PUTANGA ISSUE NO.55

MARSDEN FUND 2019 UPDATE

RUA TEKAU MĀ RIMA NGĀ TAU | 25TH ANNIVERSARY EDITION

MARSDEN FUND
TE PŪTEA RANGAHAU A MARSDEN

ROYAL SOCIETY TE APĀRANGI

ABOUT THE MARSDEN FUND

The Marsden Fund Te Pūtea Rangahau a Marsden supports excellence in leading-edge research in 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; 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 New Zealand 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

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

He iti hau marangai, e tū te pāhokahoka

After the storm comes a rainbow

RĀRANGĪ ŪPOKO CONTENTS

2019 HIGHLIGHTS TE TAU

PROJECT HIGHLIGHTS FROM NEW MARSDEN FUND AWARDS

WORLD-CLASS RESEARCH SUPPORTED BY MARSDEN FUND AND INAUGURAL AWARDS FOR TWO LARGE INTERDISCIPLINARY PROJECTS

In 2019, the Marsden Fund Te Pūtea Rangahau a Marsden allocated $83.671 million (excluding GST) to 125 research projects across Aotearoa. These grants support excellent New Zealand research in the areas of science, engineering, maths, social sciences and the humanities.

This year, two large interdisciplinary projects received inaugural Marsden Fund Council Awards worth $3 million (excluding GST) each.

One project will contribute to knowledge about predicting the behaviour of biological systems and their response to shifting temperatures, as might occur with climate change. The other is investigating genetic markers associated with metabolic diseases (like diabetes and gout) in Pasifika populations and how these diseases might have evolved.

Established researchers were awarded 74 Marsden Fund Grants.

The rangahau research projects address a range of problems and questions of both local and international interest including the role of rimu fruit in the conservation of kākāpō, measuring Antarctic glacier melting rates in the Ross Ice Shelf, examining how rangatahi young people in Aotearoa react to debates about sexual harassment in social media and identifying earthquake hazards in hidden faults in the Waikato region.

Marsden Fast-Start Grants support early career researchers to build excellent research careers in New Zealand by pursuing independent research.

In 2019, there were 49 recipients of Fast-Start Grants. Projects focus on topics such as understanding the molecular underpinning of Alzheimer's disease, studying how body-snatching parasites manipulate their hosts to enhance their own survival, looking at the 1918-19 influenza pandemic through children's eyes, and analysing how different types of river science are valued by institutions around Aotearoa.

The successful projects are of world-class standard, having made it through a highly rigorous selection process, including substantial international peer review. Marsden Fund Council Chair Professor David Bilkey says:

"International peer reviewers described some of this year's research as the best they had ever seen. Te Pūtea Rangahau a Marsden supports our leading and up-and-coming researchers to carry out cutting-edge studies that advance knowledge in a wide variety of disciplines. The outcomes of their mahi should have great scholarly impact and benefit Aotearoa in areas such as te taiao the environment, health care and education."

"The Minister for Research, Science and Innovation, Hon Dr Megan Woods, is a strong supporter of equity, diversity and inclusion in research and the Marsden Fund Council is right behind her on this," says Professor Bilkey. "Our figures show that there is equity in funding decisions. For example, success rates for applicants identifying as wāhine female or Māori are the same as those for applicants identifying as male or non-Māori."

"The Marsden Fund Council has also observed increasing engagement with mātauranga Māori across discipline areas," notes Professor Bilkey.

Some examples include a project investigating kaitiakitanga over the Kāwhia, Manukau and Whangārei harbours, another that uses Māori oral history of seafaring and wayfinding to understand low-altitude clouds and their link to surface meteorological variables, and another revitalising whai Māori string figures, the unique, complex mnemonic system that documents and transmits Māori knowledge and practice.

The overall success rate for applicants is down slightly from last year (12.4%) to 10.7% this year. However, two Marsden Fund Council Awards were funded in this round, which accounts for $6 million (excluding GST) of the budget. The success rate for Fast-Start grants for early career researchers was 12.6%.

NGĀ RANGAHAU TAUMATA TIKETIKE E TAUTOKONA ANA E TE PŪTEA RANGAHAU A MARSDEN

TAE ATU KI NGĀ TAKUHE PŪKENGAWHITIWHITI NUI E RUA A MARSDEN

He $83.671 miriona (kore GST) kua tohaina e Te Pūtea Rangahau a Marsden ki ngā kaupapa rangahau 125 puta noa i Aotearoa. E tautoko ana ēnei takuhe i ngā rangahau tino rawe o Aotearoa i roto i ngā wāhanga o te pūtaiao, mātauranga pūkaha, pāngarau, mātauranga pāpori me te aronui.

I tēnei tau e rua ngā kaupapa pūkengawhitiwhiti nui i whiwhi i te Kaunihera Pūtea Rangahau a Marsden he $3 miriona (kore GST) mā tēnā, mā tēnā.

Ka hāpai tētahi kaupapa i ngā mōhiotanga mō te matapae i te whanonga o ngā pūnaha rauropi me te urupare ki ngā pāmahana nekeneke, ka pā mai i te huringa āhuarangi. Ko tētahi atu kaupapa ko ngā takuhe iranga e pā ana ki ngā mate matūriaka (pērā i te matehuka me te porohau) i roto i ngā taupori Pasifika, ā, me te āhua pea o te hangā o ēnei mate.

E 74 ngā kairangahau matatau i whakawhiwhia ki ngā takuhe Pūtea Rangahau a Marsden.

E whakarite ana ngā kaupapa rangahau i ngā tūmomo raruraru, pātai hoki o konei me tāwāhi, tae atu ki te wāhanga o te hua rimu i roto i ngā mahi atawhai i te kākāpo, te ine i ngā pāpātanga rewa o ngā awa kōpaka o Te Kōpaka Raro i te Ross Ice Shelf, te aromātai i te āhua o te urupare a ngā taiohi o Aotearoa ki ngā tautohetohe mō te taitōkai i roto i te pāpāho pāpori me te tautuhi i ngā pūmate rū e huna ana i rō i ngā tanuku i te rohe o Waikato.

E tautoko ana ngā takuhe Tīmata Wawe a Te Pūtea Rangahau a 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 tau 2019, e 49 nga kaiwhiwhi i ngā takuhe Tīmata Wawe. E arotahi ana ngā kaupapa pērā i te rapu māramatanga mō te rāpoi ngota e pouhere ana i te mate Alzheimer's, te mātai i te rāwekeweke a ngā pirinoa kapo-tinana i ngā rauropi papa hei whakapiki ake i te oranga, te tirotiro i te mate urutā o te 1918-19 mai i te tirohanga tamariki, me te tātari i te āhua o te uara o ngā momo pūtaiao awa e ngā whakanōhanga puta noa i Aotearoa.

He taumata tiketike rawa ngā kaupapa i waimarie, i puta i tētahi tukanga tīpakonga tino pakari, tae atu ki te aropā ā-ao nui. Hei tā te Heamana o te Kaunihera Pūtea a Marsden a Ahorangi David Bilkey:

"Hei tā ngā kaiarotake aropā ā-ao ko ētahi o ngā rangahau o tēnei tau ngā mea pai rawa atu kua kitea e rātau. E tautoko ana Te Pūtea Rangahau a Marsden i ā mātau kairangahau mātāmua, pūhou hoki ki te whakahaere i ngā rangahau hou rawa e kauneke ana i ngā mōhiotanga i roto i ngā tūmomo pūkengaiti whānui. Me nui ake te pānga mā o ā rātau mahi ki te tino tohungatanga me te painga mō Aotearoa ki ngā wāhi pērā i te taiao, te hauora me te mātauranga."

"He tino kaitautoko te Minita Rangahau, Pūtaiao me te Auahatanga, a Hōnore Tākuta Megan Woods, i te ōritenga, kanorautanga me te whakaurunga i roto i te rangahau, ā, kei te tino tautoko te Kaunihera Pūtea Rangahau a Marsden i a ia mō tēnei," te kī a Ahorangi Bilkey. "E whakaatu ana ā mātau tatau i te ōritenga i roto i ngā whakataunga pūtea. Hei tauira, ko te rahinga angitu mō ngā kaitono he wāhine, he Māori rānei he ōrite ki ērā mō te tāne, mō tauiwi rānei."

"Kua kite te Kaunihera Pūtea Rangahau a Marsden i te piki haere o te mātauranga Māori puta noa i ngā wāhanga mātauranga," te kī a Ahorangi Bilkey.

Ko ētahi tauira ko tētahi kaupapa tūhura kaitiakitanga i ngā whanga o Kāwhia, Manukau me Whangārei, ko tētahi atu he whakamahi i ngā kōrero ā-waha tuku iho a te Māori mō te whakatere moana kia mōhio ai ki ngā kapua hahaka me te hono ki ngā taurangitanga tātari huarere, ko tētahi atu ko te whakarauora i ngā āhua whai Māori, te pūnaha ahurei, kupuwai matatini e mau ana, e tuku ana i ngā mōhiotanga me ngā tikanga Māori.

Kua āhua heke te rahinga o ngā kaitono i waimarie mai i tērā tau (12.4%) he 10.7% i tēnei tau. Engari, e rua ngā Takuhe Kaunihera Pūtea Rangahau a Marsden i utua i tēnei tau, he $6 miriona (kore GST) mai i te tahua. Ko te ōwehenga momoho mō ngā takuhe Tīmata-Wawe mō ngā kairangahau pūhou he 12.6%.

MARSDEN FUND COUNCIL AWARDS

TEMPERATURE-DEPENDENCE

EXPLORING HOW EARTH'S BIOSPHERE HAS RESPONDED OVER TIME AND SPACE

A defining feature of all biological systems, including microbes, plants and animals, is their ability to catalyse a wide range of chemical reactions at ambient temperatures. Enzymes are extraordinary catalysts that enable life forms to flourish in nearly every available part of our planet. These large, yet delicate, molecules show unusual responses to changes in temperature and, in turn, this has a significant impact on how biological systems respond.

Professor Vic Arcus and **Professor Louis Schipper** of the University of Waikato with **Dr Liyin Liang** of Manaaki Whenua – Landcare Research, and **Dr Bella Duncan** of Victoria University of Wellington have been awarded an **inaugural Marsden Fund Council Award** to determine whether there is a single theory of temperature dependence that applies to life in a range of scales in time and space.

Professors Arcus and Schipper have already developed a theoretical framework called Macromolecular Rate Theory (MMRT), which explains the behaviour of enzymes at different temperatures. Together with Drs Liang and Duncan, and a team of research scientists (including chemical physicists, molecular biologists, plant physiologists, soil scientists, climate modellers and palaeoclimate experts) they will discover a new model of the biosphere based on MMRT that will allow people to accurately predict the temperature dependence of biological rates across scales.

The researchers predict that the signature of enzyme MMRT is found in complex processes such as microbial growth rates, plant and soil respiration, photosynthesis and, ultimately, the removal and storage of atmospheric carbon dioxide into the landscape. Predicting the behaviour of biological systems and their response (and feedback) to increasing atmospheric greenhouse gases and climate warming is one of the grand challenges in interdisciplinary science.

TE TŪHURA I TE WHAKAMAURU O TE AO KOIORA O PAPATŪĀNUKU KI TE PĀMAHANA I ROTO I TE WĀ ME TE TUARANGI

Kua whakawhiwhia a **Ahorangi Vic Arcus** rāua ko **Louis Schipper** o Te Whare Wānanga o Waikato, i te taha o **Tākuta Liyin Liang** o Manaaki Whenua me **Tākuta Bella Duncan** o Te Whare Wānanga o Te Ūpoko o Te Ika ki tētahi **Takuhe Pūtea Rangahau a Marsden** hei whakarite mēnā kotahi te ariā ka taea mō te whakamauru ā-pāmahana e hāngai ana ki te ora i ngā tūmomo tauine i roto i te wā me te mokowā.

Ko tētahi āhuatanga taketake o ngā pūnaha koiora katoa, tae atu ki ngā moroiti, ngā tipu me ngā kararehe, ko te āheinga ki te tīmata i ngā tūmomo tauhohenga matū i ngā pāmahana huri noa. He tino whākōkī ngā pūmua whākōkī e taea ai ngā momo te puāwai ki te nuinga o ngā wāhi o tō tātau ao. E whakaatu ana ēnei rāpoi ngota nui, tūoi, i te tino rerekē o ngā urupare ki ngā huringa pāmahana, ā, he pānga nui tō tēnei ki te āhua o te urupare a ngā pūnaha koiora. Kua oti kē i a Ahorangi Vic Arcus rāua ko Ahorangi Louis Schipper (nō Te Whare Wānanga o Waikato) te waihanga i tētahi pou tarāwaho e kīia ana ko te Macromolecular Rate Theory (MMRT), e whakamārama ana i te whanonga a ngā pūmua whākōkī i ngā pāmahana rerekē. I te taha o Tākuta Liyin Liang (Manaaki Whenua), me Tākuta Bella Duncan (Te Whare Wānanga o Te Ūpoko o Te Ika), ka whakamahia e Ahorangi Arcus rāua ko Ahorangi Schipper tā rāua Takuhe o Te Pūtea Rangahau a Marsden ki te tūhura i tētahi tauira hou o te ao koiora mai i te MMRT e taea ai e te tangata te matapae tika i te whakamauru o te pāmahana o ngā pāpātanga koiora puta noa i ngā tauine.

E matapae ana ngā kairangahau ko te waitohu o te MMRT pūmua whākōkī ka kitea i roto i ngā tukanga matatini pērā i ngā pāpātanga tipuranga moroiti, tukupūngao ā-whenua, ā, ā-oneone hoki, te ahotakakame, ā, te tango me te rokiroki i te hauhā kōhauhau i roto i te taiao. Hei whakamātautau i tēnei whakapae, kua whakahiatohia mai e rātau tētahi rōpū tohunga pūtaiao e mahi ana i ngā peka mātauranga, tae atu ki te kaiahupūngao matū, tohunga koiora rāpoi ngota, ngā tohunga koiora tipu, ngā tohunga pūtaiao oneone, ngā kaiwhakatauira āhuarangi me ngā mātanga āhuarangi onamata.

Ko te matapae i te whanonga o ngā pūnaha koiora me te urupare ki te nui haere o ngā hau kati kōtuhi kōhauhau me te mahana haere o te āhuarangi tētahi o ngā whakamātautau nui rawa i roto i te pūtaiao pūkengawhitiwhiti.

STUDY INTO WHETHER ANCIENT MALARIA LED TO

GENETIC PREDISPOSITION TO DIABETES, GOUT IN PACIFIC POPULATIONS

Professor Tony Merriman, Professor Lisa Matisoo-Smith, Dr Anna Gosling of University of Otago, **Associate Professor Frank Camacho** of University of Guam, **Dr Paul Pumuye** of the University of Papua New Guinea and their team of researchers have won an **inaugural Marsden Fund Council Award** to investigate genetic predisposition to metabolic disease among Pacific populations.

The Pacific region is home to diverse populations with complex histories. Despite this diversity, they share high rates of metabolic disease including type 2 diabetes, obesity, gout, heart and kidney diseases. Evidence of metabolic disease has been identified in the skeletal remains of the earliest inhabitants across remote Oceania, including among the earliest arrivals to Aotearoa. This, teamed with evidence from genetic studies, indicates Māori and other Polynesian populations likely have an inherent genetic predisposition to metabolic disease.

This project aims to understand when and why this predisposition evolved, and to identify any consistent patterns. A central hypothesis is that the high rate of metabolic disease evolved through genetic selection by infectious disease, in particular malaria. Infectious disease is one of the strongest evolutionary forces to shape the human genome and genetic variation.

