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MARSDEN FUND 2020 UPDATE

MARSDEN FUND
TE PŪTEA RANGAHAU A MARSDEN

ROYAL SOCIETY TE APĀRANGI

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MŌ TE PŪTEA A MARSDEN

E whakahaerehia ana te Pūtea Marsden e Te Apārangi mō te taha ki te kāwanatanga. E tautoko ana te Pūtea a Marsden i te hiranga i roto i ngā rangahau tino mātāmua rawa i Aotearoa. Ka tīpakohia ngā kaupapa i ia tau mā tētahi tukanga pakari e ngā rōpū whiriwhiri tekau e ārahina ana e ngā whakaaro o ngā kairangahau ā-ao, whakaihuwaka ā-ao hoki.

Ko te tikanga ka rato ngā pūtea ki te toru tau mō ia takuhe. E rua ngā momo takuhe: Ngā takuhe Tīmata-Wawe $300 mano (kore GST) te wāriu i roto i te toru tau mā ngā kairangahau pūhou, ā, ka taea te tuku takuhe Aro Whānui atu ki te $960 mano (kore GST) mō te toru tau. Ka utua e ngā takuhe ngā utu ā-tau, ngā tūranga ākonga me te kairangi, me ngā taonga hoki.

He kairapu te Pūtea a Marsden, ā, mō ngā kaupapa ā-kaitūhura, ka mutu kāore e herea ana ki ngā kaupapa matua a te kāwanatanga. E whakahaerehia ana e Te Apārangi, ā, nā te Kāwanatanga o Aotearoa te pūtea. He mea whakaingoa tēnei Pūtea ki te kaiahupūngao a Tā Ernest Marsden. He mea whakatū e te kāwanatanga i te tau 1994. E kīia ana ko te Pūtea a Marsden te taumata o te hiranga, e taea ai e ngā kairangahau toa rawa o Aotearoa te hōpara i ō rātau huatau.

MŌ TE APĀRANGI

He whakahaere huamoni-kore motuhake a Te Apārangi e tautoko ana i ngā tāngata o Aotearoa ki te hōpara, tūhura me te tuari mōhiotanga. Ka tuku pūtea mā ana kaupapa me te tuku whai wāhitanga akoranga ki ngā kairangahau, kaiako, ākonga kura, me rātau e pakiki ana ki te ao.

Hei whakanui i ngā tūhuratanga o ngā kairangahau o Aotearoa, ka whakawhiwhia e Te Apārangi ngā mētara me te tohu Pūkenga, he manukura nō ō rātau wāhanga. Ka āwhina ēnei tohunga i te Apārangi ki te tuku tohutohu motuhake ki ngā tāngata o Aotearoa me te kāwanatanga mō ngā take e arohia ana e te iwi whānui. He whānui te kōtuinga mema me ngā hoa o Te Apārangi puta noa i Aotearoa me te pōhiri i te hunga e kaingākau ana ki ngā mahi a ngā tāngata o Aotearoa ki te hōpara, tūhura me te tuari mōhiohio kia whakauru mai.

Mō ētahi atu kōrero anō haere ki royalsociety.org.nz

ABOUT THE MARSDEN FUND

The Marsden Fund Te Pūtea Rangahau a Marsden supports excellence in leading-edge research in Aotearoa New Zealand. Projects are selected annually in a rigorous process by ten panels which are guided by the opinions of world-leading, international researchers.

Funding is usually spread over three years for each grant. There are three types of grants: Fast-Start grants worth $300K (excl. GST) over three years for early career researchers (increasing to $360K from 2021); Standard grants that can be worth up to $960K (excl. GST) for three years; and Marsden Fund Council Award grants worth up to $3 million (excl. GST) over three years. Grants pay for salaries, students and postdoctoral positions, and consumables.

The Marsden Fund is contestable, is for investigator-driven research projects, and is not subject to government socio-economic priorities. It is administered by Royal Society Te Apārangi and funded by the New Zealand Government. 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 ideas.

ABOUT ROYAL SOCIETY TE APĀRANGI

Royal Society Te Apārangi is an independent not-for-profit organisation that supports all New Zealanders to explore, discover and share knowledge. Its varied programmes provide funding and learning opportunities for researchers, teachers and school students, together with those who are simply curious about the world.

To celebrate the discoveries of New Zealand researchers, the Society awards medals and elects Fellows, who are leaders in their fields. These experts help the Society to provide independent advice to New Zealanders and the government on issues of public concern. The Society has a broad network of members and friends around Aotearoa and invites all those who value the work New Zealanders do in exploring, discovering and sharing knowledge to join with them.

To discover more visit royalsociety.org.nz

PROJECT HIGHLIGHTS FROM NEW MARSDEN FUND AWARDS

SUPPORTING WORLD-LEADING RESEARCH

In 2020, the Marsden Fund Te Pūtea Rangahau a Marsden allocated $84.751 million (excluding GST) to 134 research projects led by researchers in Aotearoa. These grants support excellent New Zealand research in the humanities, sciences, maths, social sciences and engineering.

This year, one large interdisciplinary project received a Marsden Fund Council Award worth $3 million (excluding GST).

The project will investigate the links between asthma in young children in Aotearoa and biodiversity, providing valuable insight into the role biodiversity plays in children's respiratory health, and whether areas containing native plant species are even more beneficial.

Established research leaders and their teams were awarded 74 Marsden Fund grants with a success-rate of 10.3%.

The research projects address a range of issues of both local and international importance including studying the impacts of Australian bushfires on New Zealand glacial environments; understanding the early universe through newly developed computational techniques; investigating whether 'upzoning' will make housing more affordable; using MRI to measure pressure on the brain; and transforming the Sport for Development field through the inclusion of Indigenous and feminist voices.

Marsden Fund Fast-Start grants support early career researchers to develop independent research and build exceptional careers in New Zealand.

In 2020, there were 59 recipients of Fast-Start grants for a total of $17,700,000 (excluding GST). The success rate was 13.3% for these awards. Projects include topics such as the impacts of transracial adoption on identity and wellbeing for Māori adoptees and their descendants; how toxic metal accumulation affects the brain of honeybees and hive health; and the causes of the dramatic decline of smoking, drinking and drug use among New Zealand teens.

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The research projects have undergone a highly rigorous selection process, including substantial international peer review, and are consequently of world class standard.

Marsden Fund Council Chair **Professor David Bilkey** says, "it is always humbling to see both the quality and breadth of excellent research that is being conducted within New Zealand. I congratulate those who have received funding, but I am also aware these are highly competitive funding rounds, and there are many excellent proposals that we are unfortunately unable to support. New Zealanders are world leaders in many research areas and the Marsden Fund plays a critical role in ensuring that we continue to have expertise available in these fields. Furthermore, Marsden Fund support enhances connectivity between researchers, both nationally and internationally whilst also facilitating the engagement between researchers and their communities."

> "It is always humbling to see both the quality and breadth of excellent research that is being conducted within New Zealand."
>
> **PROFESSOR BILKEY**

"The engagement with mātauranga Māori has been recognised across discipline areas," notes Professor Bilkey. Some examples include investigating how Māori food realities, values and kaupapa principles can shape discussions about what we eat, how we obtain it, and how we value it; finding out why Māori make their electoral roll choice and exploring Māori views on whether they see Māori electorates as a means of asserting Māori sovereignty or as a legacy of colonial rule; and developing a theory of anti-racism based on both kaupapa Māori theory and Western paradigms to address racism and Māori health inequities in New Zealand's health system.

The overall success rate for applicants is up slightly from last year (10.7%) to 11.5% this year. However, of the six proposals submitted for this round, only one Marsden Fund Council Award was funded, as opposed to two last year.

E TAUTOKO ANA TE PŪTEA MARSDEN

I NGĀ RANGAHAU MĀTĀMUA O TE AO

He $84.751 miriona (kore GST) kua tohaina e Te Pūtea Rangahau a Marsden ki ngā kaupapa rangahau 134 e ārahina ana e kairangahau i Aotearoa. E tautoko ana ēnei takuhe i ngā rangahau tino rawe o Aotearoa i roto i te o te mātauranga tikanga tangata, te pūtaiao, te pāngarau, pūtaiao, pāngarau, mātauranga tangata me te pūkaha.

I tēnei tau kotahi te kaupapa pūkenga whitiwhiti nui i whiwhi i te Tohu Kaunihera Pūtea a Marsden mō te $3 miriona (kore GST).

Ka tūhura te kaupapa i ngā hono i waenga i te huangō i roto i ngā tamariki nohinohi i Aotearoa me te rerenga rauropi, te tuku tirohanga hira ki te mahi a te rerenga rauropi i roto i te hauora romahā o ngā tamariki, ā, mēnā he whai hua ake ngā wāhi kei reira ngā momo tipu taketake.

I whakawhiwhia ngā kaiārahi rangahau matatau me ō rātau rōpū ki ngā takuhe Pūtea Marsden 74 me te auau angitu o te 10.3%.

Ka whakarite ngā kaupapa rangahau i ngā tūmomo raruraru hira i konei me te tāwāhi, tae atu ki te rangahau i ngā pānga o ngā ahi kai ngahere i Ahitereiria ki ngā wāhi kōpaka o Aotearoa; te mārama ki te ao tukupū pūhou mā ngā tikanga ā-rorohiko hou; te tūhura mēnā ka whaiutu ake te hanga whare teitei; te whakamahi i te MRI hei ine i te pēhanga ki te roro; me te takahuri i te wāhanga Hākinakina mō te Whanaketanga mā te whakauru mai i ngā reo Iwi Taketake, mana wahine hoki.

E tautoko ana ngā takuhe Tīmata Wawe a te Pūtea Marsden i ngā kairangahau pūhou ki te whakawhanake i ngā rangahau motuhake me te waihanga i ngā ara mahi tino rawe i Aotearoa.

I te 2020, 59 te hunga i whakawhiwhia ki ngā takuhe Tīmata Wawe, he $17,700,000 (kore GST) te rahinga. He 13.3% te auau angitu mō ēnei tohu. Ko ētahi o ngā kaupapa ko ngā pānga o te whānau ki mātāwaka ki te tuakiri me te oranga o te hunga Māori i whāngaitia me ā rātau uri; he pēhea te pānga whakatōpū o te konganuku tāoke ki te roro o ngā pīmiere me te ora o te kōhanga pī; ngā pūtake o te nui o te heke o te kai paipa, te inu waipiro me te kai whakapōauau i waenga i ngā taiohi o Aotearoa.

Photo credit: Dr Alexander Taylor

He tino pakari te tukanga tīpako i ngā kaupapa rangahau, tae atu ki te arotake aropā ā-ao matawhānui, nō reira he tino tiketike te taumata nā tēnei.

Hei tā te Heamana o te Kaunihera Pūtea a Marsden a **Ahorangi David Bilkey**, "ka ora te ngākau ki te kite i te kounga me te whānui o ngā rangahau tino rawe e whakahaerehia ana i roto o Aotearoa. Ka mihi ahau ki te hunga i whiwhi pūtea, engari kei te mōhio ahau he rauna pūtea ēnei e nui ana te whakataetaetia, ā, he nui ngā kaupapa tino rawe kāore i taea e mātau te tautoko. Kei mua a Aotearoa e haere ana i roto i te maha o ngā wāhi rangahau, ā, he wāhi tino nui tō te Tahua Marsden ki te whakarite ka wātea tonu mai ngā pūkenga i roto i ēnei wāhanga. Waihoki, ka hāpai ake ngā tautoko a te Pūtea Marsden i te honohononga i waenga i ngā kairangahau, i konei me tāwāhi me te takawaenga anō i te whakawhitiwhititanga i waenga i ngā kairangahau me ō rātau hapori."

"ka ora te ngākau ki te kite i te kounga me te whānui o ngā rangahau tino rawe e whakahaerehia ana i roto o Aotearoa."

PROFESSOR BILKEY

"E mōhiotia ana te toronga atu ki te mātauranga Māori puta noa i ngā wāhi mātauranga," te kī a Ahorangi Bilkey. Ko ētahi tauira ko te tūhura me pēhea te waihanga kōrerorero mō ngā kai Māori, ngā uara me ngā mātāpono mō ngā mea ka kainga e tātau, me pēhea te whiwhi, ā, me pēhea te uara; te rapu he pēhea te kōwhiri a te Māori i tā rātau rārangi pōti me te hōpara i ngā whakaaro Māori mēnā ki ō rātau whakaaro ko ngā rohe pōti Māori te ara ki te tino rangatiratanga Māori, he kaupapa tikanga taipūwhenua tuku iho rānei; me te waihanga i tētahi ariā ārai kaikiri i ahu mai i te ariā kaupapa Māori me ngā kaupapa whakaaro Pākehā hei whakatūtaki i te kaikiritanga me ngā rerekētanga o te hauora Māori i roto i te pūnaha hauora o Aotearoa.

