā, ko Tūrongo rāua ko Māhinaarangi: (re)tracing the journeys of our ancestors to restore tribal geographies.	Dr NB Simmonds (The University of Waikato)	$300,000
VUW1702	The straw that didn't break the camel's back: what variations in stressing-rate can faults withstand?	Dr CJ Chamberlain (Institue of Geophysics)	$300,000
VUW1704	Unpacking Opacity of Mind: How socio-cultural context shapes social cognition when minds are unknowable	Dr RA McNamara (Victoria University of Wellington)	$300,000
VUW1705	"Credit constraints and human capital: The effects of student loans on educational attainment, labour market success, and health outcomes Dr YWL Chu (Victoria University of Wellington)	Fast-Start	$300,000
VUW1709	Making International Economic Law: The Interaction of Institutions	Dr GF Sinclair (Victoria University of Wellington)	$300,000
VUW1710	Judging the Commerce of Empire: International Law and the British Court of Admiralty 1798-1875	Dr B Marten (Victoria University of Wellington)	$300,000
VUW1714	Exploring the inaccessible zone in the phase diagram of superconducting films using ionic liquid gating.	Dr GGJ Dubuis (Victoria University of Wellington)	$300,000
VUW1715	Photoluminescence shines a light on the exemplary optoelectronic properties in hybrid organic-inorganic perovskites	Dr K Chen (Victoria University of Wellington)	$300,000
VUW1716	Making Aotearoa Places: The Politics and Practice of Urban Māori Place-making	Dr RF Kiddle (Victoria University of Wellinton)	$300,000
VUW1717	A Kingdom in Concrete: Urbanizing Thailand in the Anthropocene.	Dr EA Elinoff (Victoria University of Wellington)	$300,000

Contract	Title	Principal Investigators	Funds
Standard Grants			
LCR1701	Plasticity or Adaptation: Evolution of Thermal Performance in New Zealand Stick Insects	Associate Professor TR Buckley (Manaaki Whenua – Landcare Research)	$925,000
LCR1702	Whole-genome duplication in plants: what is the pathway to success?	Professor WG Lee (Landcare Research)	$925,000
MAU1702	A new role for HDAC4 in neuronal morphogenesis and memory	Dr HL Fitzsimons (Massey University Manawatu)	$795,000
MAU1703	The Stuff Memories Are Made Of: How Bacteria Remember and Learn from Environmental Signals	Dr OK Silander (Massey University Auckland)	$895,000
MAU1704	Water in spinel: a robust hygrometer for the Earth and Planetary Sciences	Associate Professor GF Zellmer (Massey University Manawatu)	$832,000
MAU1706	From genotypes to phenotypes: Quantifying the functional load	Professor MP Cox (Massey University Manawatu)	$925,000
MAU1707	Improved modelling in evolutionary transcriptomics and proteomics will advance understanding of plant adaptation	Professor PJ Lockhart (Massey University)	$925,000
MAU1708	Is individual variation relevant to population dynamics?	Dr JG Ewen (Zoological Society, London), Professor DP Armstrong (Massey University Manawatu)	$870,000
MAU1710	Predict to decide: Investigating decision markets in theory, experiments and practical applications	Professor T Pfeiffer (Massey University Auckland)	$735,000
MAU1711	The greedy algae that are great for our environment: why do they pay an energy penalty to gorge phosphate?	Professor BJ Guieysse (Massey University Manawatu)	$920,000
MAU1715	AviaNZ: Making Sure New Zealand Birds Are Heard	Professor SR Marsland (Victoria University of Wellington)	$880,000
MAU1716	The Logic of Ordinary Language	Professor MJ Cresswell (Victoria University of Wellington), Associate Professor AA Rini (Massey University Manawatu)	$630,000
MAU1717	Lattice polytope samplers: theory, methods and applications	Professor ML Hazelton (Massey University)	$535,000
MAU1718	Biodiversity and the ecology of emerging infectious diseases	Professor MG Roberts (Massey University Auckland)	$415,000
MAU1719	Function from structure: accurate reduced models of neuronal networks	Professor CR Laing (Massey University Auckland)	$670,000
MAU1722	Going Superheavy – Exploring the Chemistry and Physics of the Heaviest Elements in the Remotest Corner of the Periodic Table	Dr E Pahl (Massey University Auckland), Distinguished Professor W Nazarewicz (Michigan State University), Distinguished Professor PA Schwerdtfeger (Massey University Auckland)	$910,000
MAU1723	What counts as consent? Sexuality and ethical deliberation in residential aged care	Associate Professor M Henrickson (Massey University Auckland)	$845,000
MAU1726	Living' wages: Transforming lives, transforming work?	Dr S Alefaio-Tugia (Massey University Auckland), Professor J Arrowsmith (Massey University Auckland), Professor SC Carr (Massey University Auckland), Professor DJ Hodgetts (Massey University Auckland), Professor J Parker (Massey University Auckland), Professor JM Haar (Auckland University of Technology)	$845,000
NIW1702	Ocean Mixing at High Reynolds Number: Efficiencies in Extrema	Associate Professor CL Stevens (NIWA)	$900,000
NIW1703	Volcanoes can make waves too: a new understanding of tsunamis generated by volcanic eruptions	Dr WL Power (GNS Science), Dr EM Lane (NIWA)	$858,000
PAF1701	Better red than dead: Ancient origins of stress tolerance in land plants	Dr KM Davies (Plant & Food Research), Professor BR Jordan (Lincoln University)	$895,000