As people began to migrate around the world, they entered new environments with new pathogens. Natural selection would favour individuals who had genetic variants that made them resistant to those pathogens. The hyperuricaemic phenotype, a common factor in metabolic disease, may have evolved in Pacific ancestors as a protection against malaria.

Professor Merriman and his team will test these hypotheses through the collection of new genome, biochemical and health data from a range of Pacific populations, to better understand any historical benefits and insights of genetic variants that now cause disease. This project has the potential to change perspectives that modern metabolic disease is purely caused by a modern lifestyle.

Bit.ly/2019MF1

TE RANGAHAU MĒNĀ I AHU MAI TE TINGA IRANGA O TE MATEHUKA,

POROHAU I ROTO I NGĀ TAUPORI O TE MOANANUI-A-KIWA I TE EKU ONAMATA

Kua whakawhiwhia a **Ahorangi Tony Merriman, Ahorangi Lisa Matisoo-Smith, Tākuta Anna Gosling, Ahorangi Tuarua Frank Camacho** o Te Whare Wānanga o Ōtakou, **Tākuta Paul Pumuye** o Te Whare Wānanga o Papua Nūkini me tō rātau rōpū kairangahau i tētahi **Takuhe Pūtea Rangahau a Marsden** hei tūhura i te tinga iranga ki te mate whakarau pūngao i waenga i ngā taupori o Te Moananui-a-Kiwa.

Ko te rohe o Te Moananui-a-Kiwa te kāinga o ngā taupori kanorau me ngā hītori matatini. Ahakoa te kanorau, he nui te mate whakarau pūngao o ngā taupori o Te Moananui-a-Kiwa pērā i te matehuka momo 2, tino mōmona, porohau, ngā mate manawa, tākihi hoki. Kua kitea ngā whakaaturanga mate whakarau pūngao i roto i ngā toenga kōiwi o ngā kainoho o nehe puta noa i Te Ao o Kiwa, tae atu ki te hunga tuatahi i tae mai ki Aotearoa. E tohu ana tēnei, me ngā whakaaturanga mai i ngā rangahau iranga kua whakahaerehia, he tinga iranga tuku iho tō te Māori me ētahi atu taupori o Te Moananui-a-Kiwa ki te mate whakarau pūngao.

Ko te whāinga o tēnei kaupapa kia marama ki te wā me te take i hangā ai tēnei tinga, ā, mēnā he tauira ōrite kei reira o te mate whakarau pūngao puta noa i ngā taupori kanorau o Te Moananui-a-Kiwa. Ko tētahi whakapae matua i hangā mai i te mate whakarau pūngao i roto i te tīpakonga iranga mā te mate maunoa, otirā te eku. Ko te mate maunoa tētahi o ngā kaha kunenga pakari rawa i tino ahu i te huingaira tangata me te tāupetanga iranga. I te hekenga o ngā iwi huri noa i te ao, i uru rātau ki ngā taiao hou me ngā moromate hou. Ka aro atu te whiringa māori ki ngā tāngata whai tāupetanga iranga i noho ātete ai rātau ki aua moromate. I hangā pea te tohuāhua waikawa-tiomimi, he āhuatanga noa i roto i te mate whakarau pūngao, i roto i ngā tīpuna o Te Moananui-a-Kiwa hei pare atu i te eku.

Ka whakamātautauhia e Ahorangi Tony Merriman me tōna rōpū i ēnei whakapae mā te kohikohi i ngā raraunga huingaira, matūkoiora, hauora hoki mai i ngā tūmomo taupori o Te Moananui-a-Kiwa. Ko tā rātau e whai ana kia mārama rātau he pēhea te pānga pea o ngā painga o nehe o ngā tāupetanga iranga e noho pūtake ana ināianei o ngā mate, e mārama ai ki te tinga o ngā mate whakarau pūngao i roto i ngā taupori o Te Moananui-a-Kiwa. Kei tēnei kaupapa ko te āheinga ki te huri i te tirohanga hē me te whakamā ko te pūtake o te mate whakarau pūngao onāianei ko te āhua noho o ēnei rā.

MARSDEN FUND GRANTS

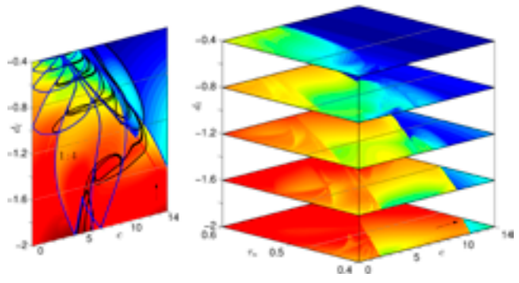
UNDERSTANDING DELAYED FEEDBACK LOOPS IN CLIMATE SYSTEMS TO

PREDICT EXTREME WEATHER

Global climate systems are extremely complex. They consist of interacting sub-systems, such as the oceans, atmosphere, land and ice, whose behaviour is both influenced by and, after a delay, itself drives, global climate. These interactions are examples of delayed feedback loops and are governed by complicated mathematics, which is not yet well understood. An important example is the famous El-Niño climate cycle operating in Te Moana-nui-a-Kiwa the Pacific Ocean, which has global impact on weather patterns and events but which is ultimately influenced by the overall global climate itself.

Professor Bernd Krauskopf from University of Auckland, will use advanced modelling and analytical techniques to improve our understanding of delayed feedback loops and the role they play in the determination of both present climate variability and future global climate change. Specifically, he aims to shed light on the properties of feedback loops in the difficult case where the delays in the system are not fixed, but depend on the state of the system itself. On top of these fundamental investigations, he will apply the acquired knowledge to a model of the El-Niño phenomenon.

This work will be of immediate benefit to the Oceania region where varying delays arise from the interaction between the ocean and the atmosphere. One crucial product of the research will be improved models of the mechanisms that underpin and control the climate, thereby leading to enhanced and more accurate predictions of future climatic events.



Representation of how delayed feedback loops influence observable behaviour in a model for the El Niño phenomenon (Professor Krauskopf, Dr Andrew Keane, Associate Professor Claire Postlethwaite, as published in SIAM Journal on Applied Dynamical Systems).

NEXT GENERATION SOLAR CELL TECHNOLOGY

FOR A GREEN FUTURE

Solar power is a highly attractive green energy source: the total solar energy absorbed by the Earth in approximately one hour is more energy than the world's population uses in one year. So-called perovskite solar cells have emerged at the forefront of solar cell research. Despite being a very young technology, perovskite solar cells are valued for their low production cost and demonstrated efficiencies, which are comparable to those of more traditional and expensive silicon cells.

The efficient conversion of sunlight to electricity relies on separating and transporting electrons out of the solar cell. In a standard perovskite solar cell, metal-oxide electrodes perform this task. Recent advances in the field suggest that graphene, a material made entirely of carbon, has superior light transmitting qualities and charge conduction, and greater chemical stability than metal oxides. This makes it a potentially attractive substitute in solar cells. **Dr Paula Brooksby** of the University of Canterbury and **Dr Noel Duffy** from CSIRO in Australia will engineer, for the first time, extremely transparent, highly conductive and stable graphene-organic film electrodes to be used in perovskite solar cells.

This technology is at the forefront of solar energy research and will enhance energy efficiency and solar cell durability. It will lay the groundwork for the next generation of solar cell design by providing an entirely new approach for constructing transparent thin film electrode materials based on graphene.

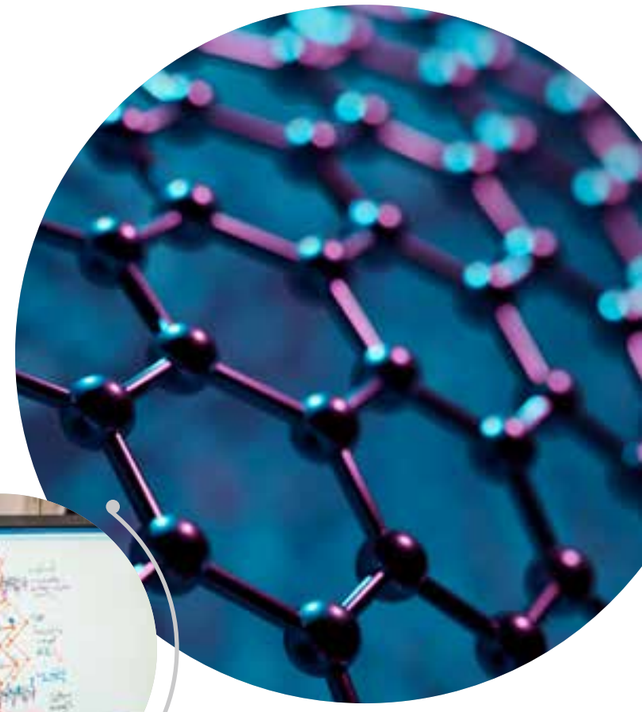


Photo: University of Canterbury

MEMORY IN THE CLOUDS – LITERALLY

Cloud formations respond to changes in winds, temperature and humidity. An exciting new observation is that cloud formations have a 'memory effect' on local changes in meteorological conditions and on up-wind changes over surprisingly great distances. The impact of these memory effects on cloud formation and on global climate models is the focus of new research from **Dr Gilles Bellon** of University of Auckland.

Tropical low-altitude cloud formations play an important role in global cooling and could represent a significant mitigating or enhancing impact on global warming. Despite their importance, current climate models do not accurately account for the influence of low clouds and the associated feedback on temperature increases due to climate change. Therefore, gaining a better understanding of tropical low clouds and improving their simulation in models is of high priority for the climate-modelling community, and has the potential to improve the accuracy of predictions. This study will use meteorological data alongside the wealth of Māori knowledge on clouds and weather. This knowledge traces back to Māori sea voyaging heritage and has been transmitted orally for generations.

Photo right: Tra Dinh (Associate Investigator) with Dr Gilles Bellon

Photo left: Subtropical low-altitude clouds as seen by satellite MODIS (copyright: NASA)

PŪMAHARA I ROTO I NGĀ KAPUA – TIKA TONU

Kei te whakahaerehia e **Tākuta Gilles Bellon** o Te Whare Wānanga o Tāmaki Makaurau i ngā rangahau hei takahuri i ō tātau mōhio mō te āhua e whakaawetia ana ngā tauira āhuahira e ngā hanganga kapua tiketike pāpaku pārūrū.

E urupare ana ngā hanganga kapua ki ngā huringa o te hau, pāmahana me te takawai. Ko tētahi kitenga whakaongaonga hou he 'pānga pūmahara' tō ngā hanganga kapua ki ngā huringa paetata i roto i ngā āhuatanga huarere, ā, ko te mea tino ohorere, ki ngā huringa ki te hau i ngā tawhiti tino nui. Ko te pānga o ēnei pānga pūmahara ki te hanganga kapua me ngā tauira āhuarangi ā-ao te aronga o te kaupapa a Tākuta Gilles Bellon e tautokona ana e Te Pūtea Rangahau a Marsden.

He wāhanga hira tō ngā hanganga kapua tiketike pāpaku pārūrū i roto i te whakamātao i te ao, ā, e tohu ana pea i tētahi pānga whakangāwari nui ki te whakamahanatanga o te ao. Ahakoa te hiranga, kāore i te tino tika ngā tauira āhuarangi onāianei mō te whakaawenga o ngā kapua pāpaku me ngā urupare hāngai ki te pikitanga o te pāmahana nā te huringa āhuarangi. Nō reira, mā te tino mārama ake ki ngā kapua pāpaku pārūrū me te whakapai ake i te whaihanga i roto i ngā tauira te mea nui rawa mō te hapori whakatauira-āhuahira. Ka whakamahia e tēnei rangahau ngā raraunga huarere i te taha o te puna mātauranga Māori mō ngā kapua me te huarere. E hoki ana ēnei mātauranga ki te ao whakatere moana o te Māori, ā, he mea tuku ā-waha i roto i ngā reanga mai i rā anō. Ka whakahiato a Tākuta Bellon i te mātauranga Māori me ngā mōhio pūtaiao o te ao Pākehā mō te huarere me te āhuarangi hei waihanga i tētahi tauira āhuarangi tika ake.

Ka taea pea e ngā hua hou mai i tēnei mahi te tino whakapai ake i te tino hāngai me te tika o ngā matapae huarangi. Ka hāngai tēnei ki ngā taupori paetata me te āwhina i te toitūtanga o te ao.

THROUGH THE LOOKING GLASS:

REINVENTING MIRROR-IMAGE CHEMICALS

Certain chemicals can exist in left-handed and right-handed forms, where each is the mirror image of the other. This includes biomolecules such as DNA, proteins and sugars. Making new molecules within a specific mirror-image form is important for pharmaceuticals and polymers and is intrinsic to the fundamentals of modern chemical sciences. For example, one mirror image of carvone smells like spearmint whereas the other smells like caraway. In aspartame, one form is sweet while the other is tasteless.

Professor Shane Telfer from Massey University will develop a novel approach to 'asymmetric catalysis' with the goal of specifically producing only the desirable single-handed form of molecules, and not their mirror images. His revolutionary new design strategy will bring precursor chemicals together by anchoring them inside the pore of a metal-organic framework, like a crystalline sponge. This will enable a chemical reaction inside the metal-organic framework to produce only the desired single-handed product in a way that is distinct from traditional catalysts. The research will be supported by computational methods to help focus experimental work and maximise efficiency.

This reimaging of 'asymmetric catalysis' will side step the compromises inherent to traditional methods in chemistry, and could deliver fundamental new knowledge and a new platform for chemical reactions with unprecedented capabilities.

DOES SLEEP LOSS IN CHILDREN LEAD TO UNHEALTHY EATING?

Research strongly suggests sleep loss in children promotes unhealthy eating, but how this occurs is largely unknown.

Although sleep loss probably isn't the direct cause of weight gain, it may provide just the right conditions for poorly regulated eating, particularly when energy dense food is easily accessible. The limited body of existing research which examines energy intake in sleep-deprived children, suggests that one to five nights of sleep loss (even just a few hours) increases energy intake by 7-21%.

Associate **Professor Barbara Galland** and **Professor Rachael Taylor** will lead a team of researchers from the University of Otago in the first large scale study of the effect of sleep loss on appetite regulation in children.

The Otago team has diverse expertise, including nutritional assessment, eating behaviour, obesity, child hauora health, sleep interventions, wearable cameras and biostatistics. With the help of parents, they will turn children's bedrooms into 'pseudo sleep laboratories' by night, applying carefully considered sleep and wake times to manipulate children's sleep for both sleep loss and gain. By day, they will capture the children's eating habits under normal everyday living conditions.

They will also bring children into the food lab to test for poorly regulated eating behaviour using carefully controlled feeding experiments. This work will lead to a better understanding of how sleep loss may change eating and appetite in children, and how this might lead to a cascade of effects on food choices, energy intake and weight gain.

IS #METOO PART OF A WIDER CULTURAL SHIFT?

Could #MeToo trigger a cultural shift around sexual harassment? While feminist activism against sexual harassment is not new, the impact of the recent #MeToo movement on public and media conversations has been huge.

#MeToo provides a key cultural moment from which to explore rangatahi young people's understandings of gender relations, gender inequality and sexual harassment today. Rangatahi are high users of social media. These platforms play a significant role in shaping their understandings and negotiation of gender and sexuality and may potentially shape their understandings of sexual harassment.

Associate Professor Sue Jackson from Victoria University of Wellington will lead a team to examine how young people in Aotearoa make sense of online discussions about sexual harassment and gender inequality. This will help us learn about, engage with and react to debates about gender and sexual harassment in social media.

How do they understand this content, what do they feel about it, and how do they respond to it in their everyday lives? Learning about how boys respond is particularly important because of how it relates to support for violence against wāhine women. There is some research with mostly white, middle class, young feminists about the use of social media to resist sexual harassment but research with boys and young men and minority groups is largely absent.