Kua āhua piki te rahinga o ngā kaitono i waimarie mai i tērā tau (10.7%) ki te 11.5% i tēnei tau. Engari, o ngā tono e ono i tukuna mai mō tēnei rauna, kotahi anake te Tohu Kaunihera Pūtea a Marsden i utua, ā, e rua kē i tērā tau.

MARSDEN FUND COUNCIL AWARD

IN THE GREEN

COULD LOCAL PLANT DIVERSITY BE THE KEY TO UNDERSTANDING CHILDHOOD ALLERGIES AND ASTHMA?

Professor Jeroen Douwes, Professor John Potter, Associate Professor Andrea 't Mannetje, Dr Collin Brooks and **Dr Marine Corbin** from Massey University, **Dr Caroline Shorter** and **Professor Julian Crane** from University of Otago, and their wider team of researchers, have won an Marsden Fund Council Award of $3 million (excluding GST) over 3 years, to investigate the links between asthma in young children in Aotearoa and biodiversity.

New Zealand has amongst the highest rates of asthma and allergy in the world, with Māori and Pasifika disproportionately affected. Asthma sufferers cannot be cured – only the symptoms can be managed. This is because we do not yet have a clear understanding of what triggers asthma development. Studying a group of 50,000 children, this multidisciplinary team has discovered that tamariki exposed to more green space were less likely to develop asthma. This effect was even more pronounced in areas with high biodiversity containing native plant species. In this Marsden Fund Council Award study, the team will build on these findings and explore in greater depth the role of local biodiversity in asthma and allergy.

There is increasing evidence that the variety of microorganisms living within the human gut play critical roles in maintaining human health. This study will explore whether loss of environmental biodiversity and reduced access to green space are linked to differences in New Zealand children's gut microbiota, and consequently to development of asthma and allergy. They will also investigate whether changes in gut microorganisms over time are associated with these factors.

Finally, they will compare samples from asthmatic and non-asthmatic children in Aotearoa, Ecuador, Brazil and Uganda to determine whether there are differences in human microbiota between different countries, which could account for the high asthma rates seen here.

This large multidisciplinary study will provide valuable insight into the role biodiversity of the local environment plays in children's respiratory health. It could also provide exciting and novel strategies for protecting our tamariki from asthma and allergy.

There is increasing evidence that the variety of microorganisms living within the human gut play critical roles in maintaining human health.

NGĀ TIPU

KO NGĀ TIPU KANORAU O KONEI TE PŪTAKE E MĀRAMA AI TĀTAU KI NGĀ MATE PĀWERA ME TE HUANGŌ I TE WĀ TAMARIKI?

Kua waimarie a **Ahorangi Jeroen Douwes, Ahorangi John Potter, Ahorangi Tuarua a Andrea 't Mannetje, Tākuta Collin Brooks** me **Tākuta Marine Corbin** o Te Kunenga ki Pūrehuroa, **Tākuta Caroline Shorter** me **Ahorangi Julian Crane** o Te Whare Wānanga o Ōtāgo, me tō rātau rōpū rangahau whānui i whakawhiwhia ki tētahi Tohu Kaunihera Pūtea a Marsden hei tūhura i ngā hono i waenga i te huangō o ngā tamariki i Aotearoa me te rerenga rauropi.

Ko Aotearoa tētahi whenua i te ao e tino kaha rawa te pā mai o te huangō me te mate pāwera, ā, e nui rawa te pā mai ki te Māori me ngā uri Pasifika. Tē taea te hunga mate huangō te whakaora – ko te whakamāmā anake i ngā tohumate. Ko te take e pēnei ai he kore kē nō tātau e mōhio ki ngā pūtake e pā mai ai te huangō. Mā te rangahau i ngā tamariki 50,000, kua kitea e tēnei rōpū pūkenga maha ko te hunga i whai wāhi ki ngā wāhi tipu nui ake he iti iho te tūpono pā mai o te huangō. He nui ake te kitea o tēnei i ngā wāhi he tino nui te rerenga rauropi e whai ana i ngā momo tipu tūturu. I roto i tēnei Tohu Kaunihera Pūtea a Marsden, ka whakawhānui ake te rōpū i ēnei kitenga me te hōpara kia tino whānui ake te wāhanga o te rerenga rauropi paetata i roto i te mate huangō me te pāwera.

E nui haere ana ngā whakaaturanga e tohu ana he wāhanga nui tō ngā tūmomo moroiti e noho ana i roto i te puku o te tangata mō te noho hauora. Ka hōpara tēnei rangahau mēnā he hono tō te korenga o te rerenga rauropi me te iti haere o ngā wāhi tipu ki ngā rerekētanga o ngā moroiti o ngā puku o ngā tamariki o Aotearoa, ā, me te pā mai o te mate huangō me te pāwera. Ka tūhuratia anō e rātau mēnā he pānga tō ngā rerekētanga ki ngā moroiti o te puku i roto i te wā ki ēnei āhuatanga.

Otirā, ka whakataurite rātau i ngā tīpakonga mai i ngā tamariki mate huangō me te kore mate huangō i Aotearoa, Ekuatoa, Parihi me Ukānga hei whakatau mēnā he rerekētanga i roto i ngā moroiti o te tangata i waenga i ngā whenua rerekē, e whakaatu ana i te take e nui ai te pā mai o te mate huangō i konei.

Ka kitea e tēnei rangahau pūkenga maha nui te wāhanga o te rerenga rauropi o te taiao o konei ki te hauora romahā o ngā tamariki. Ka puta anō pea i tēnei ko ngā rautaki rerekē mō te tiaki i ā tātau tamariki mai i te mate huangō me te pāwera.

MARSDEN FUND STANDARD GRANTS

E-CIGARETTES

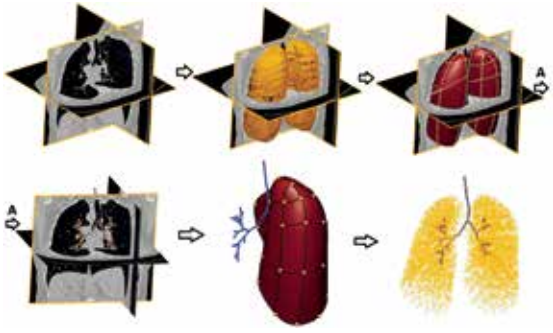
A SAFER ALTERNATIVE FOR SMOKERS?

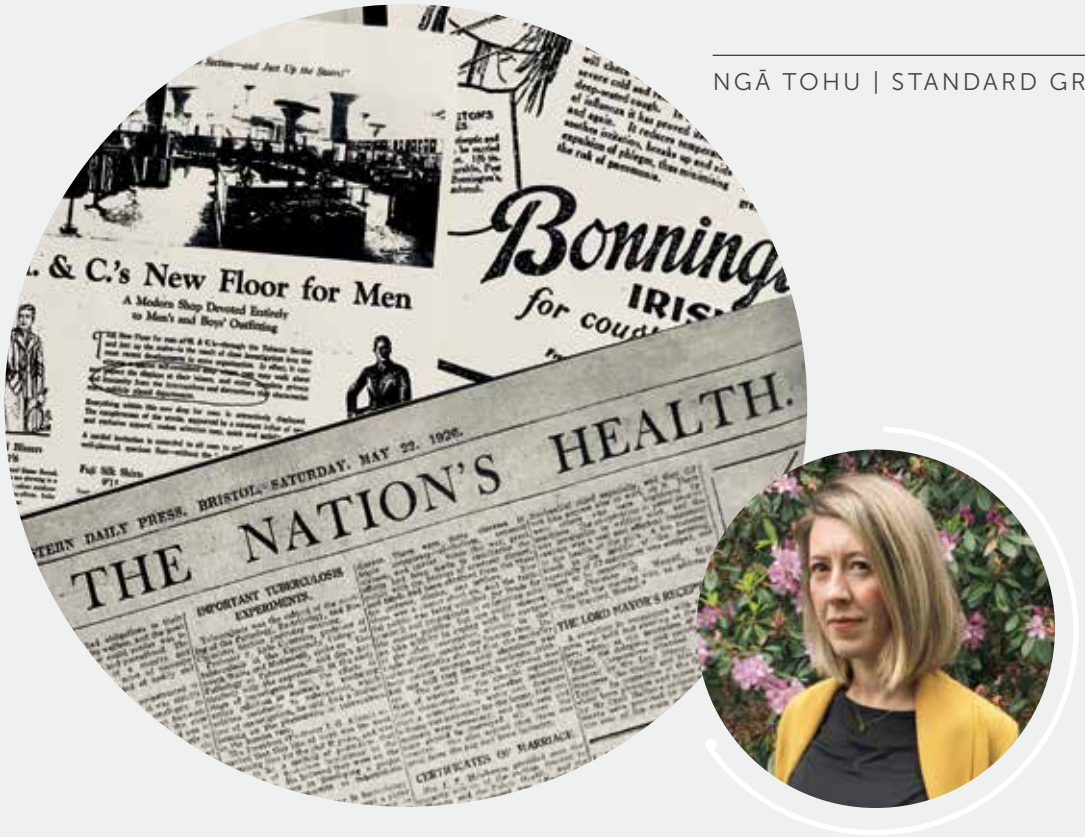
Dr Kelly Burrowes from the University of Auckland will revolutionise our understanding of electronic cigarettes and their impact on lung health through an integrative, data driven toxicology framework.

Electronic cigarettes (ECs) are touted as a safer alternative to conventional cigarettes. Perhaps they could be viewed as a "lesser of two evils" for current cigarette smokers. Yet, it is clear that there is a lot about ECs that we don't know.

ECs are electronic devices that heat a liquid, usually propylene glycol and glycerol, with nicotine and flavours, stored in disposable or refillable cartridges or a reservoir, and disperse it with an aerosol for inhalation. Since ECs appeared on the market, there has been a steady growth in sales worldwide. In Aotearoa New Zealand, 3.2% of adults use an EC at least once a day. They are also being promoted here as a tool to reach the targets for Smokefree 2025. Smokers, healthcare providers and regulators need to be sure that these devices can actually reduce the harm associated with smoking, and don't create further risks. There are significant gaps in our understanding of their short-term and long-term health effects, and while this is being addressed by a range of separate research disciplines, there is poor integration of data across these different research fields, impeding progress towards understanding the potential risks of EC use.

Dr Burrowes and her team will develop a new framework that integrates different data, including analysing what goes into EC aerosols, where they go in the body, and what effect they have on a cellular level as well as on a whole-organ level. With the help of state-of-the-art imaging techniques, the team will lead the world's most advanced study on the impact of EC use on lung health.