Contract	Title	Principal Investigators	Funds
TWR1701	Whāngai and the adoption of Māori: healing the past, transforming the future	Ms AL Mikaere (Te Wananga o Raukawa), Dr HM Potter (Te Wananga o Raukawa), Ms M Haenga-Collins (Australian National University)	$845,000
UOA1701	Defending blood flow to the Selfish Brain	Dr FD McBryde (The University of Auckland)	$959,000
UOA1704	Functional analysis of MtING2 – Uncovering an independent mechanism for control of flowering by winter cold	Professor JJ Putterill (The University of Auckland)	$895,000
UOA1705	Rewiring life: using synthetic biology and experimental evolution to unravel the evolutionary origins of DNA.	Professor J Ogawa (University of Kyoto), Professor AM Poole (The University of Auckland)	$850,000
UOA1706	Some Liked it Hot: Searching for Early Life in Terrestrial Hot Springs	Professor KA Campbell (The University of Auckland)	$958,000
UOA1709	Land and Agriculture in Ancient Samoa: Uncovering the Origins of the Polynesian Chiefdoms	Dr EE Cochrane (The University of Auckland)	$720,000
UOA1711	Political gaming: using economic games to explore the foundations of political ideology	Professor QD Atkinson (University of Auckland), Professor A Chaudhuri (University of Auckland)	$835,000
UOA1712	Conflict recovery in families: Why inevitable conflict does not have to be detrimental.	Associate Professor NC Overall (The University of Auckland), Dr AME Henderson (The University of Auckland)	$840,000
UOA1714	Why do texturally complex foods lead us to eat less?	Associate Professor MJ Hautus (The University of Auckland), Dr N Gant (The University of Auckland), Professor BJ James (The University of Auckland)	$945,000
UOA1715	Stiffness matters: Unravelling the reciprocal relationship between tissue mechanical stiffness and cellular mechanosensitivity	Dr SR McGlashan (The University of Auckland)	$920,000
UOA1716	An Atlas of the Gut: A Framework for Integrating Structure to Function.	Professor LK Cheng (The University of Auckland)	$950,000
UOA1717	Servants of God, Slaves of the Church: Rhetoric and Realities of Service in Early Medieval Europe	Dr LK Bailey (University of Auckland)	$625,000
UOA1719	Blood and Money: The 'Military Industrial Complex' in Archaic Central Italy	Dr JS Armstrong (The University of Auckland)	$635,000
UOA1720	An Ethical Framework for Social Policy Applications of Predictive Analytics	Associate Professor T Dare (University of Auckland)	$635,000
UOA1722	Noisy networks: understanding how stochasticity affects mathematical models of cognitive systems	Associate Professor CM Postlethwaite (The University of Auckland)	$545,000
UOA1723	Free Analysis and its Applications	Associate Professor I Klep (The University of Auckland)	$455,000
UOA1725	Cells and whistles: supercharging our biodiversity monitoring toolkit using genetic and acoustic records	Associate Professor RM Fewster (The University of Auckland)	$680,000
UOA1726	Blossoming of Bioinspired Supramolecular Architectures: Towards Applications in Catalysis, Drug Delivery and Materials Science	Associate Professor JD Crowley (University of Otago), Professor CG Hartinger (The University of Auckland)	$910,000
UOA1727	Ultralight Dark Matter: Dynamics and Astrophysics	Professor RJM Easther (The University of Auckland)	$910,000
UOA1729	Going straight home? The role of stable housing in reducing re-offending by ex-prisoners	Dr AL Mills (The University of Auckland)	$845,000
UOA1730	Tāngata Tiriti: Learning the trick of standing upright here	Dr A Bell (The University of Auckland), Dr BJ Lythberg (University of Auckland Business School), Associate Professor CR Woods (The University of Auckland)	$845,000
UOA1731	Shaping Public Policy: Mixed Methods Study of Alcohol, Tobacco, Gambling and Food Industry Points of Influence with Policy Makers	Professor K Kypri (University of Otago), Professor PJ Adams (The University of Auckland)	$825,000