This is a timely project that promises to open up new understandings and contribute to identifying strategies for assisting rangatahi to challenge inequitable gender and sexuality norms.

ASSESSING EARTHQUAKE HAZARDS

IN THE LIQUEFIED LAYERS IN WAIKATO LAKES

Although New Zealand's main active faults capable of producing high-intensity shaking have been mapped and seismically imaged, areas of low to moderate seismicity may contain hidden faults. These have the potential to produce large-magnitude earthquakes, so it is essential to discover if any lie under or near major cities for accurate risk assessment.

Professor David Lowe, together with **Dr Vicki Moon** from the University of Waikato, are bringing together a team of national and international researchers to better understand newly-discovered hidden faults that pose a potential seismic risk in Kirikiriroa Hamilton and in adjacent lowlands.

The study will analyse volcanic-ash layers preserved in lake sediments, focusing on cores extracted from about 30 lowland lakes. Previous work shows that the lakes preserve volcanic-ash layers (of known age) deposited from central North Island eruptions over the past 20,000 years. Some of the ash layers (or tephras) have been liquefied by earthquake shaking. Using an array of sophisticated techniques, including CT scanning and state-of-the-art geotechnical testing, the team will map and characterise the liquefaction and link this to large earthquakes generated on nearby faults. This will show the spatial extent and intensity of prehistoric ground shaking.

The findings could revise earthquake hazard potential in a region otherwise difficult to characterise seismically, and will provide unprecedented insight into future earthquake hazards, both in Aotearoa and around the world.

PROBLEMS OF HAVING A SWEET HEART

The prevalence of heart disease is increasing worldwide. Glycogen is a way by which various tissue types can store glucose sugar energy reserves.

Under metabolic stress conditions, such as fasting and diabetes, the heart also stores glycogen, despite the fact that fats rather than sugars are the primary source of energy for heart cells. Glycogen accumulation is commonly observed in many different heart disease settings but the mechanisms driving this accumulation are not well understood. Importantly, the consequences of this excess glycogen for the hauora health of patients' hearts are also largely unknown.

Dr Kimberley Mellor of the University of Auckland will examine the enigmatic biological processes of glycogen in the heart, and determine whether the glycogen response to metabolic stress is a help or hindrance to heart health. Dr Mellor and her team recently characterised a previously unknown glycogen processing pathway in the heart, which could be an important regulator of glycogen levels in both healthy and diseased hearts. The goal of their new study is to advance knowledge of the fundamental biology of glycogen regulation in the heart, and make discoveries about how intra-cellular glycogen accumulation is related to heart pump function.

Given the high prevalence of metabolic and cardiac disease in Aotearoa, with Māori and Pasifika people especially affected, the long-term benefit of this knowledge advance will have far reaching health and economic impact.

Photo: (front) Kim Mellor, Xun (Cookie) Li, Dr Lorna Daniels, Marco Annandale, (back) Parisa Koutsifeli, Calum McIndoe

TE RARURARU O TĒTAHI MANAWA REKA

Kei te tūhura a **Tākuta Kimberley Mellor** o Te Whare Wānanga o Tāmaki Makaurau i ngā pānga o te whakaputu kūhukahuka ki te hauora o ngā manawa o ngā tūroro matehuka momo 2.

Kei te piki haere te tukipū o te mate manawa, nā ngā mate whakarau pūngao pērā i te matehuka momo 2, puta noa i te ao. Ko te whakatōpū kūhukahuka tētahi āhuatanga e taea ai ngā momo ōkiko te whakaputu putunga huka kūhuka. I raro i ngā āhuatanga pēhi, pērā i te kore kai me te matehuka, ka whakaputu kūhukahuka anō te manawa, ahakoa ko ngā mōmona kē, kaua ngā huka, te pūtake matua o te pūngao mō ngā pūtau manawa. E kitea noatia ana te whakatōpū kūhukahuka i ngā āhuatanga mate manawa maha rerekē engari ko ngā āhuatanga kōkiri i tēnei whakatōpūtanga kāore i te tino mōhiotia. Ina, ko ngā mutunga iho o ēnei kūhukahuka nui rawa mō te ora o ngā manawa o ngā tūroro kāore i te mōhiotia.

Kua whakawhiwhia a Tākuta Mellor ki te takuhe mai i Te Pūtea Rangahau a Marsden ki te tirotiro mēnā ko te whakatōpūtanga o te kūhukahuka i roto i ngā manawa o ngā tūroro mate whakarau pūngao he pūtake, he pānga rānei ki te mate manawa hāngai. I whakaahuatia e Tākuta Mellor rātau ko tōna rōpū tētahi ara tukatuka kūhukahuka tē mōhiotia i roto i te manawa, ā, he kaiwhakahaere hira tēnei i ngā rahinga kūhukahuka i roto i ngā manawa hauora, mate hoki. Ko te whāinga o tā rātau rangahau hou he kauneke whakamua i ngā mōhiotanga o ngā koiora taketake o te whakahaere kūhukahuka i roto i te manawa. Ko te whāinga kia tukuna ngā whakaaturanga tuatahi ko ngā whakatōpū kūhukahuka i rō pūtau te kaikōkiri i te hē o te manawa i roto i te mate manawa-whakarau pūngao.

Nā te tukipū nui o ngā mate whakarau pūngao me te mate manawa i Aotearoa, ka mutu e tino pākia ana ko te iwi Māori me Te Moananui-a-Kiwa, he tino whānui ngā painga pūmau o ēnei mōhio ki ngā āhuatanga hauora, ōhanga hoki.

THE VOICES OF OUR HARBOURS:

KĀWHIA, MANUKAU AND WHANGĀREI

Dr Marama Muru-Lanning and **Dr Keri Mills** from the University of Auckland are investigating the complex relationships Māori have with local harbours and the use of kaitiakitanga in law and policy.

While the word 'kaitiaki' has entered our legal system, it often stands in for 'stakeholder', which fails to recognise how deeply it is embedded in Māori culture. Moreover, we seldom hear the voices of those with daily responsibilities for kaitiakitanga. Aotearoa's harbours are both historically significant and environmentally threatened. This research focuses on the stories Māori tell about harbours, how kaitiaki understand these places, and how best to use or care for them.

The team will case study three harbours: Kāwhia, Manukau and Whangārei to explore diverse local expressions of kaitiakitanga and investigate how this and mātauranga Māori interacts with local and central government ways of treating the environment. It will draw on a range of community voices, kaumātua, wāhine, rangatahi and documentary sources to learn how people have enacted kaitiakitanga in their daily lives, continued their traditions and responded to climate change and environmental appropriation.

Many harbours are subject to claims under the 2011 Marine and Coastal Area Act, and Waitangi Tribunal claims over them are yet to be settled. This timely study will lead to a fuller understanding and document untold stories to empower Māori and advance human-environment, anthropological and oral history knowledge in Aotearoa.

Photo left: Muru-Lanning and post-graduate students working with kaumātua, Whangārei Harbour.

Photo right: Dr Muru-Lanning with Ngahuia Harrison, project PhD student

NGĀ REO O Ō TĀTAU WHANGA:

KĀWHIA, MANUKAU ME WHANGĀREI

Kei te mahi tahi a **Tākuta Mārama Muru-Lanning** rāua ko **Tākuta Keri Mills** o Te Whare Wānanga o Tāmaki Makaurau me ngā ahikā ki te tūhura i te kaitiakitanga o ngā whanga o Aotearoa. Ka whakaatu tēnei kaupapa a te Pūtea Rangahau a Marsden, mō te wā tuatahi, i ngā hononga matatini o te Māori ki ngā whanga me te whakaatu i ngā mahi a ngā kaikorikori Māori mō te whakamahi i te kaitiakitanga i roto i te ture me te kaupapahere.

Ahakoa kua uru mai te kupu 'kaitiaki' ki tā tātau pūnaha ture, i te nuinga o te wā e kōrero ana mō te 'hunga whai pānga', ā, kāore e whakaatu ana i te tikanga hōhonu o te kupu i roto i te ao Māori. Me te aha, kāore tātau e rongo i ngā reo o te hunga e kawe ana i ngā mahi kaitiakitanga i ia rā. He taonga onamata te whanga o Aotearoa, kei te noho mōrearea i tēnei wā. E arotahi ana tēnei rangahau ki ngā kōrero a te Māori mō ngā whanga, te āhua o te mārama o ngā kaitaki ki ēnei wāhi, me pēhea te tino tiaki, manaaki hoki.

I roto tēnei kaupapa a te Pūtea Rangahau a Marsden, ka whakamahia e te rōpū ngā mātai take o ngā whanga e toru: Kāwhia, Manukau me Whangārei ki te hōpara i ngā whakaaturanga paetata rerekē o te kaitiakitanga me te tūhura he pēhea te pāhekoheko a te mātauranga Māori me te kaitiakitanga me ngā āhuatanga o ngā kaunihera me te kāwanatanga e pā ana ki te mōhio me te manaaki i te taiao. Ka āta tirotiro rātau ki te kaitiakitanga hei kohinga huatau, hononga hoki, tae atu ki te kaupapa tōrangapū, me te whiriwhiri he pēhea te whakararu, te āwhina rānei o te whakaurunga o te kaitiakitanga ki te ture me te kaupapahere i te Māori ki te whakatutuki i tō rātau kaitiakitanga e pā ana ki ngā whanga. Ka toro te kaupapa ki ngā puna pakipūmeka me ngā tūmomo hapori, tae atu ki ngā kaumātua, wāhine, rangatahi hoki, ki te ako me pēhea te whakatinana a te tangata i te kaitiakitanga i roto i ā rātau mahi o ia rā, te mau tonu ki ngā tikanga me te urupare ki te huringa āhuarangi me te tango poka noa mai i te taiao.

Kei te nui haere atu te mōrea ki te taiao, he maha ngā kerēme kei raro i te Ture Takutai Moana 2011, ā, he maha kāore ngā kerēme ki Te Rōpū Whakamana i Te Tiriti o Waitangi kāore anō kia whakatauhia. Ka puta he tino māramatanga mai i tēnei rangahau tika mō te kaitiakitanga me te hopu i ngā kōrero huna mō ngā hononga o ngā ahikā Māori-Pākehā mō ngā whanga. Ka whakamana te kaupapa i te Māori me te kauneke whakamua i ngā mōhiotanga ā-tangata-taiao, mātauranga tikanga tangata me ngā mōhiotanga tuku iho i Aotearoa.

CAN RIMU FRUIT SAVE THE KĀKĀPŌ?

Kākāpō are a taonga species native to Aotearoa. Tragically, this quirky flightless parrot is at serious risk of extinction, with a remaining population of just over 200.

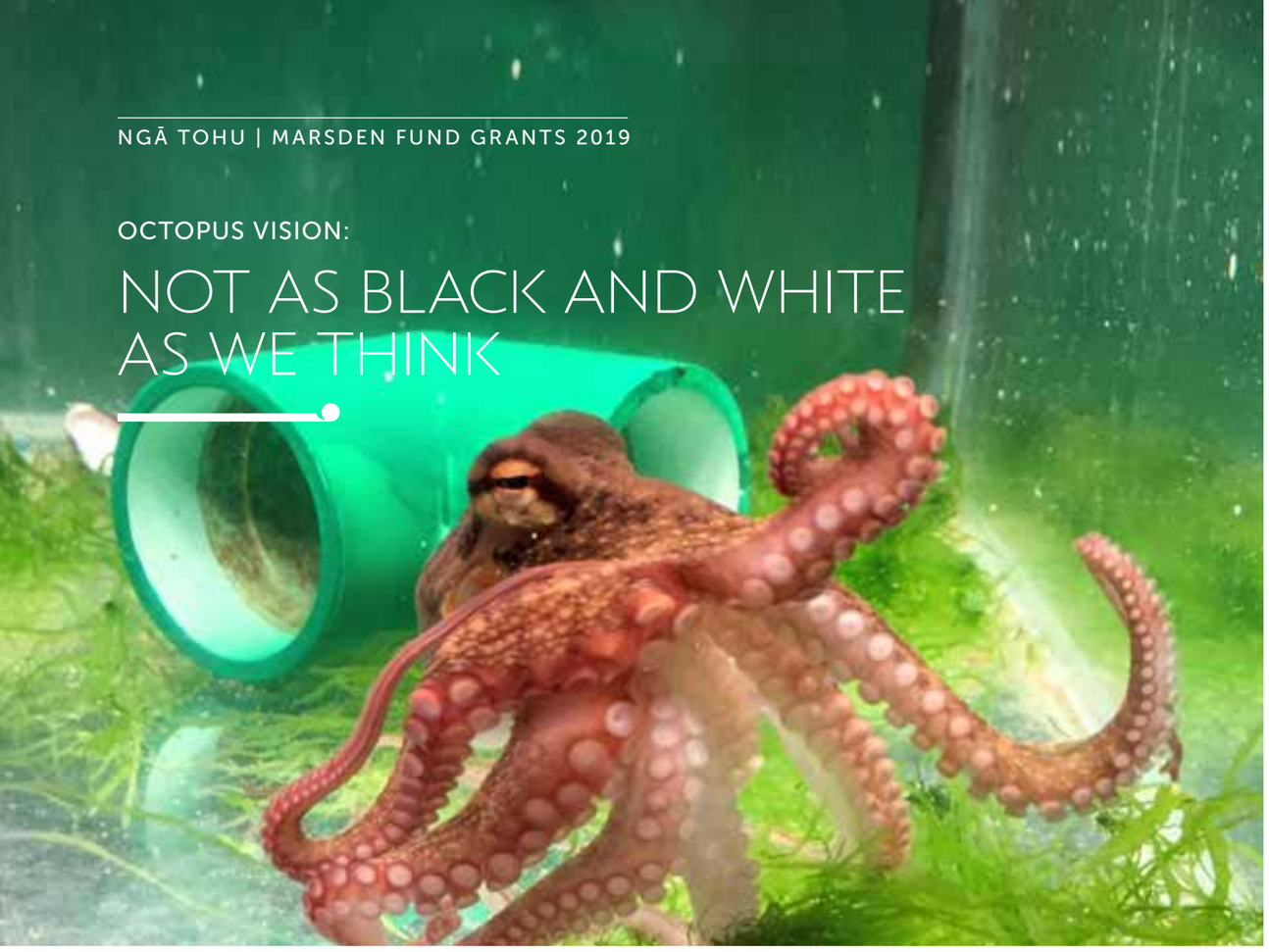
Conservation efforts are hampered by infertility and egg hatching failures. Adding to these difficulties, kākāpō only breed every 2-5 years, coinciding with mass fruiting of rimu trees. Although a trigger for kākāpō breeding seems to exist in rimu fruit, the exact nature of this is unknown.

Dr Janet Pitman and **Dr Simon Hinkley**, both from Victoria University of Wellington, will investigate whether rimu fruit is a 'super-food' that triggers breeding in kākāpō. Previously they have found that hormone-like compounds similar to oestrogen are present in rimu fruit. When kākāpō eat rimu fruit, the compounds may trigger breeding by raising circulating oestrogen levels and promoting egg yolk protein and sperm production. Using a multidisciplinary approach, they will explore this possibility through a diverse range of experiments. These experiments will isolate the plant hormone in rimu fruit, measure its response in kākāpō, and identify the genes responsible for poor breeding in kākāpō. The project will greatly benefit from a close collaboration with the recent Kākāpō 125 project, for which the DNA of every living kākāpō was sequenced.

The knowledge developed from this study could underpin the development of a natural therapeutic aid to assist in the kākāpō's fight against extinction.