SHARED IMMUNITY

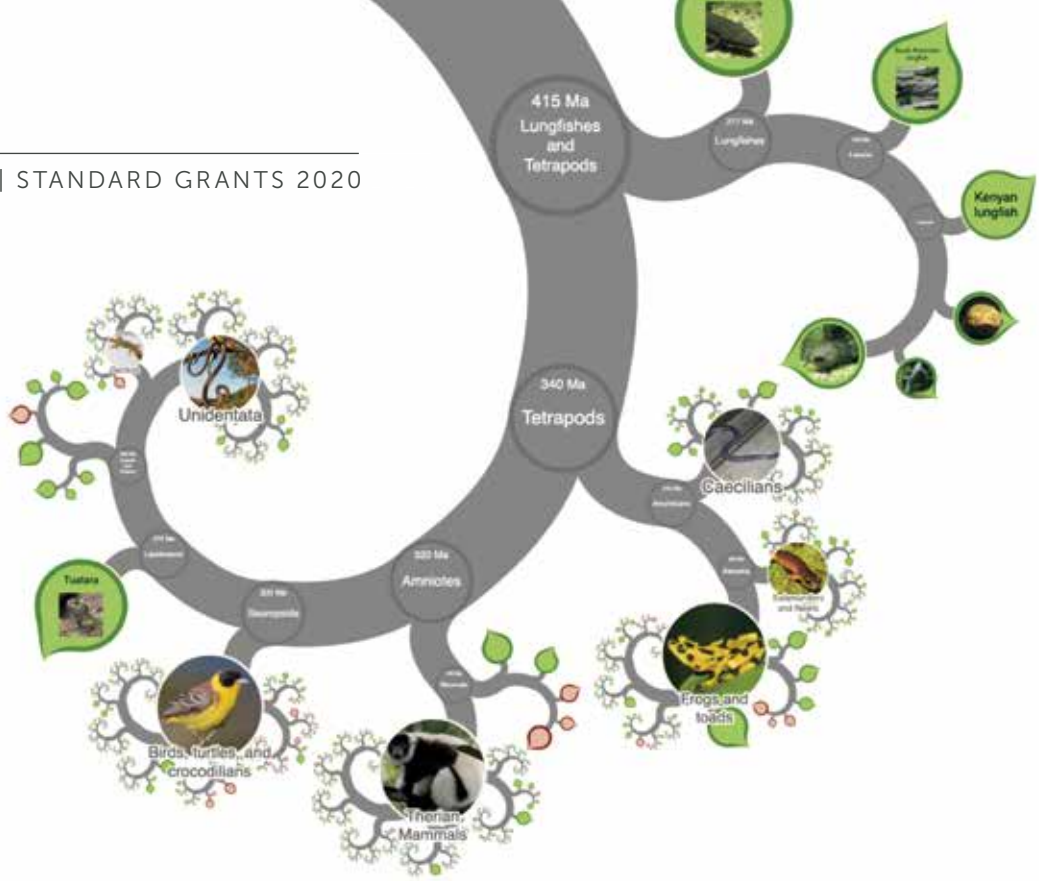
POETIC AND POLITICAL

Dr Maebh Long, University of Waikato, will explore how modernist writers fused and developed political and medical metaphors of immunity. Her transnational analysis will allow her to develop a new framework for research on literary and cultural responses to medical and political threats, including the current COVID-19 pandemic.

From the mid-nineteenth century, as knowledge of invisible germs panicked and fascinated the public, scientists borrowed the word 'immunity' from political spheres to illustrate the body's resistance to disease. For lay people coming to understand the presence of the microbial, the modern world appeared rife with invisible threats. However, advances in immunology assuaged these fears and gave the public the reassurance of bodily defences. The medical metaphor began reshaping political uses and political ideas became steeped in images of protection from ideological contagion or threatening groups.

Dr Long will identify and analyse the innovative ways modernist writers responded to anxieties of anticipated harm. She will develop a poetics (theory of literary discourse) of immunity, explaining how modernist writers fused and developed these medical and political metaphors that evoked ideas of protection, resistance and improvement. She will undertake a transnational analysis of a poetics of immunity within modernist texts from Britain, Ireland, New Zealand and Australia. This analysis will explore the ways poetics arise from the movement of power and influence across interconnected countries. This will include an examination of the conjunctions between a poetics of immunity and island nations' imagery of self-containment, isolation and impenetrability.

This research will use modernist experiences to throw light on public responses to COVID-19 quarantines, unemployment, anticipatory grief and death. It will provide an interpretative model that researchers from different fields can draw on when analysing future medical events and crises.



DISAPPEARING 'TREE OF LIFE'

THE MATHEMATICS OF EXTINCTION

Professor Mike Steel and **Professor Charles Semple** from the University of Canterbury will investigate mathematical models for extinction events in the tree of life.

Life on Earth has been shaped by five mass extinction events over the last 500 million years. Unfortunately, human impacts on the natural world are precipitating a sixth. The diversity of life is modelled using 'evolutionary trees', and each species that goes extinct is a branch 'pruned' from the tree. The harsh pruning of a mass extinction event leads to widespread loss of unique features and genetic diversity.

Professor Steel, Professor Semple and their international team will develop and apply new mathematical techniques and models to investigate the precise relationships between the different measures of biodiversity used to generate evolutionary trees. They will explore the extent to which extinction of species is linked to the loss of feature diversity, the key biodiversity measure targeted in conservation efforts. They will also develop and analyse more complex models of multiple species loss based on 'extinction cascades', investigating their impact on feature diversity loss.

This research will provide a mathematical and algorithmic framework for addressing some fundamental questions in biodiversity theory and conservation that are increasingly relevant during today's climate and ecological crises.

Explore the Tree of Life OneZoom.org

FAILING HEARTS

IN A WARMING WORLD

Associate Professor Tony Hickey and **Dr David Crossman** from the University of Auckland will study why each animal species has a critical temperature limit for mitochondrial and heart function.

Due to climate change, global temperatures are on the rise. In response, an organism's metabolic rate and oxygen consumption must also increase. In particular, an animal's heart must work harder with increasing temperature to meet the body's growing demand for oxygen. There is a certain critical temperature limit, nearing which an animal will experience heart failure and die. This limit varies between species, and for some it is only 2°C higher than habitat temperatures, a change which is alarmingly well within global warming predictions!

Mitochondria are the tiny but essential powerhouses of cells, including those of the heart. Associate Professor Hickey, Dr Crossman and their international team have discovered that near the temperature limit, heart mitochondria fail to produce sufficient energy for survival, effectively dictating the upper-temperature limit of animals. The precise mechanisms leading to mitochondrial failure, however, are not understood. Cold-blooded animals, such as fish, have evolved to live at specific temperatures. Using temperate and tropical fish, the team will study the effects of increasing temperature on heart mitochondria. Using specifically developed equipment and advanced microscopy, they will define the causes of mitochondrial failure, and why the critical temperature limit differs between species. This Marsden-funded research will be the most comprehensive analysis ever carried out on the effects of temperature on mitochondrial function, and will yield valuable insights into biological impacts of a warming world.

NURSERY CRIMES

WHEN NON-NATIVE ORNAMENTAL PLANTS BECOME ENVIRONMENTAL WEEDS

Distinguished Professor Philip Hulme FRSNZ from Lincoln University, and **Professor Charles Perrings** from Arizona State University will investigate the potential impact of popularity and pricing of non-native ornamental plants on invasive species distribution.

Ornamental plants are the primary source of environmental weeds both worldwide and in Aotearoa. These weeds pose serious threats not only to the natural environment but also to environmentally-based economic sectors. One of the issues faced in tackling this problem is that it is not well understood why some non-native species escape from cultivation to become invasive weeds when others don't. Professor Hulme and his team will test the novel hypothesis that the likelihood of a non-native ornamental plant species becoming invasive can be explained by the factors that affect demand for garden plants: gardener preferences for particular biological attributes and plant prices.

This research will integrate economic variables, human behaviour and biological attributes to forecast future biological invasions by non-native ornamental plants. Using an extensive collection of historical nursery catalogues, Professor Hulme will assess how the risk of plant invasions are shaped by the price, prevalence and popularity of non-native plants relative to their biological attributes. The results will have a major impact on how the risks of plant invasions are assessed and will generate new risk assessment tools that also integrate the social dimension of biological invasions.

A clearer understanding of the behavioural and economic drivers of ornamental plant invasions will underpin development of broader and more successful methods to manage potentially invasive plant species than the current approaches, which are based on sales and import bans.

BETTER THAN A HOLE IN THE HEAD

USING MRI TO MEASURE PRESSURE ON THE BRAIN

Dr Samantha Holdsworth and **Dr Sarah-Jane Guild** of the University of Auckland will determine if their newly developed medical imaging method can be used as a non-invasive measure of intracranial pressure.

Head injuries, brain tumours and meningitis are some of the many conditions that can lead to an increase in pressure around the brain, or intracranial pressure. If this pressure is not relieved, it can lead to serious consequences for the patient including brain injury, coma, and even death. Currently the only way to diagnose an increase in intracranial pressure is to measure it through a hole drilled into the patient's skull. But what if intracranial pressure could be measured with a non-invasive method such as a Magnetic Resonance Imaging (MRI) scan?

Dr Holdsworth and Dr Guild lead a team at the University of Auckland who, in an international collaboration, have developed a new method of three-dimensional medical imaging known as amplified MRI (aMRI). This method can detect changes in brain motion associated with increased intracranial pressure. Using a combination of bespoke computational modelling and bioengineering tools, the team will establish if aMRI can be used to differentiate normal and abnormal intracranial pressure, first in a relevant pre-clinical model, and then looking at a cohort of patients.

This Marsden Fund project has the potential to revolutionise the diagnosis and treatment of patients with increased intracranial pressure.

AUSTRALIAN BUSHFIRES

IMPACTS ON NEW ZEALAND GLACIAL ENVIRONMENTS

Dr Phil Novis from Manaaki Whenua Landcare Research and **Dr Lynda Petherick** from Victoria University of Wellington Te Herenga Waka will lead a team of scientists to determine the effect of airborne particles on snow algae and the effect of both on snow and glacier melting in New Zealand.

The size of Aotearoa's glaciers is extremely sensitive to changes in temperature and precipitation, which has led to an alarming retreat over recent decades. Fresh snow and ice have high albedo – a measure of how much solar radiation is reflected from the surface of a material without being absorbed. However, when top layers of snow and ice become contaminated with impurities, the albedo is significantly reduced, leading to greater absorption of the Sun's energy and increased ice melting. There are two important sources of impurities: wind-blown dust and airborne particles containing smoke and ash; and the growth of microbial populations, such as algae, on the surface of the ice and snow. Importantly, there appears to be a relationship between growth of these microbial communities and increased deposition of airborne particles.

The size of Aotearoa's glaciers is extremely sensitive to changes in temperature and precipitation, which has led to an alarming retreat over recent decades.

The Australian bushfires of 2019-2020 produced substantial quantities of black carbon and airborne contaminants over Aotearoa, dramatically changing the colour of snowfields and glaciers in the Southern Alps. Glacial microbial communities also darken glacier surfaces. A combination of these factors could reduce albedo of glaciers in Aotearoa and increase melt rates. However, the magnitude of these effects, as well as the interaction between microbial growth and black carbon deposition, are not well known, and current models for glacier melting do not take them into account.

Dr Novis and Dr Petherick will determine the effect of light-absorbing airborne contaminants from Australian bushfires and microbial communities on the melting of Aotearoa glacial systems – both individually and through their interactions. This study will provide the basis for future work on the effects of impurities on glacier melting.


EDELRID

NGĀ PANGA O NGĀ AHI KAI NGAHERE

I AHITEREIRIA KI NGĀ WĀHI KŌPAKA O AOTEAROA

Ka ārahina e **Tākuta Phil Novis** o Manaaki Whenua rāua ko **Tākuta Lynda Petherick** o Te Herenga Waka tētahi rōpū tohunga pūtaiao o te ao ki te whakatau i te pānga o ngā korakora rere ana i te takiwā ki te kapoke hukapapa me te pānga ki te hukapapa me te kōpaka e rewa ana i Aotearoa.

Ka tino pākia ngā kōpaka o Aotearoa ki ngā huringa o te pāmahana me te ua, ā, kua tino itiiti haere i roto i ngā tau maha. He nui te arapeto – ko te ine tēnei i te nui o te iraruke kōmaru e whakaatahia ana mai i te mata o tētahi mea me te kore e ngongoa. Engari, ina tāhawahawatia ngā papanga hukapapa me ngā tio o runga i ngā para, he tino iti rawa te arapeto, ā, ka nui ake te ngongo i te pūngao o te rā, ka nui ake hoki te rewa o te tio. E rua ngā pūtake hira o ngā para: ko ngā puehu e pūhia ana e te hau me ngā korakora whai auahi me te pungarehu kei te takiwā; me te tipu o ngā taupori moroiti, pērā i te kapoke, kei te mata o te tio me te hukapapa. Ko te mea nui, he hononga pea kei waenga i te tipu o ēnei hapori moroiti me te nui haere ake o ngā korakora kei te takiwā.

I puta i ngā ahi o ngā ngahere o Ahitereiria i te 2019-2020 ngā rahinga waro pango nui me ngā para i te takiwā i runga o Aotearoa, e kaha ana te huri o te tae o ngā papa hukapapa me ngā kōpaka i Te Tiritiri o te Moana. Ka whakapouri i ngā hapori moroiti o te kōpaka i ngā mata kōpaka. Ka whakaiti ake tētahi pahekotanga o ēnei āhuatanga i te arapeto o ngā kōpaka i Aotearoa me te whakarahi ake i te nui o te rewa. Engari, ko te rarahi o ēnei pānga, me te taunekeneke i waenga i te tipu o ngā moroiti me ngā putunga waro pango, kāore i te tino mōhiotia, ā, kāore i uru ki ngā tauira onāianei te rewa o ngā kōpaka.