Contract	Title	Principal Investigators	Funds
UOC1703	Does mother know best? Mothers, fathers and sexual conflict in sex allocation	Associate Professor EZ Cameron (University of Canterbury), Professor KJ Stafford (Massey University)	$855,000
UOC1705	A bird in the bush with the data at hand: predicting ecological networks using traits and phylogenies	Professor JM Tylianakis (University of Canterbury)	$865,000
UOC1706	Removing nitrate from contaminated water using methane. Which microbes are doing the work?	Associate Professor PA Gostomski (University of Canterbury), Ms KHR Baronian (University of Canterbury), Dr L Weaver (Institute for Science and Environmental Research)	$945,000
UOC1708	Towards an improved theory of language change: understanding the covariation of linguistic variables within and across speakers	Dr KD Watson (University of Canterbury)	$635,000
UOC1709	The Combinatorics of Reticulate Evolution	Professor CA Semple (University of Canterbury), Professor MA Steel (University of Canterbury)	$665,000
UOC1711	Tailored environments for highly active and stable electrocatalysts	Professor AJ Downard (University of Canterbury), Dr AT Marshall (University of Canterbury)	$910,000
UOO1701	The sex of stress: Understanding sex differences in neural circuits controlling stress.	Dr KJ Iremonger (University of Otago)	$958,000
UOO1702	Defining the brain circuits that interface hunger state with reward signalling to guide food consumption	Professor BI Hyland (University of Otago)	$959,000
UOO1703	Androgen excess and the female brain	Associate Professor RE Campbell (University of Otago)	$960,000
UOO1704	New players in protein recycling	Professor SPA McCormick (University of Otago)	$957,000
UOO1705	Investigating the role of peroxiredoxin redox relays in cell signalling	Professor MB Hampton (University of Otago, Christchurch)	$959,000
UOO1706	Deconstructing the neuroendocrine requirements for puberty onset and ovulation	Professor GM Anderson (University of Otago)	$960,000
UOO1707	NO Heart: A novel mechanism for modulating cardiac calcium by nitric oxide	Dr JR Erickson (University of Otago)	$937,000
UOO1710	Unraveling the molecular basis for vivax malaria's unhealthy attraction to human reticulocytes	Dr BM Russell (University of Otago)	$960,000
UOO1711	Uncovering regulatory networks controlling CRISPR-Cas adaptive immunity	Associate Professor PC Fineran (University of Otago)	$945,000
UOO1712	Lost in translation: Discovering how plant genes are regulated	Associate Professor RC Macknight (University of Otago)	$895,000
UOO1713	Understanding the cellular and molecular drivers governing a unique whole body regeneration phenomenon in a chordate model.	Dr MJ Wilson (University of Otago)	$820,000
UOO1716	Stretching ice to the limit: New flow laws for ice sheets	Professor DJ Prior (University of Otago)	$960,000
UOO1717	How does the Earth stop global warming? Testing climate stabilisation during 'hyperthermal' events	Professor CH Stirling (University of Otago)	$960,000
UOO1718	Microbes at the helm: are microbiomes shaping parasite phenotypes?	Professor R Poulin (University of Otago)	$890,000
UOO1719	TB or not TB – examining the origin and evolution of tuberculosis in the pre-European Pacific	Dr M Knapp (University of Otago)	$920,000
UOO1722	The Secret Life of Traumatic Memories	Associate Professor RA Zajac (University of Otago), Professor M Garry (The University of Waikato)	$695,000
UOO1723	A computational theory of collective action	Professor SJS Cranefield (University of Otago)	$460,000
UOO1725	Microresonator frequency combs through second-order nonlinearities	Dr HGL Schwefel (University of Otago), Dr MJ Erkintalo (The University of Auckland)	$910,000