Photo top: Phil Bendle Collection @Citscihub.nz
Dr Janet Pitman and Dr Simon Hinkley
Photo: Colin McDiarmid, VUW Image Services

Adult female kākāpō Alice with her hatchling Tumeke2
Photo: Dr Andrew Digby (Kākāpō Recovery Team)



OCTOPUS VISION:

NOT AS BLACK AND WHITE AS WE THINK

Octopuses have a remarkable ability to camouflage themselves by matching their body colour and shape to the colour and texture of the background environment.

One third of all nerve fibres from an octopus brain are connected to colour changing patches on the octopus' skin. This allows an octopus to change its appearance in a fraction of a second. In addition, octopuses have specialised muscles in their skin which can change the three dimensional texture from smooth to spikey. Incredibly, despite having very acute vision, octopuses only have one visual pigment in their eyes and therefore should be colour blind.

Dr Misha Vorobyev of the University of Auckland will disentangle this enigma of octopus vision – how can an apparently colour blind animal match its body to the background environment if it is unable to see those colours? He will examine whether octopuses can detect colour variation in the environment through means other than direct colour vision. Rather than the colours themselves, are they able to detect the presence of different wavelengths of light through light refraction, or are they able to sense the brightness of the environment, which they correlate with colour? Alternatively, do octopuses get information on colour from the polarisation of light since they possess a polarisation-sensitive eye?

Through a novel set of experiments, this wide-ranging study will test the possibilities and help scientists understand the evolutionary relationship between vision and animal body patterns.

Dr Vorobyev observing behaviour of a Picasso Triggerfish

TE KITE A TE WHEKE:

KĀORE I TE TINO MĀRAMA KI TĒRĀ I PŌHĒHĒTIA

Ka wetewete a **Tākuta Misha Vorobyev** o Te Whare Wānanga o Tāmaki Makaurau i ngā mōhio huna mō te kite ā-tae i roto i ngā wheke. Ka whakahaerehia e ia ngā whakamātautau kia mōhio ai he pēhea te wehewehe a ngā wheke i te tae me te kanokano ahakoa ko te whakapae he matapō ā-tae.

He tino kaha ngā wheke ki te kirihuna mā te whakaatu i te tae tinana me te hanga ki te tae me te kanokano i te takiwā. He hautoru o ngā weu ioio mai i tētahi roro wheke kei te tūhono ki ngā pāti hurihuri tae kei te kiri o te wheke. Mā tēnei ka taea e te wheke tōna āhua te huri inamata. I tua atu i tēnei, he uaua motuhake ō ngā wheke kei rō kiri e taea ai te kanokano ahunga toru te huri mai i te maheni ki te taratara. Ko te mea mīharo, ahakoa te koi o te kite, kotahi anake te kano ā-kite o ngā karu o ngā wheke, nō reira ko te tikanga me matapō ā-tae.

Kua whakawhiwhia a Tākuta Misha Vorobyev ki tētahi takuhe mai i te Pūtea Rangahau a Marsden hei rapu i te māramatanga mō tēnei kōrero o te kite a te wheke – he pēhea te whakaōrite a tētahi kararehe matapō ā-tae i tōna tinana kia hāngai ki tōna takiwā mēnā kāore e taea te kite aua tae? Ka whakahaerehia e Tākuta Vorobyev ētahi whakamātautau hei āta tirotiro mēnā ka taea e ngā wheke te tāupetanga tae te kite i te taiao mā ngā āhuatanga i tua atu i te kite tae hāngai. Kaua ko ngā tae ake, ka taea te kite ngā roangangaru rerekē o te mārama mā te hakoko tūrama, he rongo rānei i te pūahoaho o te takiwā, e hono atu ai ki te tae? Tērā rānei, ka whiwhi mōhiohio ngā wheke mō te tae mai i te pitoruatanga o te mārama i te mea he kite ngā karu i te pitoruatanga? Ka whakamātau ngā whakamātautau rerekē a Tākuta Vorobyev i ēnei whai wāhitanga, i tua atu i ētahi atu, i roto i tēnei rangahau tino whānui.

I tua atu i te wetewete i te kōrero huna o te matapō ā-tae o te wheke, ka āwhina te rangahau a Tākuta Vorobyev i ngā tohunga pūtaiao kia mārama ai ki ngā hononga kunenga i waenga i te kite me ngā tauira tinana o te kararehe.

FAST-START GRANTS

UNDERSTANDING THE 1918-19 INFLUENZA PANDEMIC

THROUGH CHILDREN'S EYES

The 1918-19 influenza pandemic killed some 50 million people globally. As it was especially lethal for those aged 20-40, many children lost one or both parents. While we know about how the flu impacted children's health and how it was experienced by adults, we know almost nothing about how children reacted to the pandemic or how it affected their lives.

Dr Charlotte Bennett of University of Auckland will gather children's written eye-witness accounts of the pandemic from Aotearoa, Ireland and Canada to understand how they experienced and responded to widespread illness and loss. Drawing on newspaper correspondence, school magazines and memoirs, this will give insights into children's exposure to illness and death, and their coping mechanisms throughout the pandemic, as well as how they processed its immediate aftermath.

The project will make a major contribution to cross-national exploration of childhood histories and will enhance our knowledge of experiences of pandemic across geographical distance and place.

1914-1918 Memorial Cross at St. Columba's College in Dublin, Ireland. Photo: Siobhan Beales

Right: Dr John Shaver in field
Photo: Rupeni Madigi

INVESTIGATING THE IMPACT OF RELIGION

ON COOPERATION AND INEQUALITY IN FIJI

The pervasiveness of religion implies it is useful, but who benefits, and how? The questions of how religion affects people and how it shapes social relationships are fundamental to the study of human societies.

Some see religion as a social glue that supports fair cooperation between people; others view it as a mechanism for social control and exploitation. Understanding the dynamic relationships between religion, cooperation and disparity is of special importance in globalising contexts such as Fiji, where inequality is on the rise. Throughout the South Pacific, people are rapidly leaving established religions for newer Pentecostal and revivalist movements. Pentecostal movements, in particular, often vilify membership in "traditional" religious groups which may work to undermine traditional authority, hierarchy and cooperation, which have facilitated high levels of food, labour, and other resource sharing. These same social conditions often also entail the emergence of secularism and the increased movement of individuals from villages to urban settings.

Dr John Shaver from the University of Otago will explore the dynamic relationships between religion, cooperation and social inequality in Fiji. He will collect data over three years from individuals living in Fijian villages and squatter settlements that are undergoing intense social change.

By doing so, he will create the Pacific's first longitudinal ethnographic study of religion and society. More broadly, he hopes to clarify religion's effects on social relationships and material circumstances.

NATURE AND NURTURE?

WHY GOUT AFFECTS ONE BROTHER AND NOT ANOTHER

Siblings share roughly half of their genes, and are often raised in the same environment. Why, then, does one develop a disease, and the other does not? The answer may lie in how the environment influences gene expression through epigenetics.

Gout is an auto-inflammatory arthritis characterised by sudden flares of extreme, debilitating joint pain. Environmental factors trigger gout flares when the innate immune system reacts inappropriately to non-threatening environmental cues. Gout is therefore a disease influenced by both a person's genes and their environment. The inflammatory pathways have been well characterised, but what initially triggers this inflammation and why it only occurs in some individuals is unknown.

Dr Tanya Major from the University of Otago will investigate why a disease like gout develops in one family member but not another. She will study the biological basis of how environmental factors trigger gout flares, and compare epigenetic markers on the genes of pairs of brothers.

Aotearoa has the highest prevalence of gout in the world. Māori and Pasifika people are at particular risk and experience more severe symptoms and associated diseases. To ensure her research addresses this, approximately half of the brothers in Dr Major's study will be of Māori or Pacific descent.

Photo: Ruth Topless

IMPROVING DIAGNOSIS OF GASTROINTESTINAL DISORDERS

Serious gastrointestinal disorders, including irritable bowel disease and colon cancer, can be difficult to diagnose and treat effectively.

Current detection practice often involves imaging the gastrointestinal tract lining through endoscopic imaging and biopsy collection. These methods require interpretation by specialist doctors, can be time consuming and expensive, and open to potential misdiagnosis. Clinicians urgently require a reliable identification tool to detect and classify gastrointestinal tissue changes and provide point-of-care diagnosis for a faster treatment pathway.

Dr Sara Miller from the University of Otago is developing a comprehensive tool using Raman spectroscopy. Raman spectroscopy, based on the light spectrum, is an optical tool that can be used to analyse body tissue quickly. Although its potential for cancer detection has been demonstrated, current Raman spectroscopy methods are not sensitive or specific enough to remove the need for biopsy collection. Dr Miller's work aims to improve diagnostic accuracy by adding complementary spectroscopic methods, and for a multi-spectroscopic fibre probe that can be tested on people with coeliac disease.

She will also develop state-of-the-art machine learning models for the classification and diagnosis of normal versus abnormal tissues. The probe will be able to scan large regions of tissue with near-immediate feedback to give point-of-care diagnosis, or identify regions for targeted biopsy collection. This research has the potential to produce better outcomes and faster treatment for people who suffer from debilitating gastrointestinal disorders.

Photo: Michael Schultz, Sara Miller and Keith Gordon (left to right)

TE WHAKAPAI AKE I TE WHAKATAU I NGĀ MATE WHĒKAU

Ka waihangatia e **Tākuta Sara Miller** o Te Whare Wānanga o Ōtakou i tētahi utauta matawhānui ake mō te tuku whakatau i te wāhi manaaki mō ngā mate whēkau e puta ai pea ngā whakamaimoa tere ake me ngā hua pai ake mō te hunga e pāngia ana e ēnei mate kino.

He uaua pea te whakatau i ngā mate whēkau kino, pērā i te mate whēkau nui, mate pukupuku ki te kōpiro me te mate piro me te whakamaimoa tōtika. Ko ngā tikanga onāianei mō te kimi i ēnei mate ko te whakaahua i te kiri roma whēkau mā ngā whakaahua arotahi rō-tinana me te tiki ōkiko hei aromatawai. Me whakamārama ēnei tikanga e ngā rata mātanga, ka mutu he roa te wā, ā, he nui te utu. Kei reira anō te tūponotanga mō ngā whakataunga hē. Me whiwhi ngā rata i tētahi utauta tautuhi e tōtika ai te kimi me te wehe i ngā huringa ōkiko whēkau me te tuku whakatau wāhi manaaki mō tētahi ara tere ake ki ngā whakamaimoa tika.

Kua whakawhiwhia a Tākuta Miller ki tētahi takuhe Tīmata Wawe mai i te Pūtea Rangahau a Marsden hei waihanga i tētahi utauta whakatau hou mō te mate whēkau mā te Raman spectroscopy. Ko te Raman spectroscopy, mai i te hihinga tūrama, he utauta ōmata ka taea te whakamahi kia tere ai te tātari i ngā ōkiko tinana. Ahakoa kua whakaaturia tōna pūmanawa mō te kimi i te mate pukupuku, kāore i te tino hāngai, whāiti rānei ngā tikanga o te Raman spectroscopy hei whakakore atu i te hiahia mō te tiki ōkiko hei aromatawai. Ko te whāinga o Tākuta Miller me tōna rōpū he whakapai ake i te tika o tēnei whakatau mā te tāpiri i ngā tikanga spectroscopic tautoko. Ka hangaia e rātau tētahi weronga weu spectroscopic maha me te whakamātautau i ētahi tāngata e pāngia ana e te mate piro. Ka hangaia ngā tauira akoranga mīhini tino hou rawa mō te wehewehe me te whakatau i ngā ōkiko pai me ngā mea tino rerekē.

Ka taea e te weronga a Tākuta Miller te matawai ngā wāhi nui o te ōkiko me te urupare inamata hei tuku whakatau i te wāhi manaaki, te tautuhi rānei i ngā wāhi rānei mō te tiki ōkiko hei aromatawai. Kei tana rangahau te kaha ki te whakaputa i ngā painga pai ake me te whakamaimoa tere ake i te hunga e pāngia ana e ngā mate whēkau kino.

Dr Morris loads a protein sample into the nuclear magnetic resonance (NMR) spectroscopy

UNRAVELLING THE MOLECULAR INTERACTIONS

DRIVING ALZHEIMER'S DISEASE

Alzheimer's disease is the most common form of dementia and a leading cause of death worldwide. It affects nearly 1.3% of the population in Aotearoa, and this rate is increasing due to our ageing population. While current treatments can help to manage symptoms, they are unable to slow the progression of this devastating disease, which gradually leads to loss of most brain functions and ultimately the death of the patient.

Two hallmarks of Alzheimer's disease progression are abnormal accumulation of the 'amyloid-beta' protein within brain cells and inflammation of brain tissue. Recent genetic research suggests that the TREM2 gene is associated with inflammation and protein accumulation linked to Alzheimer's disease. Moreover, people who carry rare mutations in TREM2 are three times more likely to develop Alzheimer's disease later in life. This makes TREM2 one of the strongest risk factors for Alzheimer's disease identified to date.

Dr Vanessa Morris of the University of Canterbury will use molecular and biophysical techniques to determine how 'amyloid-beta' protein aggregates interact with TREM2. She will then determine how disease-linked mutations affect this interaction, and the molecular basis by which they confer increased Alzheimer's disease risk. This work will establish crucial information on the molecular pathology of Alzheimer's disease, seek urgently needed insights into the mechanisms of disease progression, and pave the way for the development of therapies to modulate these key protein interactions in Alzheimer's disease.

Wētā in wild with the worm emerging
Photo: Jean-François Doherty

BATTLE OF THE BODY SNATCHERS

DO MULTIPLE PARASITES IN A HOST HELP OR HINDER EACH OTHER?

Body snatching for survival; it sounds like science fiction, but it is a common occurrence in the natural world. Parasites routinely manipulate their hosts, imposing changes like altering the host's appearance and behaviour.

Cave wētā, which are frequently infected by hairworm parasites, provide a notable instance of this phenomenon. When mature, the hairworms manipulate the cave wētā to induce fatal water-seeking behaviour. The hairworm can then emerge from the drowned remains of the host wētā and reproduce.

A complication (for the hairworms at least) arises when the wētā is infected by more than one hairworm. If any of these co-occurring hairworms have not yet developed enough to emerge, then they will die alongside the wētā when the mature hairworm successfully manipulates the wētā to seek water and drown itself. If these immature hairworms are to survive, they may work to sabotage and delay the host manipulations induced by mature hairworms.

Alternatively, closely related hairworms found in the same host could sacrifice their own survival for that of a close relative.

Dr Edwina Dowle from University of Otago aims to understand this dimension of host-parasite interaction using a combination of behavioural science and molecular genetics to understand the mechanisms that co-occurring parasites use to help or hinder each other's host manipulation using the cave wētā as a model.

MEASURING ANTARCTIC GLACIER MELTING RATES

IN THE ROSS ICE SHELF

Large floating ice shelves act as barriers that limit rapid ice loss from the Antarctic Ice Sheet. Although some ice shelves are thinning rapidly, thinning is not universal, and the response of ice shelves is related to their oceanographic setting.

Recent work suggests that inflow of surface water may play an important role in driving ice shelf melting, especially near the edges of ice shelves. But we know little about how far into the ice shelf interior this effect is felt. A better understanding of what drives the spatial pattern of melting within the ice shelf will significantly improve models for melting and the rate of long-term sea level rise.

Dr Craig Stewart from the National Institute of Water and Atmospheric Research (NIWA) will identify the processes that drive rapid melting in the Ross Ice Shelf. He will install a network of melt monitoring stations in a region that is critical to the structural integrity of the ice shelf. The instruments include a newly developed ground-based radar system capable of detecting subtle changes in ice thickness. The resulting data mapping, which will show seasonal variability over two summers and one winter season, will enable Dr Stewart to explore new methods for inferring the circulation of warm waters under ice shelves, and ultimately to understand how ocean circulation drives ice shelf melting and thinning.