Ka whakatauhia e Tākuta Novis rāua ko Tākuta Petherick te pānga o ngā para ngongo mārama kei te takiwā mai i ngā ahi kai ngahere o Ahitereiria me ngā hapori moroiti ki te rewa o ngā pūnaha kōpaka o Aotearoa – takitahi me ngā taunekeneke. Ka noho ko tēnei rangahau te tūāpapa mō ngā mahi ā muri ake mō te pānga o ngā para ki te rewa o ngā kōpaka.

BRINGING INDIGENOUS PERSPECTIVES TO SPORT FOR DEVELOPMENT

By centring Indigenous and feminist scholarship and aspirations, **Dr Rochelle Stewart-Withers** (Te Āti Awa), **Dr Farah Palmer** ONZM (Ngāti Maniapoto, Waikato) and **Dr Jeremy Hapeta** (Ngāti Raukawa, Ngāti Huia) from Massey University will deconstruct, decolonise and transform the Sport for Development field.

The field of Sport for Development adheres to the notion that sport has the power to change the world and that sport can be used to meet social policy, peace-making and social justice agendas and goals. Yet, despite over 20 years of theorising, research and practice, Indigenous worldviews are marginalised or absent in Sport for Development discourses. This is disturbing given that Indigenous people are often the target of deficit-focused initiatives while at the same time being excluded from decision making in the field.

In this Marsden Fund project, Dr Stewart-Withers, Dr Palmer and Dr Hapeta will use Indigenous methodologies (Kaupapa Māori and Vanua Fiji frameworks) to conduct case studies in Aotearoa and Fiji to highlight Sport for Development initiatives that are informed by Indigenous viewpoints and align with Indigenous aspirations. The team aims for a grassroots-up development of theory through observations and interviews, hui and talanoa, with groups involved in rugby, outrigger canoeing and Iron Māori (triathlons). Alongside these narratives, they will also run an international survey to provide further data.

By transforming the field of Sport for Development, the team will make an original contribution to Indigenous and feminist scholarship, Sport for Development and sport management knowledge. They will create a space for new conversations and new opportunities for innovating concepts, methods and applications in the field.

TE WHAKAURU MAI I NGĀ TIROHANGA IWI TAKETAKE KI TE WĀHANGA HĀKINAKINA MŌ TE WHANAKETANGA

Mā te whakaarotahi i nga mōhiotanga me ngā wawata o te Iwi Taketake me te mana wahine, ka turakina, ka wetewetehia me te takahuri i te wāhanga Hākinakina mō te Whanaketanga.

E arotahi ana te wāhanga Hākinakina mō te Whanaketanga ki te whakaaro he mana tō te hākinakina ki te huri i te ao, ā, ka taea e te hākinakina te whakatutuki ngā kaupapa me ngā whāinga kaupapahere pāpori, te whakatau i te rongomau me te tika tōkeke ā-iwi. Engari, ahakoa kua neke atu i te 20 tau e wānanga ana, e rangahau me te whakamātautau, kāore e arohia mai ngā tirohanga a ngā Iwi Taketake, kāore rānei e whakaurua mai ki ngā kōrerorero o te Hākinakina mō te Whanaketanga. He tino raruraru tēnei ina ko ngā Iwi Taketake te hunga e tino arohia ana e ngā kaupapa rawakore, me te aha kāore rātau i te whai wāhi atu ki te whakatau tikanga i roto i tēnei wāhanga.

I roto i tēnei kaupapa Pūtea Marsden, ka whakamahia e **Tākuta Rochelle Stewart-Withers** (Te Āti Awa), rātou ko **Tākuta Farah Palmer** ONZM (Ngāti Maniapoto, Waikato) ko **Tākuta Jeremy Hapeta** (Ngāti Raukawa, Ngāti Huia) ngā tikanga Iwi Taketake (kaupapa Māori me te kaupapa Vanua Fiji) hei whakahaere mātai take i Aotearoa me Whitī hei whakaatu i ngā kaupapa Hākinakina mō te Whanaketanga e whāngaia ana ngā mōhio e ngā tirohanga Iwi Taketake me te ū ki ngā wawata o ngā Iwi Taketake. E whai ana te rōpū ki te waihanga ariā mai i te iwi kāinga mā kitenga me ngā uiui, ngā hui me ngā rōpū e whai wāhi ana ki te whutupōro, waka ama me ngā Hākinatoru Māori. I te taha o ēnei kōrero, ka whakahaeretia anō e rātau tētahi rangahau ā-ao hei tuku raraunga atu anō.

Mā te takahuri i te wāhanga Hākinakina mō te Whanaketanga, ka tuku wāhanga te rōpū ki ngā mōhiotanga iwi taketake me te mana wahine, te Hākinakina mō te Whanaketanga me ngā mātauranga whakahaere hākinakina. Ka whakaarahia e rātau he wāhi mō ngā kōrerorero hou me ngā whai wāhitanga hou mō ngā huatau auaha, ngā tikanga me ngā mahi i roto i tēnei wāhanga.

PICK-A-PATH BIRDS

CAN NEW CALEDONIAN CROWS PLAN FOR DIFFERENT POSSIBLE FUTURES?

Dr Alexander Taylor, University of Auckland, will test whether New Caledonian crows are capable of planning for future uncertainty. This will determine if planning for alternate future events is unique to humanity or shared with other species.

Planning is a key human adaptation. The ability to plan for alternate future events can greatly increase the chance of reproduction and survival as it gives us the capacity to deal with uncertain environments. The apparent lack of this ability among chimpanzees has led to the hypothesis that it is planning for alternate futures that marks a fundamental difference between our minds and those of non-human animals. However, recent studies have shown that birds can perform comparably to primates on a variety of cognitive tasks. One species in particular, the New Caledonian crow, has concurrently evolved tool manufacture skills that are more sophisticated than those seen in chimpanzees, the ability to mentally pre-plan solutions to problems, and the ability to plan flexibly for events occurring 15 minutes into the future. This bird is therefore the model species for testing the hypothesis about the uniqueness of the human mind, namely that one distinct ability of our species is the ability to plan for alternate future events.

This Marsden Fund research will test if a bird famed for its intelligence, the New Caledonian crow, can plan for alternate future events, while taking into account the probability of different events occurring. Dr Taylor and his team will also carry out experiments to see if these crows take action to try to reduce future uncertainty. Finally, they will examine the temporal scale over which New Caledonian crows can plan for alternate future events.

This research will robustly test whether one of humanity's most important adaptations, the ability to plan for alternate future events, has evolved in parallel in a non-human animal species. It will lead to breakthroughs in our understanding of human evolution, human uniqueness and convergent evolution, while also potentially increasing awareness of our mental links to the natural world.

BIODEGRADABLE POLYMER ELECTRONICS

A NEW FRONTIER

Professor Jadranka Travas-Sejdic, University of Auckland, will develop polymer based materials for use as transient electronics that breakdown into environmentally friendly by-products. These electronics have the potential to be used in temporary medical implants that don't require removal.

Transient electronics are an emerging class of devices that are intentionally designed to breakdown into environmentally friendly by-products. This degradation happens in a programmable way and after the device has had a well-defined lifetime of operation. Since no harmful by-products are released, the devices can be used in the human body as a monitoring, diagnostic, or therapeutic tool. For example, an electronic component could be temporarily implanted in a patient and then dissolve safely on its own without the need to remove it. Transient electronics can also address the ecological challenges associated with our electronics-intense society and the global shift towards a circular economy. While significant advancements in electronic materials have recently been made using metal-based, semi-conductive materials, the development of transient polymer electronics is an exciting new frontier.

Transient electronics are an emerging class of devices that are intentionally designed to breakdown into environmentally friendly by-products.

Polymer-based electronics may provide electronic conductivity, biocompatibility, desirable mechanical properties and controlled degradation, all in one macromolecule. Yet, the development of materials that are stretchable enough for medical use but crystalline enough for electronic performance remains a challenge.

Professor Travas-Sejdic has been awarded a Marsden Fund grant to develop a novel approach to transient organic electronic materials using polymers. With **Dr Eddie Chan**, the Associate Investigator, and her research team, she aims to make innovative materials by grafting conducting polymers onto degradable, stretchable, natural biopolymer backbones to realise well-defined semi-crystalline and transient structures. Her team will explore the use of chitosan– sourced from seafood waste; collagen– the most abundant protein in mammals; and poly(*γ*-glutamic acid)– derived from bacteria, as the most appropriate backbone material.

With these polymer based materials, Professor Travas-Sejdic will establish a new class of transient electronics that are especially suited for medical applications.

MARSDEN FUND FAST-START GRANTS

PIGS, DOGS AND CHICKENS IN THE PACIFIC PAST

Dr Karen Greig of the University of Otago will study the bones of domesticated animals from across the Western Pacific to study how social networks and structures have changed over time.

Pigs, dogs, and chickens have been important to communities across the Western Pacific since their introduction around 4,000 years ago. These domesticated animals are central to exchange systems and ideological and religious practices in many societies across the Pacific. Studying the remains of these domestic animals will provide valuable insight into the complex ways that people formed connections between communities over time, and how social structures developed and changed.

Unfortunately, compared to ceramics and other traditional objects of archaeological study, bones are less durable. If bones survive, they are often highly fragmented and difficult to identify as a particular species. This Marsden Fast-Start grant will allow Dr Greig and her team to use state of the art molecular techniques to determine what species the bones derived from and their how old they are.

Additionally, looking at chemical signatures within the tooth enamel of pigs and dogs, they can determine if the animals were moved between regions during their lifetime. These approaches will allow the researchers to trace the patterns of trade and husbandry of domestic animals, mirroring the interactions and movements of people throughout the Western Pacific.

These approaches will allow the researchers to trace the patterns of trade and husbandry of domestic animals.

USING LIGHT TO TRACK AND TARGET DRUG DELIVERY

Dr Cassandra Fleming, Auckland University of Technology, will develop new light-responsive drug delivery systems to control when and where drugs target their therapeutic activity.

One of the major challenges in medicinal chemistry is reducing the toxic side effects caused by poor selectivity of drugs. Among efforts to improve chemotherapy treatments and achieve personalised medicine regimens, a promising approach is the development of targeted drug delivery systems. Effective targeted drug delivery systems enable the therapeutic agent to be delivered, not only to the desired cell, but also to a specific sub-compartment of the cell to enable maximum potency.

Advancing the field of targeted drug delivery is strongly dependent on being able to track where the drug is delivered, and to activate it when it has reached the desired location. An innovative solution to both these challenges is to use light as a means to both track where the drug builds up and trigger the release of the drug within the desired location.

With her Marsden Fund Fast-Start grant, Dr Fleming will develop new 'light-responsive' targeted drug delivery systems to control exactly when and where drugs are activated within cells. Molecules which target specific sub-compartments within cells will be linked with fluorescent groups that then form a 'cage' around the drug, masking its activity. The fluorescent group will enable the drug to be tracked to its target using light. When it reaches the desired target within a cell, the fluorescent cage is then unlocked with light, activating the drug. Light responsive systems have the potential to be much smaller and simpler than current drug delivery systems.

Dr Fleming will focus on an important drug target for Alzheimer's disease, an enzyme called GSK-3, whose role in different sub-compartments of the cell is poorly understood. Results arising from this project will provide unique molecular tools to study the mode of action of drugs in individual cellular compartments.

THE HORMONE THAT MAKES GOOD DADS

Dr Kristina Smiley, University of Otago, will study the role the hormone prolactin plays in inducing good parental behaviour in male mice.

Like human fathers, male mice make a significant contribution to rearing their offspring. For male mice this involves a dramatic change in behaviour towards infant mice. This transition is triggered by the act of mating, but after this there is a delay of about two weeks before behavioural changes are seen. By three weeks, when up to ten new babies arrive, male mice are ready to be good fathers. However, the mechanisms that drive this behavioural shift are not known.

Dr Smiley has recently shown that that the hormone prolactin, known best for its role in milk production, is essential for good parental behaviour in male mice. In female mice, prolactin stimulates the generation of new neurons in a specific region of the brain. The timing of the appearance of these new brain cells, about two weeks, is associated with the onset of maternal care behaviour. In this Marsden Fund Fast-Start study, Dr Smiley will determine if similar changes occur within the male mouse brain following mating, and whether these changes are required for good paternal care behaviour.