Contract	Title	Principal Investigators	Funds
UOO1726	Making, Probing, and Understanding Two-Dimensional Quantum Turbulence	Dr AS Bradley (University of Otago)	$905,000
UOO1728	Polymer-Immobilized Carbon Monoxide Donors: Agents for Tissue Protection	Professor DS Larsen (University of Otago), Associate Professor IA Sammut (University of Otago)	$910,000
UOO1730	Putting Hope into Action: What inspires and sustains young people's engagement in social movements?	Associate Professor KM Nairn (University of Otago)	$840,000
UOO1731	Whakaarahia anō te rā kaihau! Raise up again the billowing sail! Revitalising cultural knowledge through analysis of Te Rā	Ms DL Campbell (University of Waikato), Dr CA Smith (University of Otago)	$845,000
UOO1732	Betwixt two worlds? Disruptive technology and negotiating identity change	Professor JA Hoek (University of Otago, Wellington)	$845,000
UOO1733	Eviction and its consequences: representation, discourse and reality	Professor PLH Howden-Chapman (University of Otago)	$845,000
UOW1701	From Geothermal Hot Springs to Microbial Gene Pools: Explaining Intra-Species Genomic Variations in Bacteria	Dr CK Lee (The University of Waikato), Professor MF Polz (Massachusetts Institute of Technology)	$925,000
UOW1702	Writing the new world: Indigenous texts 1900-1975.	Associate Professor A Te Punga Somerville (University of Waikato)	$642,000
UOW1703	Refugee families in early childhood education: constructing pathways to belonging	Associate Professor LM Mitchell (The University of Waikato)	$845,000
VUW1701	Did a previous collapse of the Antarctic Ice Sheet cause abrupt climate change in the Southern Hemisphere?	Associate Professor AN Mackintosh (Victoria University of Wellington)	$960,000
VUW1703	Silencing immunity to determine how pathogens influence invasion success	Professor PJ Lester (Victoria University of Wellington)	$925,000
VUW1706	Does the Tracking of Others' Mental States Depend on Motor Processes? Why Constraining Your Body Limits Your Understanding of Others' Minds.	Associate Professor JK Low (Victoria University of Wellington)	$840,000
VUW1707	Developmental changes in children's learning and application of "ground rules" during interviews about past experiences	Dr DA Brown (Victoria University of Wellington)	$840,000
VUW1708	Training multiplexed electronic aptasensors to profile hormones in complex samples	Dr NOV Plank (Victoria University of Wellington)	$950,000
VUW1711	Revealing Desire between Men in the Byzantine Empire	Dr M Masterson (Victoria University of Wellington)	$476,000
VUW1712	Uncountable structures and effective properties	Professor N Greenberg (Victoria University of Wellington)	$660,000
VUW1713	Supercharging electromagnetism: Tuneable magnetoelectricity in unconventional materials	Professor UOP Zuelicke (Victoria University of Wellington)	$905,000

For the complete list of awarded Marsden Fund investigators please see: https://royalsociety.org.nz/what-we-do/funds-and-opportunities/marsden/awarded-grants/marsden-awards-2017/

Marsden Fund
Royal Society Te Apārangi
11 Turnbull Street, Thorndon,
Wellington 6011
PO Box 598,
Wellington 6140,
New Zealand

T +64 4 470 5799
E marsden@royalsociety.org.nz
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