Photo: Ross Ice Shelf approaching Mt Terror supplied by C Stewart

WHOSE SCIENCE IS PRIVILEGED IN

THE PROTECTION OF OUR RIVERS?

Over the past decade, agricultural intensification and urbanisation have taken their toll on the water quality of many rivers in Aotearoa. Scientists have conducted a lot of research to help us understand the degradation of rivers, however, not all scientific knowledge is considered, valued and used equally.

Dr Marc Tadaki from the Coastal and Freshwater Group at the Cawthron Institute will investigate what kind of river science is privileged by environmental decision makers. The inclusion of Māori perspectives in this research is critical to understanding how decision making about fresh water might be improved. He will examine how river science is valued in the courts, regional planning and freshwater monitoring. By identifying which knowledges are dominant and which are marginal, Dr Tadaki will consider the consequences of these arrangements for ecosystems and communities. He will draw on documentary materials, interviews, and observations of scientists and policy makers for his investigations and will examine how competing river knowledges are adjudicated in court.

By exposing the often invisible practices that favour certain sciences and biophysical aspects of rivers, this project will inform public debate. The research will make an important contribution to determining what type of science-policy arrangements can help society incorporate the value of diverse sciences and knowledge systems to ensure better outcomes for rivers.

NŌ WAI TE PŪTAIAO RANGATIRA I

ROTO I TE TIAKI I Ō TĀTAU AWA?

Ka tūhura a **Tākuta Marc Tadaki** mai i te Coastal and Freshwater Group i te Cawthron Institute he aha te momo pūtaiao awa e whirinakitia ana e ngā kaiwhakatau mō te taio. He mea taketake te whakauru mai i ngā tirohanga Māori i roto i tēnei rangahau kia mārama ai me pēhea te whakapai ake i ngā tuku whakatau mō te wai māori.

I roto i te tekau kua huri, ko te mauri o te wai o ngā awa maha o Aotearoa te utu o ngā mahi ahuwhenua kaha rawa me te hekenga nui ki ngā tāone. E mōhio ana mātau kei te pēhi ngā mahi a te tangata i ngā pūnaha rauropi, me ngā awa, ki te wāhi kua tata tonu te papahoro mai, ā he nui ngā rangahau i whakahaerehia e ngā tohunga pūtaiao hei āwhina i a mātau kia mārama ai ki te whakakinotanga o ngā awa. Engari, ehara i te mea e ōrite ana te whakaaroarotia, te uaratia, te whakamahia hoki o ngā mōhiotanga pūtaiao.

Ka tūhura tēnei kaupapa Tīmata Wawe o te Pūtea Rangahau a Marsden i te āhua o te uara i ngā momo mātauranga taiao rerekē, otirā te mātauranga Māori me ngā mātauranga Pākehā, i roto i ngā whakatau. Ka āta tirotiro a Tākuta Tadaki he pēhea te uara o te pūtaiao awa i roto i ngā kōti, i roto i ngā whakamahere ā-rohe me te aroturuki i te wai māori. Ka whiriwhiri anō ia i ngā mutunga iho mō ngā pūnaha rauropi me ngā hapori. Mā te toro i ngā rauemi pakipūmeka, ngā uiui me ngā kitenga a ngā tohunga pūtaiao me ngā kaihanga kaupapahere, ka tūhura ia ka pēhea pea te whakatiki a ngā kaikōkiri whakanōhanga ko ēhea ngā momo mātauranga ka whakaputaina, ka whakaūhia. Ka whakaatu anō ia he pēhea te takoto o te pūtaiao awa hei tuku i ngā kaupapa ā-whakahaere, ā, he pēhea te whakawā a te kōti i ngā mātauranga o te awa e tukituki ana tētahi i tētahi.

Mā te whakaatu i ngā tikanga huna e hinga atu ana ki ētahi pūtaiao me ngā āhuatanga ōkikokoiora o ngā awa, ka whāngai tēnei kaupapa i ngā mōhio ki ngā tautohetohe tūmatanui ko ēhea ngā mātauranga me whakamahi hei whakahaere i ngā awa, he aha ai, ā, mā ēhea tikanga. Ka tuku i tētahi wāhanga nui hei whakarite he aha ngā momo whakaritenga kaupapahere-pūtaiao ka āwhina i te iwi whānui ki te neke ki te toitūtanga rauropi e rata ana ki te mātauranga Māori hei whakarite i ngā hua pai ake mō ngā awa.

USING BIOLOGICAL BIG DATA

TO PREDICT DISEASE RISK

In medicine, individual patients display a complex array of symptoms and genetic risk factors and respond differently to a specific treatment. This diversity of condition and outcome makes the task of disease risk prediction extremely challenging.

The emerging idea of 'precision medicine' provides great promise for improved disease risk prediction and arises from the recent availability of large quantities of human genome, biomarker and molecular data. An essential step towards precision medicine is to understand the relationship between diseases and these complex biological big data. However, the high dimensionality – each piece of data can have millions of variables – and the intricate relationships between data, bring tremendous analytical challenges. Due to the overwhelming complexity of data, current methods for personalised medicine fail to select important risk factors.

Dr Yalu Wen from the University of Auckland will develop a new data driven model to overcome these challenges. She will use the model to predict Alzheimer's disease, which will help with early screening and developing effective treatments. Among the goals of this project, the new model will be able to describe the similarities among millions of potential complex predictors and incorporate prior biological knowledge to guide predictions. It will also incorporate new data screening rules, allowing for the compression of data, which will improve computational efficiency and lead to the development of user-friendly software.

RESEARCH IN FOCUS

TRANSNATIONAL MATAI

EXAMINING THE EXPERIENCES OF INTERGENERATIONAL GLOBAL SAMOAN TITLED CHIEFS

With her Marsden Fund grant for her project 'Samoan transnational matai (chiefs): ancestor god avatars or merely title-holders?' **Dr Melani Anae**, from the University of Auckland, is examining the Samoan transnational fa'amatai chiefly system in New Zealand, Australia, and the USA.

Dr Anae is tracing the multiple uses and conceptions of 'culture' to find out how transnationality – the condition of cultural connectedness and mobility across space – is used to refer to the cultural specificities of global processes. Are Pacific nation states being transformed by globalisation into a single globalised economy? How are global cultural forces impacting on Pacific peoples, cultures, and identities? Dr Anae explores these questions by focusing on the links between 'cultural logics' of human action and economic and political processes within the Pacific. Her project is a longitudinal study examining experiences of intergenerational global Samoan matai, or titled family heads, and the Samoan transnational chiefly system. Refuting claims about the end of traditional fa'amatai, her research provides an account of the cultural logics of globalisation and development and contributes to the study of Pacific modernity and its links to global social change.

Today, Samoa is governed by matai. The role and responsibilities of the matai in Samoa is to ensure the wellbeing of his or her family both in the village and in transnational spaces. Transnational matai living i fafo, out of Samoa, look after the wellbeing of their family in the host country, family in Samoa, and family in other transnational spaces. Samoans have exported their matai system to New Zealand, Australia, and the United States. Western-educated Samoans are earning better incomes, acquiring matai titles, and entering politics. The foremost source of change in Samoa today is from New Zealand, and there is hardly a family in Samoa without relatives in New Zealand, and even fewer Samoans in New Zealand who do not maintain a relationship with their homeland.

An examination of matai registrations held in the Samoa Land and Titles Court in 2016 revealed that of the registered matai born outside of Samoa, 83.5% were born in New Zealand, 6.6% born in Australia, 6.3% born in the United States, and 3.6% born elsewhere in the world. These results suggest that Samoans in New Zealand are the powerhouse of transnational fa'amatai. Of the 420,000 Samoans who live outside of Samoa, over a quarter of them live in New Zealand. In fact, population projections reveal that the Samoan population in New Zealand will outstrip Samoa's entire population of 200,000 by 2025. Moreover, economic indicators show that cash flows are mainly coming from New Zealand. Tautua, or service/serving, provides the four directional flows of transnational remittances that form the cornerstone of Samoa's socioeconomic stability. These cash flows are aiga (family) cash remittances, 'tourist' dollars and visits, saofai (chief bestowal ceremony) contributions, and aiga reunion and funeral contributions.

Having no control over the erosion or corruption of fa'amatai customary practices happening in Samoa, transnational matai continue to value and act on their tautua to their transnational Samoan communities, their families, and Samoa through their affective ties.

These produce effective action through the cash flows that are driving Samoa's development. Despite complaints by transnational Samoans and matai reading articles in *Samoa Observer* about challenges to fa'amatai from the Samoan Government and Land and Titles Court, very few transnational matai have totally departed from fa'amatai obligations and practices and their centrality for the wellbeing of their families in and out of Samoa. Despite its alleged faults and ambiguities, fa'amatai is an integral part of their lives and Samoa's sustainable future depends on it.

One of the exciting outcomes of this research project is Dr Anae's supervision of PhD student Muliagatele Vavao Fetui, who is writing the very first PhD in the Samoan language in the world. The title of his PhD thesis is 'O Toe Laumeanuti o le Fa'aaloalo I Agatausili a Samoa I Atualuga (Notions of politeness and respect in a Samoan transnational community). It will be submitted at the end of 2020.

Samoan matai protestors outside Parliament. On 28 March 2003, this group of 3,000 Samoans, among them hundreds of transnational matai, protested against the Citizenship [Western Samoa] Act 1982 outside Parliament. They carried with them a petition presented to Parliament of around 100,000 signatures calling for its repeal. Source: NZ Herald 28 March 2003, photo Mark Mitchell.

Ranui Ngarimu examining Te Rā at the British Museum. Photo: Adam Rowley

WHAKAARAHIA ANŌ TE RĀ KAIHAU!

RAISE UP AGAIN THE BILLOWING SAIL!

REVITALISING CULTURAL KNOWLEDGE THROUGH ANALYSIS OF TE RĀ, THE MĀORI SAIL

Te Rā is the sole remaining customary Māori sail. An oceanic spritsail, she is held in the collection of the British Museum, London and was possibly collected by Cook.

The discovery of Aotearoa was an unrivalled feat of ocean-going navigation, and while many aspects of Māori voyaging have been re-invigorated, a Māori sail had never been systematically studied or documented until this project. This Marsden Fund grant has therefore created the opportunity to apply innovative, collaborative and interdisciplinary research techniques to understanding Te Rā for the first time.

Engagement with Te Rā from a Māori cultural perspective is the foundation of the project and ensures that appropriate tikanga is followed. **Dr Donna Campbell** (Ngā Puhi, Ngāti Ruanui) and **Ranui Ngarimu** (Ngāi Tahu, Ngāti Mūtunga), are weaving practitioners with extensive experience in the revitalisation of cultural knowledge. The project team visited the British Museum in January 2019, taking with them weaving samplers they had created previously to help to fully understand the weave structure of Te Rā. The highly complex weave, with a three-way pattern that extends through the hiki (joins) and panels of the sail, is not seen elsewhere in Māori weaving. To enable contextualisation of Te Rā, mātauranga Māori, archival, pictorial, and material culture research is ongoing. The team are interviewing navigation and sailing experts to enhance understanding of Māori sails and sailing.

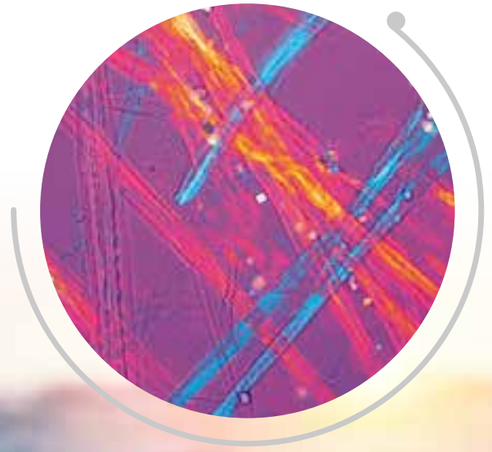
Another important aspect of the project is to identify the materials used in the construction of Te Rā. **Hokimate Harwood**, an expert on New Zealand feather identification, used a number of methods to identify the feathers used on Te Rā. Firstly, she undertook detailed imaging, measurements and recording of macroscopic feather characteristics such as size, shape, colour and patterning of feather shafts, the downy barbs at the feather base, and feather vanes. Then, microscopic sections of feather down were sampled from the base of some feathers. Finally, comparisons were made between the sail feathers and previously collected reference image databases of bird skins, feathers and feather down. She has been able to confirm that the small red feathers from the grommet style rings (loops) around the sail's outer edges are the small covert underwing feathers of kākā (Nestor meridionalis ssp.). The larger brown feathers along the top and matairangi (streamer) of Te Rā are from kāhu (Circus approximans; mostly wing feathers) and kereru (Hemiphaga novaeseelandiae; mostly tail feathers).

The work of identifying the plants from which Te Rā is made was accomplished by **Dr Catherine Smith**, using Polarised Light Microscopy (PLM) and a previously developed New Zealand plant materials reference database. While at the British Museum in January, she collected 15 samples of plant fibre and strip from various locations over the surface of Te Rā, with permission from the British Museum Scientific Research Committee. Once back in New Zealand, the plant material was macerated to reveal the ultimate fibre cells, and their morphological characteristics and optical properties were examined using PLM. Morphological characteristics include the length, shape and appearance of the cells, while optical properties relate to the structure of the cell and the appearance of those structures when exposed to light, and include using tests like the modified Herzog test, which shows the twist of the fibre. A number of tests were carried out on each sample, and when the results were combined and compared with the reference material, identification was possible; harakeke (New Zealand flax) forms all of the fibre and plant material used in the construction of Te Rā.

The project team travelled to Te Roopu Raranga Whatu o Aotearoa National Weavers Hui, held at Ngā Hau e Wha Marae in Christchurch, 25-28 October 2019, to disseminate information to weavers about the materials identification they have carried out, and their progress at understanding the form and structure of Te Rā. The next phase of the project is undertaking photogrammetry, which is a tool that can create 3D models of artefacts, useful for preservation, further analysis (like Computational Fluid Dynamics), and for display and exhibition. They will also be using Reflectance Transformation Imaging, which works through a combination of mathematical enhancement of the surface of the artefact. It reveals surface information that is not apparent from direct examination of the physical object. The team will be using these tools with the help of Cultural Heritage Imaging, a San-Francisco-based not-for-profit specialising in imaging technology for cultural material.

The connection of Māori to Te Rā is a spiritual and holistic one. As a taonga tuku iho, Te Rā embodies knowledge of the past that is relevant to contemporary cultural revitalisation. This research project will help reconnect Te Rā with cultural narratives, contextualise its significance and allow all New Zealanders access to this important taonga.

Bit.ly/2019MF2



Harakeke fibres viewed using PLM (Polarised Light Microscope)

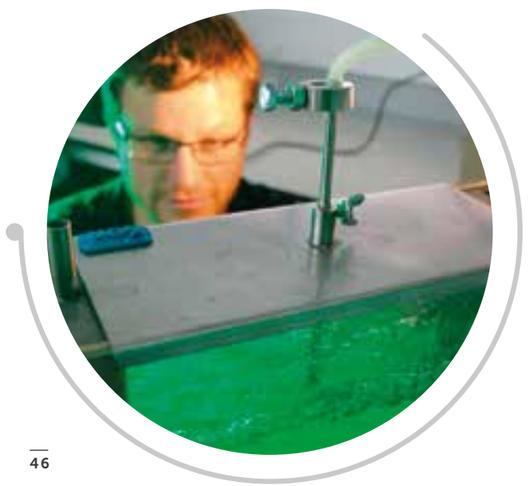
GREEDY ALGAE

THAT ARE GREAT FOR OUR ENVIRONMENT

Phosphorus fertilisers are extremely expensive for New Zealand. We import so-called 'cheap' fossil phosphorus (a rapidly diminishing resource) but its use causes widespread aquatic pollution.