Determining the basis of normal parental care is essential to understanding the causes of postnatal mood disorders, which occur in both men and women. Dr Smiley hopes to eventually provide a greater insight into mood disorders associated with fatherhood, which could help address issues relating to child abuse or neglect.

ARE TOXIC METALS TESTING THE HONEYBEE'S METTLE?

Dr Megan Grainger, University of Waikato, will study how toxic metal accumulation affects the brain of honeybees and hive health.

The decline in honeybee populations and colony health is a global crisis and there has been increasing loss of honeybee colonies in recent times in Aotearoa. Honeybees are important not just for the honey industry, but also for pollination of food crops and a wide variety of other plants. Honeybee decline jeopardises both ecosystems and economies, yet the reasons for this are still not well understood. While a combination of different causes are thought to play a role in this decline, one largely overlooked factor is the exposure of honeybees to inorganic elements, such as toxic metals. Unlike many other toxins, metals do not break down to less toxic products, which means they accumulate in bees as well as in their hives. Chronic exposure to even low concentrations of toxic metals may cause a deterioration in the function and health of the entire colony over multiple generations.

Dr Grainger has been awarded a Marsden Fund Fast-Start grant to assess the impact of metals at the cellular, individual bee, and colony level. She will examine the relationship between metal accumulation in specific regions of the bee brain and changes in gene expression, colony function and overall health. The research will involve placing bee colonies on land contaminated by cadmium, for example, from extensive fertiliser use. Dr Grainger will then monitor the colonies over successive years for various measures of hive health. This study will provide important new knowledge on the long-term effects of toxic metals on honeybee colonies.

One largely overlooked factor is the exposure of honeybees to inorganic elements, such as toxic metals.

CLEAN TEENS

WHY ARE FEWER YOUNG PEOPLE SMOKING, DRINKING AND USING DRUGS?

Dr Jude Ball of the University of Otago will investigate the dramatic decline of smoking, drinking and drug use among Māori and non-Māori adolescents to determine the drivers of this 'megatrend'.

Adolescent smoking, drinking and drug use have declined dramatically over the past 15-20 years in New Zealand and other OECD countries. This 'megatrend' is poorly understood despite its public health importance. This large and unprecedented decline is youth-specific and sits alongside almost universal declines in teen pregnancy, juvenile crime and dangerous driving. What is driving this trend is unknown. This leaves policy makers and researchers struggling to influence further positive change or prevent future reversals in the trend. Understanding the drivers of the declining substance use among Māori teens is particularly important as gaps between Māori and non-Māori remain stark.

In her Marsden Fast-Start grant, Dr Ball will work with Māori advisor **Anaru Waa** of the University of Otago along with a Māori Masters student to investigate the possible contribution of the changing functions and meanings of substance use in adolescents' lives, for both Māori and non-Māori.

In this qualitative study, she will compare archival interview data collected at the peak of adolescent substance use 20 years ago, with contemporary data collected for this study. The interviews cover friendships, lifestyle, and perceptions about substance use and non-use. They aim to address questions such as whether other practices (social media and gaming for example) are fulfilling the social functions that substance use once did (such as projecting a 'cool' or 'grown up' identity, bonding with friends and meeting new people). The findings will contribute to international efforts to understand why substance use has declined in adolescents. This work may also inform local efforts, including those by and for Māori, to reduce substance-related harm.

NGĀ TAIOHI URUTAPU

HE AHA TE TAKE KUA ITIITI HAERE AKE NGĀ TAIOHI HE KAI PAIPA, INU WAIPIRO ME TE KAI WHAKAPŌAUAU?

Ka tūhura a **Tākuta Jude Ball** o Te Whare Wānanga o Ōtāgo i te nui o te heke o te kai paipa, te inu waipiro me te kai whakapōauau i waenga i ngā taiohi Māori, Tauiwi hoki kia mōhio ai ki ngā kaikōkiri o tēnei 'ia nunui'.

Kua tino heke te nui o te hunga taiohi he kai paipa, inu waipiro me te kai whakapōauau i roto i ngā tau 15-20 tau i Aotearoa me ētahi atu whenua OECD. Kāore i te tino mōhio mō tēnei 'ia nunui' ahakoa tōna hiranga ki te hauora tūmatanui. E hāngai ana tēnei hekenga nui, tino rerekē hoki, ā, e ōrite ana ki ētahi atu hekenga arowhānui e pā ana ki ngā taiohi mō te hapūtanga, ngā taihara taiohi me te hautū waka whakamōrea. Kāore i te mōhiotia te kaikōkiri i tēnei ia nui. E uaua ana ki ngā kaihanga kaupapahere me ngā kairangahau te whakaawe i ētahi atu huringa pai, te ārai rānei kia kaua e huri kōaro tēnei ia ā muri ake. He mea nui hoki te mārama pai ki ngā kaikōkiri i te hekenga o te kai whakapōauau a ngā taiohi Māori i te mea e mārama ana ngā wehenga i waenga i te Māori me Tauiwi.

I roto i tōna takuhe Tīmata Wawe, ka mahi tahi a Tākuta Ball me te kaitohutohu Māori a **Anaru Waa** o Te Whare Wānanga o Ōtāgo me tētahi ākonga Tohu Paerua ki te tūhura i ngā tautoko ka taea a ngā mahi me ngā kaupapa hurihuri o te kai whakapōauau i ngā ao o ngā taiohi, mō te Māori me Tauiwi. I roto i tēnei rangahau ine kounga, ka whakataurite ia i ngā raraunga uiui pūranga i kohia i te wā e tino nui rawa te kai whakapōauau a te taiohi i ngā tau 20 ki mua, ki ngā raraunga onāianei i kohia mō tēnei rangahau. E kōrero ana ngā uiui mō ngā whakahoanga, āhua noho, me ngā whakaaro mō te kai whakapōauau me te whakapōauau-kore. E whai ana rātau ki te whakautu i ngā pātai, arā mēnā kei te whakatutukihia e ētahi atu tikanga (hei tauira, te pāpāho pāpori me te purei kēmu) i ngā āhuatanga pāpori i tutuki i te kai whakapōauau i mua (arā, e whakaatu ana i te tuakiri 'whakahīhī', 'whakapakeke' rānei, te honohono ki ngā hoa me ngā tūtaki ki ngā tāngata hou). Ka tautoko ngā kitenga i ngā mahi i te ao kia mārama ai ki te take kua heke te kai whakapōauau i roto i ngā taiohi. Ka whāngai mōhio anō pea ēnei mahi ki ngā whakapau kaha i konei, tae atu ki ērā a te Māori mā te Māori, ki te whakaiti i ngā tūkinotanga nā te whakapōauau.

> He mea nui hoki te mārama pai ki ngā kaikōkiri i te hekenga o te kai whakapōauau a ngā taiohi Māori i te mea e mārama ana ngā wehenga i waenga i te Māori me Tauiwi.

EXCEPTION TO THE RULE

WHY WERE FEMALE MOA LARGER THAN MALES?

Dr Kieren Mitchell of the University of Otago will use ancient DNA to investigate why female moa were so much larger than their male counterparts.

Among birds and mammals, males are typically larger and/or more colourful than females. For example, male southern elephant seals are up to four times the size of females; and peacocks have brilliantly coloured feathers compared to peahens. These intriguing differences are thought to result from competition between males for mating rights with females.

In contrast, among Aotearoa's nine species of extinct moa, females were more than twice the size of males. The phenomenon, known as 'reverse sexual dimorphism' is rare and its causes and consequences are hotly debated. This size reversal is also seen to a lesser extent in some living flightless birds closely related to moa, such as kiwi, emu and cassowary, but not in others, such as rhea and ostriches. This diversity in female/male size makes moa, and their relatives, an ideal system for studying reverse sexual dimorphism.

Dr Mitchell has been awarded a Marsden Fund Fast-Start grant to investigate this phenomenon. He will isolate ancient DNA from moa bones found in university and museum collections held by New Zealand universities. Dr Mitchell proposes that female moa competed for territory and access to males – a reversal of the usual situation. He will determine if this atypical mating behaviour has left a genetic legacy within moa ancient DNA. This study will develop moa as a globally significant model system for studying the evolution of mating systems and provide new insight into the biology of these vanished giants.

Diversity in female/male size makes moa, and their relatives, an ideal system for studying reverse sexual dimorphism.

DESCENDANTS OF MĀORI ADOPTEES SEARCHING FOR THEIR TŪRANGAWAEWAE

Dr Erica Newman from the University of Otago will follow the journeys of descendants of Māori adoptees who do not know their taha Māori as they connect to their tūrangawaewae, bringing to light the impacts of transracial adoption on identity and wellbeing for adoptees and descendants.

Not being able to say your pepeha, or your entire whakapapa, identify your marae, and your tūrangawaewae, is the very real outcome for an adopted Māori child raised in a non-Māori household, and for their descendants, when they have not been able to establish a connection to their Māori whānau. The 1955 Adoption Act enabled closed stranger adoption, which severed all connections between birth parents and their biological child. This detachment is inherited by future generations if connections are not able to be found. Absence of tūrangawaewae for descendants of Māori adoptees has an effect on their identity, health and wellbeing. Finding whakapapa connections can benefit and strengthen their Māori identity.

Dr Newman's Marsden Fast-Start research project will focus on these descendants and follow them on their journey to reconnect with their ancestry. She will explore how they identify with their taha Māori, the steps they take to connect with their tūrangawaewae, and how they are received by their whānau and hapū. She will draw on statistical and archival research, personal testimonies, and collaborative research with whānau and iwi. A private Facebook page for descendants will provide ongoing support as they begin (or continue) their journey to find their taha Māori.

The project walks in two worlds: understanding the government practices of adoption and whakawhanaungatanga between those who have been dislocated from te ao Māori to their tūrangawaewae. The research will advance the field of transracial adoption both in Aotearoa and around the world.

NGĀ URI O NGĀ ADOPTED MĀORI E RAPU ANA I Ō RĀTAU TŪRANGAWAEWAE

Ka whai a **Tākuta Erica Newman** o Te Whare Wānanga o Ōtāgo i ngā hīkoi a ngā uri Māori kāore nei i te mōhio ki tō rātau taha Māori i a rātau e hono ana ki tō rātau tūrangawaewae, e whakaatu ana i ngā pānga o te adoption i waho i tō rātau ake ao tuku iho me te oranga o ngā adoptee me ō rātau uri.

Ko te noho kūare ki tōna pepeha, tōna whakapapa rānei, he kore mōhio ki tōna marae, me tōna tūrangawaewae, te tino pānga mō tētahi tamaiti Māori i adopted i roto i tētahi kāinga Tauiwi, me ō rātau uri, mēnā kāore i whai wāhi ki te tuitui hononga ki tōna whānau Māori. Nā te Ture Adoption 1955 i āhei ki te whāngai tamariki ki ngā tauhou, ā, ka motukia atu ngā hononga katoa i waenga i ngā mātua ake me tā rāua ake tamaiti. Ka taka mai tenei motunga ki ngā uri o muri mai ki te kore e kitea ngā hononga. Ka pā te kore tūrangawaewae mō ngā uri o ngā whāngai Māori ki tō rātau tuakiri, hauora me te oranga. He hua kei roto i te kimi i ngā hononga whakapapa me te whakapakari i tō rātau ao Māori.

Ka arotahi te kaupapa rangahau Tīmata-Wawe Marsden a Tākuta Newman ki ēnei uri me te whai i tā rātau hīkoi ki te hono anō ki tō rātau taha Māori. Ka tūhura ia i te āhua o tā rātau hono ki tō rātau taha Māori, te ara ka whāia e rātau ki te hono ki tō rātau tūrangawaewae, ā, he pēhea te manaaki a ō rātau whānau me ō rātau hapū i a rātau. Ka toro ia ki ngā rangahau tatauranga, pūranga hoki, ngā kōrero taunaki, me ngā rangahau ngātahi me ngā whānau, iwi hoki. Ka tuku tautoko haere tonu tētahi whārangi Pukamata tūmataiti i a rātau ka takahi i tēnei ara (ka haere tonu rānei) ki te rapu i tō rātau taha Māori.

Ka hīkoi tēnei kaupapa i roto i ngā ao e rua: te mārama ki ngā tikanga adoption a te kāwanatanga me te whakawhanaungatanga i waenga i a rātau e noho momotu mai ana i te ao Māori me ō rātau tūrangawaewae. Ka whakawhānui ake te rangahau i te wāhanga whāngai i waenga mātāwaka i Aotearoa me tāwāhi.

> Ka pā te kore tūrangawaewae mō ngā uri o ngā whāngai Māori ki tō rātau tuakiri, hauora me te oranga. He hua kei roto i te kimi i ngā hononga whakapapa me te whakapakari i tō rātau ao Māori.

USING PENGUIN POO TO MEASURE CONTAMINANTS IN ANTARCTICA

Dr Tanya O'Neill, University of Waikato, will study penguin mounds as natural archives of contamination in remote Antarctic environments.

Antarctica remains the most pristine landscape on Earth with the lowest levels of environmental pollutants sourced from human activity. Increasingly, however, contaminants such as microplastics, DDT, and heavy metals are being found in Antarctic ecosystems. Because there are few possible sources of contamination within Antarctica, they must have been transported over long distances from external sources. Recent research suggests that animals may be the most important vector for long-range transport of pollutants to the polar regions, both through their movements and through biomagnification, a process whereby toxins like mercury and lead increase in concentration as they are successively ingested by species higher on the food chain.

To test this theory, Dr O'Neill has been awarded a Marsden Fund Fast-Start grant to investigate the long-term history of transport and accumulation of pollutants in Antarctica through the natural foraging and nesting activities of Adélie penguins. Penguins forage within 100km of their colonies and, in doing so, consolidate both atmospheric and oceanic sources of pollutants. Furthermore, penguin mounds form over generations as penguins build new nests over top of previous ones. An individual nest site can record thousands of years of history. By applying a wide-range of analytical techniques to soil, bone, feather and eggshell fragments, the team will determine the concentration of mercury and lead over time. They will measure various isotopes to assess the rate that poo piles accumulate to make accurate timescale calculations as well as to identify potential sources of the contaminants.

This study will be the first to use penguin mounds as natural historical archives to investigate the timescales of contaminant transfer, and will provide unique insight into pollutant cycling in the Antarctic environment.

BETWEEN THE REAL AND IMAGINARY WORLDS

INTERACTIVE MIXED REALITY IN REAL TIME

Dr Fang-Lue Zhang from Victoria University of Wellington Te Herenga Waka will develop a novel framework for enriched immersive experiences in Mixed Reality.

Mixed Reality (MR) is a blend of the physical and digital worlds. A given MR experience can sit anywhere on the MR continuum between physical and virtual reality. Using a combination of wearable screens, cameras and physical controls, this technology provides tremendous potential for opportunities in entertainment, education and other enriched experiences. However, there are still important technological limitations to overcome.

Recently, researchers have developed 360 degree video technology that allows for the capture and augmentation of entire 3D environments. To build an authentic MR experience, it is necessary to reconstruct physical scenes in a fully interactive virtual reality. However, current approaches are poorly adapted to rapidly evolving scenes containing moving objects captured from a moving camera – all features required of a practical MR application. Dr Zhang proposes to use a Marsden Fund Fast-Start grant to develop a framework for scene reconstruction, which goes beyond these restrictions, allowing for MR experiences that synthesise interactive dynamic content in real time.

The proposed research will bring together many strands of cutting-edge technology and innovation, such as deep learning, spherical image synthesis and MR into a single coherent project for the first time. This will inspire a cross-fertilisation of ideas and enhance New Zealand's international reputation in computer graphics.

GUT SPEAK

THE MECHANICS OF GUT COMMUNICATION

Dr Timothy Angeli from the University of Auckland will study how the small intestine communicates with the stomach via the smooth muscle valve called the pyloric sphincter.

We bite, we chew, we swallow, we defecate. These are the conscious actions that we perform during digestion, but there are also other underlying subconscious physiological processes that move and digest food along our gastrointestinal tract to ultimately power our bodies.

The pyloric sphincter, or 'pylorus', is a band of smooth muscle at the junction between the stomach and the small intestine. It plays a vital role in digestion, acting as a valve to control the flow of partially digested food from the stomach to the small intestine. The pylorus also selectively controls the communication between the stomach and small intestine via electrical signals. Therefore, it is critically important to normal gastrointestinal function, and abnormal electrical signals have been associated with gastrointestinal disorders. However, the electrical signal conduction across the pylorus remains enigmatic, largely due to technical limitations of current recording systems and the intricate anatomical structure of the pylorus.

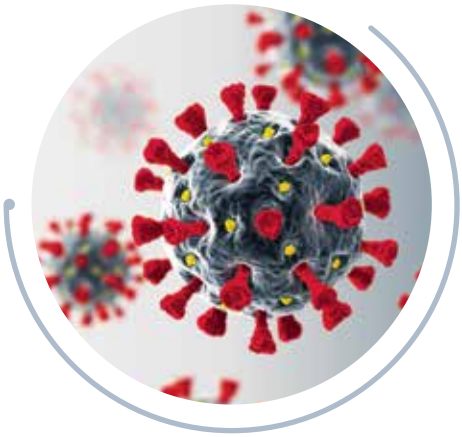
Previous researchers have discovered that pylorus tissue isolated and studied in the lab selectively allows certain electrical waves across its barrier. However, the mechanism behind selective conduction remains a mystery. Dr Angeli has been awarded a Marsden Fast-Start grant to address this important gap in gut communication. He and his team will develop a high-resolution gastrointestinal electrode device to map the electrical activity in the gut, customising the device specifically for the pylorus region. They will use this to determine the bioelectrical control of the junction between the stomach and the small intestine in fine detail.

The electrical signals recorded by the device will be linked to pyloric function via pressure recordings from the pylorus, and structural analyses of the pylorus region, to determine cellular and bioelectrical mechanisms of pyloric function.

This project will pioneer a new generation of anatomically specific electrical mapping devices that could potentially be applied to understand various pylorus-related disorders and offer new treatment options.

MARSDEN FUND NEWS

HE PITOPITO KŌRERO



IMPACT OF COVID-19

ON THE 2020 FUNDING ROUND

With the pandemic bringing widespread disruption, we remain thankful that the 2020 funding round was able to proceed, albeit with some modifications.

During the COVID-19 Alert Level 4 lockdown (March-April 2020), the Marsden Fund Council saw a clear need to simplify the Marsden Fund Expression of Interest (EOI) selection processes and ease the pressure and burden on the convenors, panellists and Royal Society Te Apārangi staff, as well as the wider research community. These changes allowed the EOI round to go ahead, without EOI panel meetings taking place. Panellists graded each proposal, aggregate panellist scores were used to form a ranked list of proposals, and an algorithmic approach was used to set Full round cut-offs. This allowed convenors to recommend a list of EOIs to go through to the Full round. Unfortunately, due to this modified process, it was not possible to give qualitative feedback to EOI Fast-Start applicants in the 2020 round. However, all Fast-Start and Standard applicants still received quintile feedback for their EOIs.

Although Aotearoa moved down to COVID-19 Alert Level 2 in mid-May 2020, COVID-19 was still highly likely to impact the preparation of Full proposals. Therefore, the Full round deadline was extended by one week to Wednesday 24 June 2020. Fortunately, the rest of the 2020 Marsden Fund round ran according to plan. Full proposal meetings were able to take place through a mix of online and face-to-face meetings, with one panel meeting entirely run online.

Impacts of COVID-19 on researchers

Existing Marsden Fund contract holders also experienced significant disruption to their research due to the COVID-19 pandemic. These disruptions have prevented international travel, hampered recruitment of postgraduate students and staff, caused significant delays in shipments of research consumables and complicated international collaboration. As an indicator of the tremendous scale of this disruption to our researchers, the Society has observed a 2-5 fold-per-month increase in requests for Marsden Fund contract variations since June 2020.

Digital support for applicants in 2021

This year the Society team recorded a virtual roadshow on 'how to apply to the Marsden Fund in 2021'. We also ran a number of live sessions online to respond to questions from the research community. This new approach provides a safeguard against potential domestic travel restrictions which might prevent delivery of our usual roadshow. The digital channel also gives us wider reach to interested parties, and should improve the availability of application information to diverse organisations across the sector. Slides from the presentations are also available as a PDF.

We also created a Vision Mātauranga web resource which is a conversation with **Associate Professors Melinda Webber** and **Angela Wanhalla** that gives some guidance from previous Marsden Fund applicants and current panellists on different approaches to Vision Mātauranga.

Read more: Bit.ly/MF56-41

DAYS OF ICE

In October, Marsden Fund Te Pūtea Rangahau a Marsden joined with the Antarctic Science Platform, Royal Society Te Apārangi, GNS Science, Christchurch City Libraries, Victoria University of Wellington, HITLabNZ (Human Interface Technology) at the University of Canterbury and the International Antarctic Centre to co-host four events. These were part of the annual 'Days of Ice' festival in Ōtautahi Christchurch, celebrating the city's unique connections with Antarctica.

The first event was a Kōrero On Ice panel discussion, which featured seven people with unique Antarctic experiences from the frozen continent. It was held at Tūranga Christchurch city library and was facilitated by Dr Cilla Wehi, conservation biologist and Rutherford Discovery Fellow at Manaaki Whenua Landcare Research.

Panellists were writer Toni Wi (Ngāti Maniapoto), Antarctic Science Platform director Associate Professor Nancy Bertler, field engineer Darcy Mandeno, host of TV series *Science on Ice* Sonny Ngātai, award-winning filmmaker Anthony Powell and director of HITLabNZ Professor Rob Lindeman. They recounted tales of sleeping through 24-hour sunlight, surviving penguin 'attacks', staying hydrated in the driest place on Earth and experiencing serene, untouched wilderness. Within this, they gave first-hand accounts of the effects of global warming and shared their hopes for the continent's future.

Much of the festival targeted a younger audience, including the Explore Antarctica Family Day at the Arts Centre Market Square. Dr Georgia Grant and Dr Katelyn Johnson from GNS Science put together an exhibit showcasing Antarctic sediment and ice cores by layering ice, sand, water and insects. They used this to illustrate how researchers detect past and future warming by examining the cores.

Children and students were invited to participate in the 'Antarctica through Fresh Eyes' Tauira Film Competition. Winning entries were shown at a celebratory event hosted by filmmaker Anthony Powell, and Miranda Satterthwaite and Todd Schmidt from the International Antarctic Centre. Winning videos explored Antarctica before it was covered in ice, the effects of climate change through the eyes of a penguin, the importance of climate action for the continent's future, and the implications of melting ice on Pacific nations.

Marsden Fund Te Pūtea Rangahau a Marsden also supported the Immersive Antarctica VR experience, which allowed attendees to be transported to Antarctica through virtual reality headsets to explore 360-degree images and video.

Photo credit: Victoria Metcalf

NEW INSIGHT ON ALPINE FAULT RISK

Original article by Jamie Morton published on 11 January 2021 in Whanganui Chronicle. Republished with permission of the author.

'Scratch marks' point to epicentres of earthquakes. A discovery made in the wake of 2016's Kaikoura Earthquake could help scientists better understand how the big-risk Alpine Fault may unravel.

The Alpine Fault, which runs about 600km up the western side of the South Island between Milford Sound and Marlborough, poses one of the biggest natural threats to New Zealand.

It has a clear geologic record of rupturing around every three centuries – and 2017 marked the 300th anniversary of what is thought to have been a magnitude 8 quake that moved one side of the fault by about 8m in a matter of seconds.

Recent studies have suggested a big quake could block South Island highways in more than 120 places, leave 10,000 people cut off, and cost the economy about $10 billion. Now, a project led by GNS Science's **Dr Russ Van Dissen** will dig into the hidden system and another large South Island fault the Wairau Fault – to work out which way they'll rupture in the future.

Van Dissen said the direction of rupture propagation, called unzipping, had a major influence on where seismic energy was focused.

Because the 7.8 Kaikoura earthquake ruptured from south to north, it sent a pulse of energy northwards that was sharply felt across the lower North Island – especially in Wellington.

For scientists trying to calculate potential levels of ground shaking in a given area, they typically looked at where, when, how strongly, and in which direction past ruptures had unfolded.

But the last of those four factors remained tricky to quantify. "A lot of people have carried out modelling and found that, if we knew which way the Alpine Fault would actually rupture, this would be the sort of energy and ground motions it might send to the north, or to the south, and so on," he said.

"But we actually don't know what to look for, or even how to measure which way ruptures have propagated in the past." That was where what were called slip striations or "scratch marks" could prove vital.