Phosphorus supports photosynthesis which is positive for terrestrial plants. The same mechanism causes algal growth and the consequent pollution of aquatic ecosystems. This unwanted effect can be mitigated if the aquatic microalgae fertilised by phosphorus pollution are contained and harvested. This solution has global application because microalgae thrive in ponds used by farmers and rural communities around the world to treat their wastewater effluents. Unfortunately, wastewater treatment ponds do not currently remove phosphorus as the biomass generated during the degradation of organic pollutants can only assimilate small amounts of phosphorus and the biomass itself is not removed following treatment.

In order to boost the amount of phosphorus removed by these organisms, **Professor Andrew Shilton** (Massey University) led a Marsden Fund project to investigate the conditions that trigger polyphosphate accumulation in mixed microalgae cultures. While this research identified important advances in the process parameters in mixed microalgae cultures, the cellular mechanisms remained poorly understood. The technology is therefore still difficult to implement in a reliable way.



With his current Marsden Fund grant, **Professor Benoit Guieysse** (Massey University) and his team **Professor Emilio Fernández Reyes** (University of Cordoba), **Professor Andrew Shilton** and **Dr David Wheeler** (both of Massey University) are taking a step back from Shilton's research to identify and characterise by function the genes involved in polyphosphate accumulation in the green model alga *Chlamydomonas reinhardtii*. **Dr Maxence Plouviez**, the post-doctoral researcher on the project, has been successful in reproducibly triggering polyphosphate synthesis in this and other microalgae species commonly found in New Zealand's aquatic environment. This was achieved by changing the concentration of phosphorus in the cultures grown in the laboratory. Using a combination of genomics and bioassays involving *C. reinhardtii* mutants, the team was then able to demonstrate that polyphosphate synthesis is performed by specific proteins (Vacuolar Transport Chaperones), which are potentially under the control of inositol phosphates.

Based on this new understanding of the cellular mechanisms of microalgae, the team is exploring its evolutionary and ecological implications. The ultimate goal is to generate the bioengineering fundamentals needed to develop new technologies to aid in phosphorus recycling. The team is now closer to understanding what drives the accumulation of polyphosphate in microalgae. This is crucial when designing a process that naturally selects species which excel at polyphosphate accumulation, and for providing conditions that reliably make use of this ability. As an additional outcome, the team hopes to identify new chemical or physical stimuli that can trigger the polyphosphate response on demand.

GAME OVER

FOR LOOT BOXES

Loot boxes are currently unregulated in Aotearoa but, based in part on evidence provided by **Dr Aaron Drummond** (Massey University) and **Dr James Sauer** (University of Tasmania), the House of Commons Digital, Culture, Media and Sport Committee has recommended restrictions on the use of them in the UK.

Loot boxes are rewards in games. They contain items of varying value that players can use to affect the game they are playing. Players can earn some loot boxes through gameplay, but they can buy and sell others with real-world money. The rewards contained in a loot box are randomised, meaning that the player does not know what will be in the box until it's opened. Dr Drummond and Dr Sauer argue that the random delivery of game rewards is structurally and psychologically similar to gambling, and potentially leads to similar negative outcomes.

The two academics submitted evidence to the Committee as part of their Marsden Fund Fast-Start project, started in 2019, which aims to understand the effects of gambling-related mechanisms in game design, and how they influence problematic gameplay behaviours. Short-term consequences of these problematic behaviours include overspending in order to access the loot boxes, while long-term consequences could include moving toward conventional types of gambling. Games that include loot boxes have previously fallen under the radar, in part because the rewards they offer are virtual.

This could change if the recommendations made by the Committee come into effect. Gambling content labelling and age limits may be brought into law for games containing loot boxes that players can purchase with real-world money. The change in classification would acknowledge project findings so far, which indicate that some loot boxes can introduce a competitive advantage in the game environment. This alone can influence the behaviour of players without necessitating the conversion of rewards into real world currency.

In Aotearoa, the Department of Internal Affairs does not currently consider loot boxes to be a form of gambling while the Office of Film and Literature Classification does not restrict them because rating gambling and gambling-like activities does not fall under its mandate. However, according to Dr Drummond, the increased attention has meant that from 2020 some companies have agreed to disclose the odds of winning particular items in loot boxes.

Dr Drummond says that this move by some game companies is "a positive step forward, but there is probably more work to be done to safeguard vulnerable consumers".

Bit.ly/2019MF3

AUCKLAND VOICES

NEW FACES, NEW VOICES?

Astonishingly, research over the last three decades on New Zealand English has largely ignored Auckland, despite the fact that a third of all New Zealanders live there. We know that migration is changing how Auckland looks, but what about how it sounds?

A three-year Marsden Fund project looking at Auckland English, led by **Professor Miriam Meyerhoff** (Victoria University of Wellington), provides a few answers to this question. Some demonstrate new, shared norms for speaking emerging across the city, and some suggest that areas with high levels of recent migration are especially innovative.

The research team recorded casual conversations with people who live in Titirangi (little demographic change over the last twenty years), South Auckland (a highly mixed community for decades) and Mount Roskill (a lot of demographic change in the last two decades). These people grew up speaking English in New Zealand (although often alongside other languages in South Auckland and Mount Roskill).

Younger speakers in Mount Roskill had some surprising pronunciations, suggesting that areas with very high levels of immigration might have an impact on our national accent. In particular, younger Roskillites are reversing the distinctive Kiwi pronunciation of the vowel in words like back and tap. To understand why, the researchers will analyse speakers' attitudes and look at exactly when they reverse this raising. "It's possible that ethnically diverse younger Roskillites don't have a lot of interest in sounding like your classic Kiwi. They're hearing lots of different ways of pronouncing New Zealand English around them and they have new ways of 'being Kiwi'", suggests Professor Meyerhoff.

A striking discovery is how little difference there is between the way the younger speakers across the city pronounce their vowels, as vowels are the prime carriers of accent differences in English. "At a moment in New Zealand's history when there is increasing national introspection about the wellbeing and belonging of migrants, we can draw a very powerful message from the fact that young people across Auckland apparently signal like-ness more than they signal difference in the way they sound", says Professor Meyerhoff.

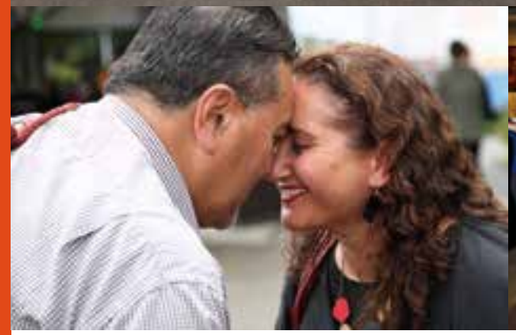
In future work, the team will analyse the consonants in New Zealand English: things like the increasingly widespread use of R in words like work, corner, and arm. New Zealanders tend to associate this with Southland speech, but the pronunciation of a constricted R in these kinds of words in Auckland (and other urban centres) has nothing to do with the Southland accent. Young people in South Auckland and Mount Roskill are not looking to Southlanders as a target for how to sound. What exactly its use signals will be interesting to unravel because it is a new feature of New Zealand English that has attracted much attention. Earlier work showed that the stereotype across wider Auckland is that this is a feature of 'South Auckland', but within South Auckland, some people associate it with Samoan speakers while some Samoans associate it with Tongan speech.

Communities that have experienced high levels of migration may be leading the way for the pronunciation of the definite article 'the' in Auckland. Instead of 'turning thee other cheek', Aucklanders are likely to say 'turn thuh other cheek'. The data suggest that this is an innovation that spread out of South Auckland (where it is most generalised), but it is widely used by younger Roskillites, and is even a feature of the speech of some young people in Titirangi.

As for grammar, Aucklanders have surprises for even the most jaded linguists. Aucklanders have developed a rule in their grammar that governs when they use 'that' to introduce relative clauses. They are much more likely to say there's 'nothing I like' than 'nothing that I like', and they talk about 'someone who knows a lot about this' rather than 'someone that knows a lot about this'. Both are possible, but the Auckland preferences indicate that people are reanalysing English grammar to accurately express very subtle meaning differences.

Where Auckland goes today, the rest of New Zealand goes tomorrow? Whatever the answer, the researchers believe it will say a lot about our cohesiveness as a nation and how we perceive our communities and neighbours.

Photo left: Mt Roskill, supplied by M. Meyerhoff, source: Puketapapa Historical Society
Photo right: Mt Roskill, Photo supplied by M. Meyerhoff, source: stuff.co.nz



CELEBRATING 25 YEARS! KA WHAKANUIA TE RANGAHAU!

After 25 years of funding rounds, we have a lot of people to thank and stories to tell! In this section, we share how we marked the occasion and reflect on the impact of the Marsden Fund on the global and local research environment.

A special event was held in Rotorua on 23 March 2019 to acknowledge achievements and affirm ngā matawhānui our vision for the Fund as we look to the future. Our manuhiri guests were formally welcomed into Te Puia with a pōwhiri by Te Awara.

Marsden Fund Chair Professor David Bilkey thanked everyone who had contributed to administering the Fund over the years, from those who manage the mass of applications every February, to those who ensure the selection process is fair and identifies the most excellent work available. He included those who have served on assessment panels, Chairs, and Council members, and the many thousands of international referees who have provided independent assessment over the years. He also thanked the institutions, CRIs and academic community and the Fund recipients themselves.

All of the speakers acknowledged the Christchurch mosque shootings. Professor Linda Tuhiwai Smith FRSNZ reflected that it could perhaps have been avoided had we had a better understanding of challenges facing our society, acknowledging the need to support greater research of social issues.

Professor Juliet Gerrard FRSNZ, Prime Minister's Chief Science Advisor and former Marsden Fund Chair, said the Marsden Fund allows New Zealand researchers to follow their best ideas. She noted that it is a fund where, as applicants, women do as well as men and Māori are as least as successful as other groups. She said that the Fund supports scholars in all disciplines, including those with expertise in how we deal with highly relevant challenges of the day, such as hate speech.

Bit.ly/2019MF4

A KŌRERO AND KAUPAPA FOR THE REGIONS

Our challenge for the Marsden Fund 25 Series was to go regional – to take the kōrero about the Fund's work programme, its support of, and influence in, Aotearoa research to a wider hapori community than ever before.

Over 1,800 people came to hear the fifteen public lectures. Our speakers took their stories to schools, marae, libraries and venues from Invercargill to Whangārei. Another ten Marsden Fund recipients were featured online and in video profiles. All were chosen for their passion in communicating about their subject, and because their lively curiosity and challenging ideas epitomise what the Marsden Fund stands for.

Professor Greg Cook (University of Otago) kick-started the series with compelling support of drug development research for diseases prevalent in the developing world. His Napier talk was kindly supported by Hawkes Bay Branch of Royal Society Te Apārangi.

In her online profile, **Dr Andreea Calude** (University of Waikato) described how "loan words", like whānau, are finding their way into our lexicon and evolving our language in Aotearoa.

In Auckland, **Associate Professor Siân Halcrow** (University of Otago) explained, among other things, how bioarchaeology research focused on infants and children is relatively new. Until quite recently, infants and children would have been passed over in favour of adults, and males in particular, yet have much to tell us of health and disease of the past.

In his video interview, **Associate Professor Nick Golledge** (Victoria University of Wellington) described the challenges of fieldwork in Antarctica, and how numerical modelling is measuring trends, interpreting changes from the geological record, and gives data that can be used to evaluate and improve the performance of our models for climate change.

Professor Rangi Matamua (University of Waikato) gave his talk *Ko Matariki ārau ana The Gathering of Matariki* retelling the customs set out by his tūpuna, leaving many audience members enriched by this kōrero on the knowledge of the ancestors.

Associate Professor Renate Meyer (University of Auckland) gave a fascinating online profile about her pioneering work in applied Bayesian statistics. Thanks to her collaborations, extraordinary discoveries are being made about black holes, neuron stars and the origins of the Universe.

Molecular anthropologist **Professor Lisa Matisoo-Smith** (University of Otago) was delighted to have the opportunity to return to Blenheim to talk with tangata whenua about her discoveries at Wairau Bar on the health, histories and origins of the earliest New Zealand settlers.

Professor Brendon Bradley (University of Canterbury) was warmly welcomed by Te Apārangi's Wanaka Branch to discuss his ground-breaking research on the Alpine Faultline. While this cannot predict when an earthquake will occur, it is looking to improve predictions about how strong ground shaking will be at particular locations.

Antarctic Science Platform Director, **Associate Professor Nancy Bertler** (Victoria University of Wellington and GNS Science) gave a frank presentation in Lower Hutt on changes in the Southern Ocean environment, with startling predictions about sea level rise and the likely frequency of climate events, such as large storms.

Dr Haki Tuaupiki (University of Waikato), combined ancient Māori navigational knowledge with contemporary voyaging practices to create the first comprehensive, uniquely Māori navigation system.

West Coast beekeepers packed the Buller District Library for a standing-room only opportunity to hear entomologist **Professor Phil Lester** (Victoria University of Wellington) talk about his research into social insects – bees, wasps and invasive ants.

A well-pitched talk at Hamilton City Library on chirality and discrete mathematics by **Distinguished Professor Marston Conder** (University of Auckland) left everyone comfortable with numerically describing the fourth dimension, or the fifth, sixth...

Associate Professor Janet Wilmshurst (Maanaki Whenua Landcare Research and University of Auckland) spoke with a local focus about her leading-edge research in pre-historic plant and animal ecology, fire disturbance, and the impacts of human settlement. Her Nelson talk was kindly supported by Te Apārangi branch.

Ferrier Research Institute Associate Dean, **Professor Emily Parker** (Victoria University of Wellington) is Principal Investigator for some of New Zealand's most outstanding biomedical research, seeking to develop cutting-edge drugs and vaccines, tools for early diagnosis and prevention, and new models of disease.

Dr Rachael Shaw (Victoria University of Wellington) spoke at the New Plymouth Girls' High School to a gathering keen to hear about her research into the behaviour of the toutouwai, kākā and her work at Zealandia. Their interest evident by the many questions she fielded afterwards.

In her video interview, **Dr Isabelle Sin** (Motu Institute), described what interests her about studying labour economics, the gender wage gap and brain drain, and what the solutions might be.

In Whakatāne, we were warmly welcomed by colleagues and whānau of **Dr Naomi Simmonds** (Te Whare Wānanga o Awānuiarangi) where she spoke about the personal connection she feels to her research. She described the practice of hīkoi in relation to ancestress Mahinārangi, who journeyed 500kms from the lands of her people in Kahungunu (near Te Aute) to those of her husband, Tūrongo, at Rangiātea (near Te Awamutu) whilst heavily pregnant, and her own quest to recreate that journey.

In his Tauranga talk, **Professor David Ackerley** (Victoria University of Wellington) described the work he is leading in engineering enzymes and looking to advance a new form of gene therapy that exclusively targets cancer cells. The core idea is that genes encoding these enzymes can be delivered to cancer cells using viruses or bacteria that are only able to replicate in tumours.

Our interview with **Dr Natalie Robinson** (NIWA) illustrated how Antarctic scientists look for new ways to communicate climate change and make their research accessible to everyone. She spoke of her up-and-coming platelet layer research, and her hopes for better understanding these ecosystems and climate change in Antarctica.

Emeritus Professor Alison Mercer (University of Otago) specialises in the brain and behaviour of honey bees. Her fascinating research has changed our understanding of how bees communicate and the role of pheromones in neuronal development, learning and memory.

Typifying current interest in renewing traditional ecological knowledge, **Dr Pauline Harris** (Victoria University of Wellington) attracted a large audience in Gisborne, who were keen to hear her insights into maramataka Māori lunar calendars.