"In essence, scratch marks on fault surfaces provide a signpost that points towards the epicentre of the quake," he explained. "We know that a fault has two sides to it. After one slides past the other, you can notice irregularities – like bear claw marks – that show which way the fault has moved." The importance of these previously-unrecognised markers emerged after the catastrophic 1995 Kobe earthquake in Japan.

"Colleagues came up with a model of how the dynamics of rupture interacted with the stresses and caused these scratch marks to curve near the ground surface." What wasn't noted at the time was how the marks curved differently on each side relative to the epicentre's location. That struck Van Dissen while working on Marlborough's Kekerengu Fault, after the Kaikoura quake.

It was the fault's rupture in November 2016 that created a dramatic rift across kilometres of farmland north of Kaikoura, which became known as the Wall of Waiau. Rock in this rupture-made wall bore those all-important scatch lines. "We noticed they were consistently curved one way, so they kind of looked like a big rainbow." Using modelling, they discovered the link between the curves and the epicentre's direction.

"I can't say it was an Einstein moment – we just thought, oh, that's pretty significant." The team planned to revisit the site, and then look for similar markings on sections of the Alpine Fault, along with the Wairau fault, stretching 1000km between Lake Rotoiti and Cloudy Bay.

It was similarly late in its rupture cycle – and also thought to be capable of triggering large quakes.

"The direction of rupture of future quakes on these faults will have a significant influence on the strength of shaking experienced across the South Island and the lower North Island," Van Dissen said.

"If we can show that both faults have ruptured a number of times in a certain direction, then that information could be used to better plan for future earthquakes, and in designing more resilient buildings and infrastructure.

"Large faults are like a heavyweight boxer – you know they are going to pack a wallop. So if you want to prepare yourself, it's helpful to know which direction the energy is going to be coming from." He added that the findings of the collaborative project – supported by a $960,000 Marsden Fund grant – may influence the seismic hazard evaluation, by opening up an archive of past fault rupture directions.

"If what we do pans out, there'd be huge interest in it at places like the San Andreas Fault in California, the North Anatolian Fault in Turkey – basically anywhere there's long strike-slip faults like the Alpine Fault."

"Large faults are like a heavyweight boxer – you know they are going to pack a wallop"

VAN DISSEN

Read more: Bit.ly/MF56-45

HĪKOI OF A LIFETIME

RETRACING MĀHINAARANGI'S FOOTSTEPS

"It was an incredible privilege to follow, even if not in its exact form, the path that Māhinaarangi likely took to Rangiātea, and to have six strong Raukawa wāhine join me in this mission."

DR NAOMI SIMMONDS

This item was first broadcast and published by RNZ, 9 December 2020 by Te Aorewa Rolleston, Reporter, and is reproduced with permission.

Seven wāhine Māori from Raukawa have completed a 370km trek across the north island retracing the footsteps of their ancestor Māhinaarangi. Over three weeks, Dr Naomi Simmonds from Te Whare Wānanga o Awananuiārangi and her six relatives travelled on foot from Hastings to a pā site in Rangiātea.

Māhinaarangi trekked 500km while pregnant, on the way giving birth to her son, the ancestor Raukawa.

"It's a love story, Māhinaarangi fell in love with Tūrongo from Tainui Waka, who had gone over to the neck of the woods down in Ngāti Kahungunu to help build a house. They fell in love, and she fell pregnant," Dr Simmonds said.

The hīkoi will contribute to Dr Simmonds' final doctorate research project, funded by Marsden, Taku Ara Rā.

The journey was a chance for the women to reconnect with ancestral whenua while also having a physical and spiritual experience as wāhine Māori.

"For years I'd researched the journey of Māhinaarangi as part of my PhD research, and one thing that was missing was the actual physical experience of the haerenga itself," Dr Simmonds said.

The wāhine were well looked after along the way by local marae and whānau who joined the hīkoi at different stages.

Dr Simmonds said it was an incredibly humbling experience to reconnect with their tribal stories and the surrounding terrain. Although the journey was challenging, the women bonded amidst the sweat and tears while learning what it meant to be Raukawa wāhine in contemporary Aotearoa.

"It was an incredible privilege to follow, even if not in its exact form, the path that Māhinaarangi likely took to Rangiātea, and to have six strong Raukawa wāhine join me in this mission."

The other wāhine who joined Dr Simmonds were Kyea Watene-Hakaraia, Arahia Moeke, Ngahuia Kopa and Lisa Begbie along with her two daughters Tyra and Klee.

She hoped more ancestral hīkoi would be able to be carried out in the near future.

See original article: Bit.ly/MF56-48

Below: At the 300km mark of the hīkoi on the banks of the Waikato River. L-R: Ngahuia Kopa, Naomi Simmonds, Arahia Moeke, Klee Begbie, Kyea Watene-Hakaraia, Tyra Begbie, Lisa Begbie.

RESEARCH IN FOCUS

AOTEAROA NEW ZEALAND'S DIFFICULT HISTORIES

How do New Zealanders remember and forget difficult events in the colonial past? Why are some conflicts publicly remembered while others are forgotten or overlooked? And who decides?

These are the central questions of 'He Taonga Te Wareware? Remembering and Forgetting Difficult Histories in Aotearoa New Zealand' (a.k.a. the Difficult Histories project).

Led by **Professor Joanna Kidman** of Victoria University of Wellington Te Herenga Waka and **Dr Vincent O'Malley** of HistoryWorks, the Difficult Histories project examines the different ways in which the nineteenth-century New Zealand Wars have been remembered and forgotten and how they continue to shape identities today. It has proven to be a timely research project.

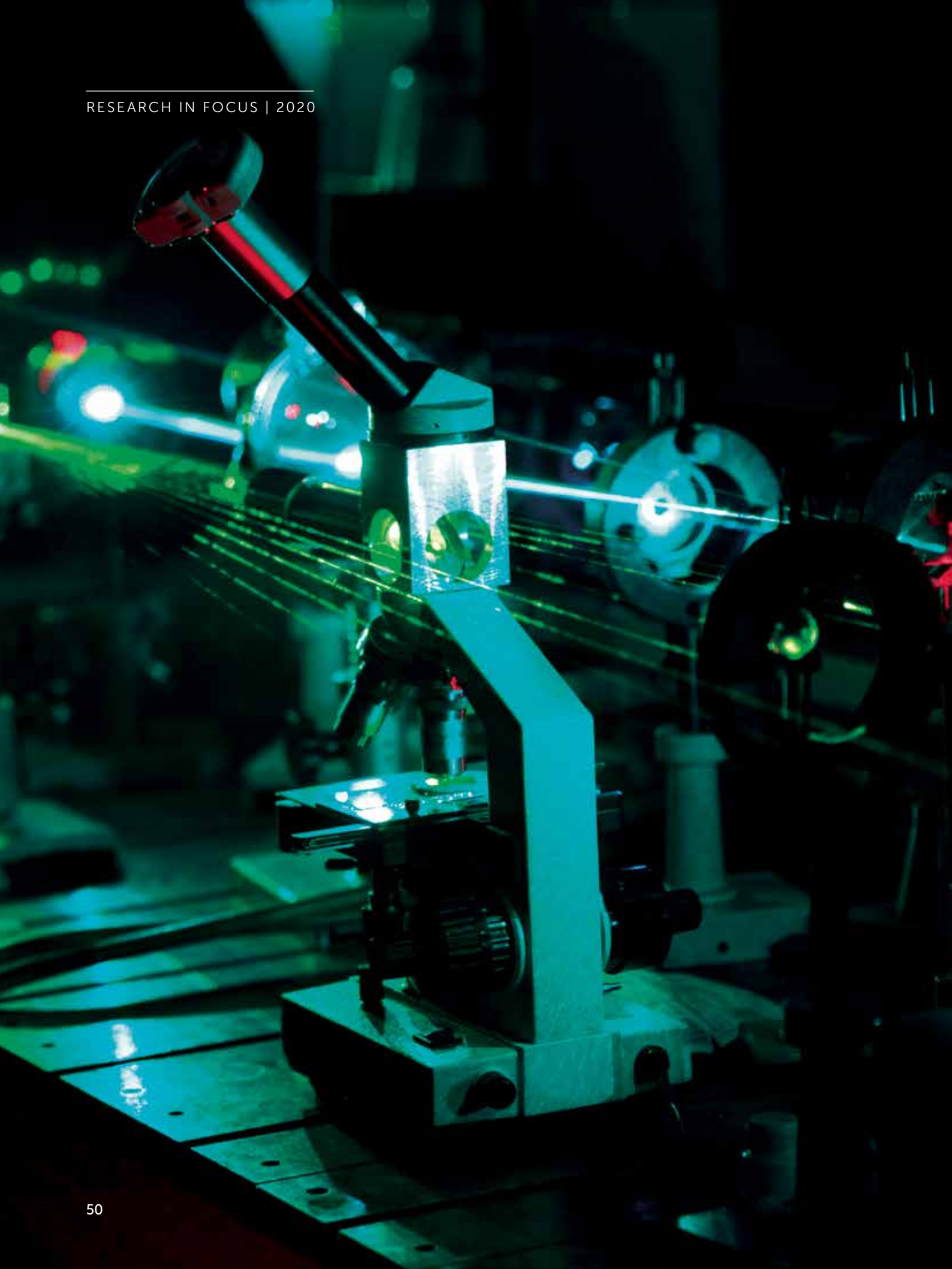
What began as a much smaller study examining responses to the 2015 Ōtorohanga College petition calling for a national day of commemoration for the New Zealand Wars became even more topical with the announcement that New Zealand history will be taught in all schools from 2022. It was further amplified in 2020 with the Black Lives Matter protests following the killing of George Floyd by US police, and the toppling or removal of statues around the world (including Captain John Fane Charles Hamilton in the Waikato city named after him). All of a sudden, the past and who and how we remembered and commemorated, became matters of great import and interest to a large number of people.

For the large, multi-disciplinary research team, many of whom have ties to iwi attacked during the New Zealand Wars, it has been an exciting time to be involved in such a project. Despite Covid-19 disruptions to fieldwork, data collection and archival research and analysis continued apace, much of it online. Fieldwork in Northland in February 2020 has been followed by work in Taranaki, Tauranga and Waikato.

Some of the former battle sites are relatively well preserved, with Ruapekapeka and Rangiriri standing out. At other places, members of the team find nothing at all to mark spots where acts of great violence were committed. Sometimes just finding them is challenging. And this kind of fieldwork can be especially gruelling when you know what happened at these places. Karakia and other rituals help keep the team safe.

Interest in the project has grown enormously since work first started. The Difficult Histories research team has also expanded. **Leah Bell**, one of the organisers of the Ōtorohanga College petition, who is now studying history at Victoria University of Wellington Te Herenga Waka, is providing research assistance on a part-time basis.

Among the various talks delivered to date, members of the team presented a roundtable session on the project at the New Zealand Historical Association conference in November 2019 and a webinar for the Tiriti-Based Futures online event in March 2020. They have also published articles in outlets with a wide reach such as E-Tangata. As part of their efforts to reach beyond a narrow academic audience, they have been documenting their work through social media platforms, and Joanna and Vincent have begun work on a book about the project.



NEW TYPE OF MICRO LASER SOURCE SUITABLE FOR COMMERCIALISATION

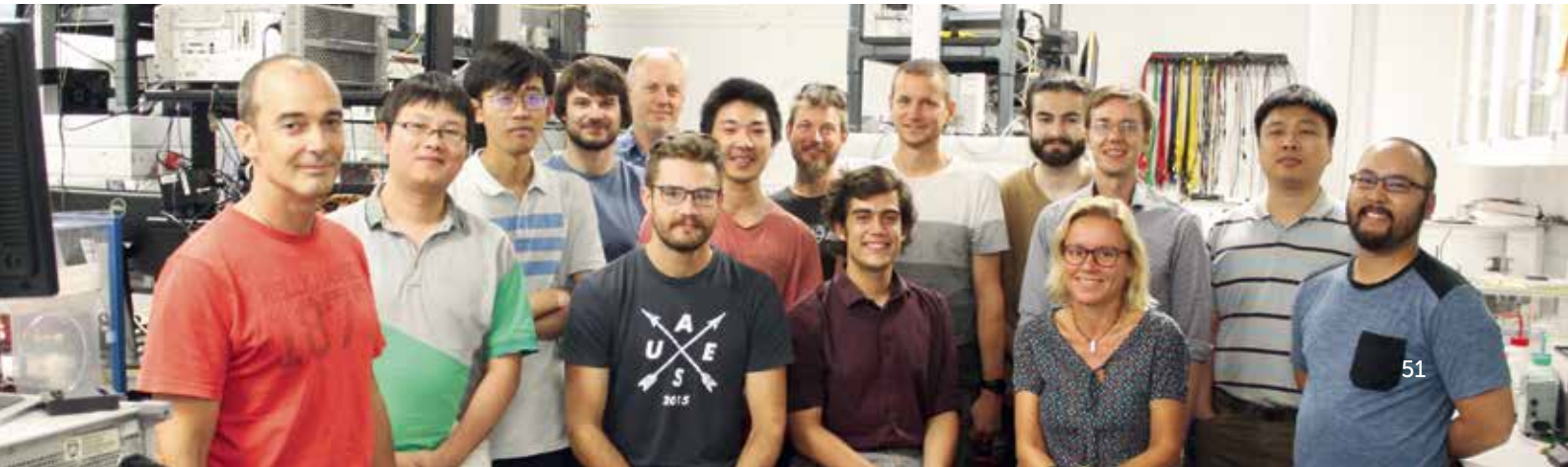
Associate Professors Stuart Murdoch and **Stephane Coen**, **Dr Miro Erkintalo**, **Dr Vincent Ng**, and PhD student **Noel Sayson** from the Physics department at the University of Auckland have developed a new type of micro laser source. This new micro laser source is capable of generating new optical frequencies tunable across the mid-infrared spectrum. This invention is cheap, tiny and suitable for commercialisation.

Lasers are everywhere in the modern world. All email and phone calls are encoded as data to be sent around the world using lasers. Lasers are used in areas ranging from surgery and the detection of disease, to precision cutting and welding, to the sensors needed for self-driving cars. Each frequency, or colour, of laser light is like a different sized spanner suited to a particular job. Yet some frequencies of light remain difficult to produce. Frequencies in the mid-infrared range are particularly difficult to generate yet needed for the sensitive detection of many chemicals, including gases such as methane and carbon-dioxide.

The team on this Marsden Fund project developed a new type of laser light source based around a tiny disk of magnesium fluoride crystal (known as an optical microresonator). When illuminated by a laser, the microresonator can transform the input laser light to a new frequency through a nonlinear process called optical parametric oscillation. While there are commercial devices available that can also achieve this, they are expensive and bulky and have struggled to find application outside of research laboratories. The device developed by this project is simple, cheap, and tiny.

For efficient operation, the microresonator must possess an ultra-high optical quality (with a roundtrip loss of the order of 1 part in 100,000 or lower). To achieve such high performance the team collaborated closely with **Professor Harald Schwefel's** microresonator lab at the University of Otago. The microresonators were first cut to shape using a purpose built diamond point turning lathe, then hand-polished to the ultra-high quality optical finish required. Using these tiny devices (the smallest disk had a diameter of just 300 microns) the team was able to demonstrate tunable parametric output that spanned 2 octaves of optical frequency, from 1 to 4 microns.

These ground-breaking results were published in Nature Photonics in 2019. Since this publication, other groups have also succeeded in reproducing these results across a range of different microresonator platforms. Most importantly, these include integrated photonic chip devices that offer a potential route for the future commercialisation of this technology.



NO TE HURIHURINGA ON REFLECTION

PROFESSOR DAVID BILKEY

CHAIR, MARSDEN FUND COUNCIL

Kia ora koutou

There is no doubt that 2020 will be identified as the year of COVID-19. This virus has dominated the news, rearranged our behaviour and affected all of us in many ways. For some of us the consequences have been tragic, and I wish to extend my sympathies to those who have lost whānau, colleagues and loved ones either here or abroad.

There have been disruptions and challenges for all of us, and for many in our research community the pandemic has had an impact on our ability to manage or conduct research programmes. This includes difficulties generated when lockdowns have intruded into our work, delays in sourcing material from overseas, and major problems with research that has an international component. Those in the early stages of their research career may have found it particularly difficult. For example they may have lost opportunities to take up the 'overseas experience' that is often a critical part of skill development post-PhD, or through feeling particularly vulnerable as research institutions restrict hiring in an attempt to cut costs. The Marsden Council is aware of these issues and, where we can, we are working to help mitigate against some of the effects.

On a more positive note, one particularly notable aspect of the COVID-19 response has been the Government's reliance on advice from researchers to underpin evidence-based decision-making. This has been cited by many as one of the reasons Aotearoa has managed to get through the pandemic as well as it has. We should thank all of those researchers who tirelessly provided support through the pandemic, whether that has been through technical advice, providing expertise on everything from testing protocols, policy impact, and modelling of disease transmission, through to public outreach and science communication.

One thing that 2020 has taught us is that resilience is key. Whether we are talking about psychological, economic or structural resilience, one factor that has supported resilience during 2020 is having this expertise available in a wide range of fields. This kind of resilience has been built on a broad-ranging research infrastructure that has been ready and available to provide support during this moment of crisis. I am certain that the Marsden Fund has played an important role over the last 25 years in helping to ensure that that expertise has been available when called upon. While the key aims of the Marsden Fund are to support investigator-led research aimed at generating new knowledge and to foster creativity and innovation in the research sector, it also has the objective of contributing to the development of advanced skills in Aotearoa. It is this latter aspect that I believe has helped underlie our country's response to COVID-19 over the last year.

The COVID-19 response has been the Government's reliance on advice from researchers to underpin evidence-based decision-making. This has been cited by many as one of the reasons Aotearoa has managed to get through the pandemic as well as it has.

HE RĀ KI TUA
Better days are coming

Out of interest, I did a quick review of the projects that the Marsden Fund has supported over the previous 20 years where the outcomes would have been researchers with enhanced skills in some aspect of the pandemic response. This included the obvious areas like epidemiology and immune responses, but also stretched to research on leadership and food security. Interestingly, almost 70 projects of this type have been supported by the Marsden Fund between 1998 and 2019. This represents a large number of research teams and individual researchers who were likely available to provide input to, and commentary on, the progress we made over the last year. While providing this type of resilience is not the primary function of the Marsden Fund, it illustrates just one of the useful spin-offs that occur when you are able to provide broad support for research across multiple disciplines.

Despite the challenges of 2020, the Marsden Fund has been able to continue to provide support to Aotearoa-New Zealand's researchers. I wish to thank the Marsden Fund Council and Royal Society Te Apārangi executive staff who put in the mahi right through 2020 to make this happen. Special credit to this latter team, who worked with Council to allow us to respond quickly to the first New Zealand-wide lockdown, which occurred as the initial Expression of Interest stage of the Funding round was about to occur. This support allowed us to develop protocols that were the foundation for robust process in the round, while at the same time allowing us to accommodate the extra demands that were placed on applicants, panellists, and support staff.

I congratulate those researchers who were successful in the 2020 funding round. As I look back at the projects that were supported, I see a beautifully diverse range of excellent research. These projects, and the ideas behind them, will all contribute to the storehouse of knowledge that is accumulating across Aotearoa and will help to build the diverse and resilient research community that we have all come to value.

It is uncertain what the year ahead will bring us, and as Director General of Health, Dr Ashley Bloomfield, has reminded us, we're not out of the woods yet. As I write this in April 2021, however, I do believe that we can see the first glimmerings of sunlight through the leaves.

Despite the challenges of 2020, the Marsden Fund has been able to continue to provide support to Aotearoa – New Zealand's researchers.

MARSDEN FUND RECIPIENTS 2020

This list of recipients is abridged. For the complete list of awarded Marsden Fund investigators including abstracts of all projects, **visit:** | Bit.ly/MF56-54

Project ID	Institution	Principal Investigator	Project	Funding (ex GST)
20-AUT-023	Auckland University of Technology Auckland University of Technology	Associate Professor JD Kidd Dr HA Came	Re-imagining anti-racism theory in the health sector	$870,000
20-AUT-037	Auckland University of Technology	Dr CL Fleming	Light-responsive drug delivery systems to probe dynamic biological functions	$300,000
20-GNS-001	GNS Science	Dr LM Wallace	Tipping the balance: what makes slow earthquakes episodic?	$960,000
20-GNS-006	GNS Science GNS Science	Mr RJ van Dissen Dr Y Kaneko	Geological fingerprinting of earthquake rupture directions: Can it be done?	$960,000
20-LCR-002	Manaaki Whenua Landcare Research Victoria University of Wellington	Dr PM Novis Dr LM Petherick	Australia burning, NZ melting: impacts of bushfires on NZ glacial environments	$960,000
20-LCR-008	Manaaki Whenua Landcare Research	Dr AJ Veale	Pausing pregnancy: The convergent evolution of, and mechanisms underpinning embryonic diapause observed across mammals	$300,000
20-LCR-010	Manaaki Whenua Landcare Research	Dr MK Dhami	Does home-field advantage confer resilience against competitive exclusion under warming?	$300,000
20-LIU-002	Lincoln University Arizona State University	Professor PE Hulme Professor C Perrings	Nursery crimes: Does the popularity and pricing of alien plant species traded in NZ ornamental horticulture markets determine the risk of introducing environmental weeds?	$798,000
20-MAU-005	Massey University	Dr KA Holt	Unlocking centuries worth of surface UV-B radiation history hidden in pollen	$944,000
20-MAU-017	Massey University	Professor MP Cox	Unravelling the 3D structure of archaic hominin DNA in the human genome	$960,000
20-MAU-021	Massey University Massey University	Dr RR Stewart-Withers Dr FR Palmer	Our game by our rules: Bringing an Indigenous perspective to the Sport-for-Development (SFD) field	$870,000
20-MAU-028	Massey University	Professor J Brand	Three atoms in a tight spot	$939,000
20-MAU-050	Massey University	Professor MG Roberts	The dynamics of interacting infections	$491,000
20-MAU-054	Massey University	Dr NE Freed	Predicting evolution: Quantifying the emergence of antibiotic resistance in diverse environmental strains of E. coli	$300,000

20-MAU-071	Massey University Massey University Massey University University of Otago Massey University University of Otago Massey University	Professor J Douwes Dr CR Brooks Dr MA Corbin Professor J Crane Professor JD Potter Dr CL Shorter Associate Professor AM 't Mannetje	Biodiversity, microbiota, and childhood allergies and asthma: variation across space and time	$3,000,000
20-MAU-090	Massey University	Dr RT Firestone	Navigating Pacific Indigenous knowledge and practices in relation to contemporary dietary patterns: Investigating 'ai ia e ola' – eat to live well	$870,000
20-MAU-093	Massey University	Dr WH Webb	Understanding the evolution of complex female song in songbirds	$300,000
20-MAU-101	Massey University	Dr AL Clavijo-McCormick	Plant communication in times of rapid environmental change	$300,000
20-PAF-002	Plant & Food Research	Dr J Jayaraman	How do new pathogen incursions evolve during host infection?	$300,000
20-PAF-008	Plant & Food Research Plant & Food Research	Dr KM Davies Dr JW van Klink	From the road less travelled: How hornworts can help decipher the evolution of a fundamental stress tolerance adaptation of land plants	$954,000
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20-UOA-004	University of Auckland University of Auckland	Professor BJ Connor Associate Professor DM Svirskis	Reprogrammed dopamine cells in three-dimensional microspheres to treat Parkinson's Disease	$958,000
20-UOA-008	University of Auckland	Associate Professor NR November	Cultivating musical arrangements in early nineteenth-century Vienna: Uncovering women's agency in the domestic sphere	$638,000
20-UOA-027	University of Auckland	Dr JW Astin	Releasing the brake on lymphatic regeneration. Developing new paradigms for the treatment of secondary lymphoedema	$959,000
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20-UOA-036	University of Auckland	Dr S Manuela	Psychology of Pacific peoples or Pacific psychologies? How Pacific psychologists are changing the discipline	$300,000
20-UOA-041	University of Auckland	Dr CL Rivera-Rodriguez	Methods for the analysis of complex routinely collected data	$300,000
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20-UOA-056	University of Auckland	Dr K Sila-Nowicka	Digital breadcrumbs feeding urban decision-making	$300,000
20-UOA-074	University of Auckland University of Auckland	Associate Professor VJ Kirk Professor JR Sneyd	Modelling calcium dynamics in living animals: Multiple time and space scales in theory and practice	$717,000
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