Professor Jon Waters (University of Otago) specialises in marine biological research, analysing genetic variation of marine mammals, penguins, kelp and invertebrates and the emphasis the roles of extinction and long-distance dispersal have had in shaping biological assemblages of the Southern Hemisphere.

In Invercargill, we were generously hosted by Southland Hospital as part of its public programme. **Professor Stephen Robertson** (Curekids Professor of Paediatric Genetics, University of Otago) outlined his research into single gene disorders in children, with a particular emphasis on disorders that affect the development of the skeleton and the brain.

Dr Susie Wood (Cawthron Institute) leads a growing field of research into algal biotechnology. She is considered a world expert in cyanobacteria, and is passionate about improving our understanding of freshwater lakes and waterways in Aotearoa.

In keeping with the regional theme of the talks, Northland Mathematics Association kindly invited us to Whangārei Girls' High School, where **Professor Geoff Whittle** (Victoria University of Wellington), a world leader in discrete mathematics, described maths in the digital age and the joy of mathematical research.

KO MATARIKI E ĀRAU ANA

THE GATHERING OF MATARIKI SERIES OF TALKS

Professor Rangi Matamua, a son of Tūhoe, shared his detailed knowledge about Matariki and highlighted connections between cultural knowledge and science in a 20-talk series in New Zealand and Australia during 2019.

Professor Matamua is passionate about Māori astronomy and is the author of the best-selling book *Matariki: The Star of the Year*. As Associate Dean Postgraduate within the Faculty of Māori and Indigenous Studies at the University of Waikato, Professor Matamua is heavily involved in researching how Māori studied and applied their knowledge of the celestial bodies.

Their relationship set in course the collection and recording of Māori astronomical knowledge by Te Kōkau. This lecture series helped celebrate and disseminate Māori knowledge of the cosmos to a new generation.

Watch interview with Professor Matamua on Māori Television's Marae programme.

Bit.ly/2019MF5

Professor Matamua and his family have an astronomical connection with Royal Society Te Apārangi that stretches back to the late 1800s. His ancestor, Te Kōkau Himiona Te Pikikōtuku, was an informant and friend of Society member Elsdon Best.

KA MUA, KA MURI

LOOKING BACK IN ORDER TO LOOK FORWARD RESEARCH EXCELLENCE OVER THE YEARS

The Fund was announced in the 1994 Budget by the Minister of Research, Science and Technology, Rt Hon Simon Upton. It came at the end of an era of upheaval in research funding and in recognition of the need for an investigator-led approach.

The first round of competitive bidding was in 1995, at that stage run through a Foundation. Funds of nearly $6 million were allocated to 60 projects across five panels. After the first round, the administration was transferred to the then Royal Society of New Zealand. The first Marsden Fund Committee, chaired by Sir Ian Axford, was appointed in time for the 1996 funding round.

This year, funds of $83.671 million were allocated to 125 research projects across ten panels. Over the twenty five years 2,328 projects have been supported, totalling nearly $964 million.

Competition for funding is intense, and every year many brilliant ideas must be turned away for lack of funding, even though they are of truly top international standard. Despite its comparatively small size, the Marsden Fund has nevertheless become synonymous for its support of "blue sky thinking" among the very best emerging, established and eminent researchers. It has provided seeding funding for many investigator-inspired initiatives now regarded as mainstream, and allowed for international participation. Importantly, it has continued to support the career development and training of new researchers including many postdoctoral fellows and post-graduate researchers.

Grants are not only held in high regard here, but are well-known overseas particularly given there are so many examples of top researchers being recognised. One such was **Sir Paul Callaghan** FRS FRSNZ, who in 2004 was awarded the prestigious Ampere Prize for his (Marsden Funded) work on nuclear magnetic resonance imaging. He was the first scientist outside Europe to win the award.

As well as demonstrating Aotearoa's potential as a dynamic, knowledge-based economy and society to international audiences, the Marsden Fund has helped us understand many aspects of our unique local environment and culture. On occasion, this has meant rewriting our history through discoveries about our ecology, tūpuna and early settlement, or giving voice to un-told stories, mātauranga Māori or Pasifika ways of being and learning.

All areas of Marsden Fund research, across the sciences, social sciences and humanities have the potential to kick-start new sources of wealth creation. This gives us opportunities to add new high value sectors to our economy, and for the renewal of ones we already have.

Here we take a glimpse at a small selection of the excellent research and researchers supported over twenty five years of Te Pūtea Rangahau a Marsden. Ka mua, ka muri: looking back in order to move forward.

MODELLING HUMAN LUNGS

Professor Merryn Tawhai and **Distinguished Professor Peter Hunter** FRS FRSNZ (University of Auckland) developed the first published methods modelling human lungs with accurate relationships between the lungs, airways and blood vessels. The research resulted in at least 12 international journal publications and led to follow up funding and support from major research organisations in the US.

MEASURING EARTH'S WOBBLE

The **Canterbury Ring Laser Project** which unfortunately closed following the Christchurch earthquakes, was initially led by **Emeritus Professor Geoff Stedman** FRSNZ, then by **Professor Jon-Paul Wells** (both University of Canterbury). It involved sending laser light in both directions around a rectangular path, allowing parts per million changes in the rotation of the Earth to be measured. The research led to an observation of a wobble in the Earth's axis of less than 1m at the poles.

DATING EARLY SETTLEMENT

The kiore, or Pacific rat, spread throughout the islands of the Pacific with voyaging humans, and helped pin down when the first people arrived in Aotearoa. **Associate Professor Janet Wilmshurst** FRSNZ (University of Auckland and Manaaki Landcare Research) found gnawed seeds and determined their age by radiocarbon dating, revealing kiore's arrival with Māori is likely to have been no more than 800 years ago.

NAVIGATION OF MIGRATORY ANIMALS

Professor Michael Walker FRSNZ (University of Auckland and Ngā Pae o te Māramatanga) and his colleagues demonstrated the magnetic sense of trout and pigeons is based on very small crystals of magnetite in the nose or beak of the animal. It significantly advanced our understanding of the navigational feats of migratory animals. It led to publications in *Nature* and selection by *Faculty of 1,000* as one of the most important papers in biology.

REWARD RESPONSE

Professor Jeffrey Wickens, **Professor John Reynolds**, and **Professor Brian Hyland** (University of Otago) showed how dopamine, a reward chemical in the brain, primed the brain for learning. Dr Reynolds, who worked on a rare type of brain cell involved in reward learning, was the first New Zealander to be awarded the prestigious Brain Research Young Investigators Award in 2004.

BOOKS AND BIOGRAPHIES

The Marsden Fund has supported numerous publications and books, many of them highly praised. *The Book of Iris: a Life of Robin Hyde* by **Derek Challis** and **Gloria Rawlinson**, was a finalist in the Montana New Zealand Book Awards 2003. The following year, *Long Journey to the Border: a Life of John Mulgan* by **Vincent O'Sullivan**, was also a finalist. And *The Trial of the Cannibal Dog: Captain Cook in the South Seas* by **Professor Dame Anne Salmond** FRSNZ, won the 2004 Montana Medal for Non-Fiction. More recently, **Professor Alison Jones** and **Kuni Kaa Jenkins**' *Tuai: A traveller in two worlds* won the 2018 Ockham New Zealand Book Awards for illustrated Non-fiction.

PLANET HUNTING

The **Microlensing Observations in Astrophysics (MOA) Project**, which received almost continuous funding in the early days of the Marsden Fund, observed the bending of light, as proposed by Einstein, to hunt for extrasolar planets. One of its discoveries of those years was a Jupiter-sized planet orbiting its parent star, a red dwarf, some 17,000 light years away – at the time it was the most distant known planet.

TINY ELECTRICAL CIRCUITS

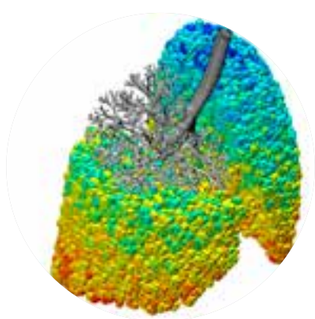
Professor Richard Blaikie FRSNZ (University of Otago) was included in *New Scientist's* timeline – *A Brief History of Negative Refraction* for his Marsden Funded research. His work demonstrated a technique to focus light more tightly, overcoming a barrier to the further miniaturisation of silicon chips.

HEALING WOUNDS

Marsden research has thrown up some chance discoveries. **Professor Colin Green** (University of Auckland) and his group accidentally discovered a way to increase the rate of skin wound healing, decrease scar formation, and prevent the spread of brain damage. The research led to the development of Nexagon™, a gel which interrupts cell communication and prevents the production of a protein that blocks healing. Through CoDa Therapeutics NZ and later CoDa Therapeutics Incorporated in the United States, this has resulted in clinical trials on the skin and eyes.

SUPERCONDUCTOR WORLD LEADER

Professor Bob Buckley FRSNZ and **Professor Jeff Tallon** FRSNZ led Industrial Research Limited's (IRL) superconductor research and commercialisation activity for more than 20 years, and won the inaugural Prime Minister's Science Prize for continued development of the technology. Partly supported by The Marsden Fund, they made a string of discoveries in high-temperature superconductors and established a world-leading export business and joint venture, General Cable Superconductors.



ORIGINS OF ANGKOR CIVILISATION

Emeritus Professor Charles Higham FRSNZ and **Associate Professor Hallie Buckley** (University of Otago) have directed archaeological research in the Upper Mun Valley of northeast Thailand for over 20 years, investigating the prehistoric foundations of the early Angkorian state. Thai researchers, including **Dr Rachanie Thosarat**, were co-directors of the project, and an extensive team of people (including about 40 Thai locals and 15 overseas volunteers every summer) take part in fieldwork, carbon dating and analyses uncovering iron-age origins of Ban Non Wat and other Southeast Asian sites.

ORGANIC AND MEDICINAL CHEMISTRY

A pioneer in drug discovery in New Zealand, **Distinguished Professor Dame Margaret Brimble** FRS FRSNZ (University of Auckland and Auckland Uniservices) has discovered a treatment for Rett Syndrome, Fragile X Syndrome and autism disorders. Trofinetide, currently entering phase III human clinical trials, is the first drug successfully developed by a New Zealand spin-out company and one of very few discovered in an academic laboratory.

MENTAL TIME TRAVEL DURING HUMAN DEVELOPMENT

Professor Harlene Hayne FRSNZ (University of Otago) does research that examines age-related changes in episodic memory during childhood and adolescence, and has resulted in over 100 scholarly books, chapters, and journal articles. Her findings have important theoretical implications for current views of memory development and childhood amnesia and important practical implications in settings in which children must rely on their memories, including clinical, legal, and educational contexts.

SECRETS OF HAIR AND SKIN MOLECULES

The complex biology and structure of hair, skin and muscle and how proteins can be designed from simple building blocks has been the lifelong research focus of world-leading scientist **Distinguished Professor David Parry** FRSNZ (Massey University). One of his projects, funded by Marsden, led to a world breakthrough into the arrangement of hair filament molecules. Aspects of his work have been applied in the wool and meat industries, in surgical procedures as well as in physiology and medicine.

INCREASING OUR UNDERSTANDING OF ANTARCTICA

Marsden Funding has long supported projects to model, monitor and increase our understanding of changes in Antarctica in a warming world, and the implications for global sea level and climate. Two such examples are **Associate Professor Nancy Bertler** (Victoria University of Wellington), who leads Antarctic field deployments for our ice core research and the Antarctic Climate Archives Programme; and the work of **Associate Professor Craig Stevens** (University of Auckland and NIWA), a specialist in fluid mechanics and glacier melt.

INTERACTIONS BETWEEN MATHEMATICAL PHYSICS, TOPOLOGY AND GROUP THEORY

A Marsden Fund supported project to facilitate meetings between leading New Zealand and international mathematicians was so successful, **Professors Vaughan Jones**, **Marston Conder** FRSNZ and **David Gauld** (University of Auckland) went on to establish the New Zealand Mathematical Research Institute to organise them in the future.

EARLY GENOME DATABASE

Professor Emeritus David Penny FRSNZ (Massey University) received a number of early Marsden Funds for his research, using these to integrate DNA sequencing, computing and mathematics to explore theoretical evolution. This work involved the generation and analysis of large amounts of information, including complete mitochondrial genomes of birds and mammals and an improved database of fossil records – all new at the time.

WHAT MAKES A JUST SOCIETY?

Giving Māori and other indigenous perspectives an opportunity for an equal share in discussions about social and global justice, **Dr Krushil Watene** (Massey University) is introducing whakapapa, mana and manaakitanga into international scholarly discussion, and relating this to other indigenous concepts and mainstream theories of justice in western philosophy.

BOSE-EINSTEIN CONDENSATION

Following the pioneering work in quantum optics of **Professor Crispin Gardiner** (University of Otago) and the late **Professor Dan Walls** FRS FRSNZ, the Marsden Fund strongly supported this field and Bose-Einstein condensation, in which atoms lose their individual identities at ultra-cold temperatures. The work led to a number of influential scientific publications, mainly concentrating on kinetic processes in Bose–Einstein condensates, and in particular seven papers on quantum kinetic theory.

FASTEST GAS ANALYSIS TECHNOLOGY AVAILABLE

Syft Technologies are sold around the world, providing highly sensitive gas detectors in a host of applications, from mud logging to cutting-edge breath research. These arose out of Marsden-funded research on interstellar chemistry investigating the ion chemistry in the Earth's atmosphere, and other planetary atmospheres, led by **Professor Murray McEwan** FRSNZ (University of Canterbury).

REVITALISING TE REO AND TE AO MĀORI

Māori language newspapers, comprising over 35 titles, constitute one of the richest, oldest and most extensive indigenous language archives in the world, containing a uniquely important historical social and cultural record. Projects from **Professor Ngapare Hopa** and **Dr Jane McCrae** (University of Auckland) resulted in the publication *Rere Atu, Taku Manu!* (Fly out, my bird!).

RAPE MYTHS AS BARRIERS TO FAIR TRIAL PROCESS

Cross-examination strategies in rape trials remain resistant to reforms, which continues to negatively impact on complainants despite initiatives to improve the legal process, **Professor Elisabeth McDonald** (University of Canterbury) found. Her research has been made freely available to those working in this area of law and is published in an Open Access book through Canterbury University Press (CUP).

SUSTAINABLE IRRIGATION AND SOIL PHYSICS

Dr Brent Clothier FRSNZ (Plant & Food Research) has developed world-leading theories for water and chemicals moving through soil, along with inventing new devices that enabled the parameterisation of these models. His development of a new technology to directly measure water use by trees and vines has helped improve water management in water-short regions globally.

DISCOVERY OF NEW SPECIES

Among the discoveries of new species supported by Marsden Funding, are some of the largest flying birds ever, Pelagornithids. The 62 million-year-old huge seafaring birds were found in Waipara, and researched by **Professor Paul Scofield** and **Dr Vanesa De Pietri** (Canterbury Museum). It was identified by the same team that announced the discovery of a 1.6 metre-high giant penguin from the same site.

HYDROGEN DISCOVERY

Bacteria use an astonishing variety of ways to generate the energy they need to grow and survive, and hydrogen gas is a particularly powerful fuel source. **Professor Greg Cook** FRSNZ (University of Otago) and his team noticed the "scavenging of atmospheric hydrogen" and are hunting down bacteria that can metabolise hydrogen, and are developing bacterial metabolism and energetics as a new target space for drug development to combat bacterial pathogens (Mycobacterium tuberculosis) and environmental microorganisms that contribute significantly to greenhouse gas emissions.

MARSDEN NEWS

AFTER THE ORIGINAL:

ITERATIVE POETICS AND GLOBAL CULTURE

Associate Professor Jacob Edmond, Department of English, University of Otago, has published *Make It The Same: Poetry in the Age of Global Media*, Columbia University Press with support of the Marsden Fund.

In *Make It The Same*, Associate Professor Edmond examines the turn toward repetition in poetry, using the explosion of copying to offer an inventive account of modern and contemporary literature.

Make It The Same explores how poetry – an art form associated with the singular, inimitable utterance – is increasingly made from other texts through sampling, appropriation, translation, remediation, performance and other forms of repetition.

Bit.ly/2019MF6 for further details about the book
Bit.ly/2019MF7 for a recent interview

DR DIANA MARTIN

We were saddened to hear of the death of **Dr Diana Martin** FRSNZ ONZM, a former member of the Marsden Fund Council, on 31st December 2019.

For many years Diana was Principal Scientist at the Institute of Environmental Science and Research, and an advisor to the Ministry of Health's meningococcal vaccine strategy. She also served as an international advisor to meetings of the World Health Organisation. She was elected a Fellow of Royal Society Te Apārangi in 2000, and in 2008, she became an Officer of the NZ Order of Merit for services to microbiology. Council members recall Diana very efficiently chaired the Biomedical Sciences panel for three years, from 2008 to 2010, and was a pleasure to work with on Council. Our deepest condolences go out to her whānau

London in 1958, Ernest Marsden receiving his knighthood. Left to right: Ernest Marsden, Joyce Chote, Adair (in the dark fur coat),and family member.

Adair and Tim on their wedding day.

DR ISIDORE ADAIR (ADAIR) MARSDEN

18 August 1924 – 18 March 2019

Sir Ernest Marsden's daughter-in-law, Dr Isidore Adair (Adair) Marsden MBCHB FRNZCGP, passed away last year, aged 94. Adair, née Mackersey of Te Kuiti, married Ernest David Lindsay (Tim) Marsden in 1951, a marriage that lasted nearly 57 years, and had three children Alastair, Nigel and Rosemary, and seven grandchildren.

Adair had many happy memories of family time with Gramp, as Sir Ernest was known in the family, and flew to London with baby Alastair for his investiture.
The 10th Anniversary Edition of the Marsden Fund Update featured an interview with Tim, which provided glimpses into Sir Ernest's life. A short excerpt is reproduced here:

The Marsden family bought a bach on the Kapiti coast, where they enjoyed fishing and walks on the beach, and on one occasion, set an accidental scrub fire that set light to the whole hillside. Ernest was, like many, a man greatly unsettled by war who nevertheless made a significant contrinbution. Tim recounted how, late in 1939, Ernest returned from the UK after doing a crash course in radar, but was disappointed when the Armed Forces chiefs didn't want to know about it. So, early one morning, he and Charles Watson Munro (later Professor of Physics at Monash University in Melbourne) went up Mount Victoria, in Wellington. They knew the ship HMNZS Achilles was coming into port that morning so, even though it was pitch dark, with their radar set, it was easy for them to track Achilles' exact course and time of entry. That morning, Ernest presented the data to a defence meeting. At first, they accused him of having an informer on board, but this was soon disproved and the acceptance of the new technology was confirmed.

We would like to extend our deepest sympathy to the Marsden Family, and thank them for their assistance with this article.

Images courtesy of the Marsden Family

NO TE HURIHURINGA ON REFLECTION

PROFESSOR DAVID BILKEY
CHAIR, MARSDEN FUND COUNCIL

April 2020

Kia ora tātou

How good it is to read through these summaries of some of the excellent research that has been supported by Marsden this year. It is clear that we have exceptional research talent in this country, across a broad range of disciplines and I'm pleased that the Marsden Fund can help to energise this activity.

This year we have celebrated the 25th Anniversary of the Marsden Fund and in doing so we have been able to both reflect on the enormous impact the Fund has had on promoting excellent investigator-led research in New Zealand over that period, and also celebrate many of the individual research successes that underlie that impact.

Marsden was delighted to support Professor Rangi Matamua's *Ko Matariki e ārau ana The gathering of Matariki* in his 20-talk series. It attracted a mainly Māori audience of over 10,000 in locations across New Zealand – often in the largest venues that could be secured in each town, such as in Rotorua, Gisborne and Whangārei. It provides strong predication for the revitalisation of tikanga and te ao Māori. It was important for this series, which discussed the re-establishment of central traditions once almost lost, to be taken to the large Māori population now living in Australia. On the final night of the tour in Melbourne, Rangi received a spontaneous haka from the 500-strong audience, deeply moving to everyone present.

We challenged our Marsden Fund 25 speakers to go regional with their talks – they did not disappoint! Professor Phil Lester took his insights on invasive insects to Westport in a standing-room only talk at the Buller District Library. Rather than choosing a Wellington venue, Associate Professor Nancy Bertler described her Antarctica work to a Lower Hutt audience. Distinguished Professor Marston Conder spoke to a small, but curious audience in an open space at Hamilton City Library. And Professor Stephen Robertson's talk on gene disorders and brain development was kindly supported by Invercargill's Southland Hospital at its new education facility. All this meant greater reach and different audiences for us to share Marsden research with.

My thanks to all the grant recipients who presented at the events, provided online profiles and video interviews. They embody the research excellence that Marsden stands for so well. I would also like to acknowledge those who assisted: the schools, hapū, libraries and Te Apārangi branches, to thank all those who came to hear these Marsden stories and the many who invited us to come back again.

At any significant anniversary we should not only reflect back on our past, but also look to the future. In this regard, 2019 gave us a glimpse into that future when the Government released a draft of its Research, Science and Innovation strategy. This document provides a roadmap for New Zealand's research strategy and unveiled a key aim to grow national research and development expenditure to two per cent of GDP by 2028 (currently around 1.4%). I am sure researchers across the country will applaud this aim, and I for one was pleased to see how well the objectives of the Marsden Fund align with the strategy. Our focus continues to be on the key objectives of excellence, connectivity, diversity and scholarly impact, and we already have a significant role in growing, supporting and retaining the best early-career research talent in New Zealand through our Fast-Start grants.

In terms of connectivity, I was very pleased that 2019 saw the Fund support two large interdisciplinary projects through the inaugural Marsden Fund Council Awards. One of these projects will contribute to knowledge about predicting the behaviour of biological systems and their response to fluctuating temperatures, as might occur with climate change. The other investigates the genetic markers associated with metabolic diseases, such as diabetes and gout, in Pasifika populations and asks how these diseases might have evolved. These projects have the potential to have a huge impact both nationally and internationally and are also built on collaboration and connectivity that is being developed between New Zealand researchers and those located in the USA, UK, Australia, Ireland and the Pacific Islands.

It has become increasingly apparent that research that works for the 2020's needs to maintain its social license and credibility with the public. It was unfortunate that this aspect of the relationship between researchers and the wider community was missing from the draft Research, Science and Innovation strategy. While the public need to know that government funds are being well spent in developing economic advantage, they should also be aware that basic research in a wide variety of disciplines can underlie government decision-making, can form the basis for informed personal decision-making, can be relevant to their own experiences and can be valued for its own sake and for its role in enriching our own understandings. I am hoping that with our continued outreach activities and engagement with the community, as has occurred so well in 2019, we can have a small part to play in achieving that goal.

Looking ahead, it is clear that the COVID-19 event will be massively unsettling for everyone, including having an impact on the research landscape. Although this will be a major challenge for us all, I believe that if the Marsden Fund continues to focus on its primary objectives, then we can provide the best possible support for the New Zealand research community through these difficult times.

2019 MARSDEN FUND RECIPIENTS

Recipient	Research Project	Funds
Auckland University of Technology Te Wānanga Aronui o Tāmaki Makau Rau		
Associate Professor SB Singamneni	Controlled magnetic heterogeneity	$956,000
Cawthron Institute		
Dr MY Tadaki	Channels of influence: how does river science structure political options and material realities?	$300,000
GNS Science Te Pū Ao		
Dr DG Bassett	Solving the enigma of Tsunami Earthquakes – the underrated hazard	$300,000
Malaghan Institute of Medical Research		
Professor IF Hermans	Using the tumour-homing properties of CAR T-cells to facilitate targeted chemotherapy of solid tumours	$958,000
Manaaki Whenua Landcare Research		
Dr JR Wood	New Zealand's truffle-like fungi – ghosts of mutualisms past?	$959,000
Dr RAB Leschen	Debris Cloaking in Cryptic Beetles	$954,000
Massey University Te Kunenga Ki Pūrehuroa		
Associate Professor IA Bond	Lifting the interstellar dust veil to reveal undiscovered planets by infrared observations	$958,000
Dr RE Bell	Staying on the Land? Surviving the Reform of New Zealand Agricultural 1984 – 1987	$300,000
Dr PMC Steer	Settler Literature and Environmental Change in Colonial New Zealand and Australia	$657,000
Professor SG Telfer	Reinventing Asymmetric Catalysts Using Multicomponent Frameworks	$891,000
Dr TN Boraman	Knocking off: Strikes in Aotearoa New Zealand from the late 1960s to the mid-1980s in a global context	$340,000
Dr JMR Hunter	Exploration of Pāsifika funds of knowledge in mathematics	$300,000
Dr BA Andersen	Housing and Everyday Security in Papua New Guinea	$300,000
Professor TF Cooper	Evolving to evolve: testing how history and community influence evolutionary potential	$953,000
Dr EA Ostrowski	Can Arms Races Occur Within a Species?	$957,000
Dr A Szabo	Growing old in an adopted land: Redefining 'ageing well' in the context of migration	$300,000
Associate Professor G Lube	Turbulent killers – how do volcanic eruptions become ferocious?	$948,000
Dr MM Faleolo	Towards a Pacific criminological theory: Life histories of Samoan people's involvement in gangs in Oceania	$300,000
Distinguished Professor MJ Anderson	Not too hot, not too cold, just right: New models of species' responses to their environment	$936,000
NIWA Taihoro Nukurangi		
Dr CL Stewart	Quantifying melt rate variability beneath the north-western Ross Ice Shelf	$300,000
Dr AR Orpin	Testing the veracity of turbidite paleoseismology using the Kaikōura earthquake	$954,000
Scion		
Dr WJ Kelton	The hidden influence of diversity within the constant region of antibodies	$300,000
University of Auckland Te Whare Wānanga o Tāmaki Makaurau		
Professor AR Gover	A new bridge between geometry and analysis	$643,000
Dr BP Ruddy	The magnetic myocyte: applying inspiration from muscle physiology to electric motors	$300,000
Dr NG Ellis	Ngā Taonga o Wharawhara: The World of Māori Body Adornment	$523,000
Associate Professor SH Trnka	Ka Hao te Rangatahi: Fishing with a New Net? Rethinking Responsibility for Youth Mental Health in the Digital Age	$842,000
Dr ML Muru-Lanning	Listening to the Voices of our Harbours: Kāwhia, Manukau and Whangarei	$660,000
Associate Professor SG Murdoch	Multimode microresonator optical frequency combs	$922,000
Dr JC Lim	The tick tock of the redox clock: shedding new light on the role of the lens in regulating circadian rhythms	$896,000
Dr TM Vatanen	Phages as modulators of the human gut microbiome	$300,000
Dr M Vorobyev	Colour blind camouflage in octopus	$960,000
Dr JM Dean	Short and sweet: Does the breakdown of extracellular matrix sugar hyaluronan impair brain development after inflammation?	$959,000
Dr AC Hood	Coercive Disarmament in International Law: 1919-2019	$300,000
Dr JP Fisher	Unravelling a clot-less link between atrial fibrillation and dementia	$938,000
Professor PR Shepherd	Why does a gene variant specific to Māori and Pacific peoples increase blood pressure ?	$959,000
Dr Y Wen	Disease risk prediction using high-dimensional multi-omics data	$300,000
Dr BC Stevenson	Estimating animal population size in an unobservable spatial obstacle course	$300,000
Dr D Wang	Reconceptualising Chinese language learning in New Zealand: the unheard stories of learners	$300,000
Dr A Nieuwenhuys	Tired and out of control? Effects of sleep deprivation on response inhibition under low and high threat	$300,000
Professor B Krauskopf	Feedback loops in climate systems: the maths of delays and the consequences	$689,000
Dr AW Santure	The role of transposable elements in rapid adaptation of invasive species	$960,000
Associate Professor SR Pearson	Asian New Zealanders on Screen: visibility past and present	$842,000

Recipient	Research Project	Funds
Dr DW Waite	The role of viruses in the spread of antibiotic resistance: Evolution through rapid, selection-free diversification of resistance genes	$300,000
Dr CJS Bennett	"We are now fighting the germs": Recovering children's experiences of the 1918-19 Influenza Pandemic in New Zealand, Ireland, and Canada	$300,000
Associate Professor KE Waldie	Polygenic and environmental markers of mental health status in New Zealand children	$766,000
Dr TJ Giffney	Simultaneous deposition and poling of piezoelectric composites for 3D printed sensors and actuators	$300,000
Dr KM Mellor	Cardiac glycogen processing: defining a new metabolic pathway in heart health & disease	$952,000
Associate Professor RM Simon-Kumar	Double jeopardy or double advantage? Ethnic women in New Zealand politics	$842,000
Dr CD Erb	Capturing the Mind in Action: Linking the Behavioural and Neural Dynamics of Cognitive Control	$300,000
Dr C Aguergaray	New pulse dynamics for the lasers of tomorrow	$960,000
Dr ID Hay	Nanoscale imaging and characterisation of bacterial phage secretion	$300,000
Professor BH Smaill	Getting to the heart of it: Image-based network modelling of cardiac function	$960,000
Dr CN Whittaker	To accrete or erode? New insights into wave (re)shaping of coastal dunes	$300,000
Dr IA Pecher	Geologic champagne: What controls sudden release of CO2 at glacial terminations on the Chatham Rise?	$952,000
Professor A Nies	Topological algebra, first-order logic, and computability	$448,000
Dr GD Bellon	Memory in the clouds	$829,000
Dr D Mercadante	Looking at the dark side of the proteome: how do post-translational modifications control highly disordered proteins for the regulation of genetic transcription?	$300,000
University of Canterbury Te Whare Wānanga o Waitaha		
Dr TR Love	It looks grim: The future of Māori academics in New Zealand universities	$300,000
Professor RCJ Dobson	Understanding bacterial membrane transport proteins: setting an antimicrobial TRAP	$890,000
Professor JM King	Awakening the proto-lexicon	$660,000
Professor AJG Cockburn	Understanding the Human Experience of Intelligent User Interfaces	$530,000
Dr TM Allison	Exposing the intricate interactions of membrane-bound bacterial machinery	$300,000
Dr PA Brooksby	Molecular wiring of graphene with organic films: optically transparent charge selective electrode materials for efficient solar energy conversion	$960,000
Dr LE Revell	Could airborne microplastics play a role in climate change?	$300,000
Professor JB Hay	Tracking the emergence of an adult proto-lexicon	$858,000

Recipient	Research Project	Funds
Dr SP Flanagan	Does sexual selection drive the evolution of sex-biased gene expression?	$300,000
Dr JM Moses	Issue mapping and analysing the lethal autonomous weapons debate	$842,000
Dr MG Cowan	Engineering defect-free metal organic framework membranes in tubular ceramic supports	$300,000
Dr VK Morris	Unravelling molecular details of protein interactions that drive Alzheimer's disease	$300,000
University of Otago Te Whare Wānanga o Otāgo		
Dr EJ Dowle	Battle of the body snatchers; do co-occurring parasites help or hinder each other?	$300,000
Dr SDH Diermeier	Assessing the molecular mechanism of a cytoplasmic long non-coding RNA	$300,000
Dr PP Gardner	Are molecular mis-interactions a major constraint on the evolution of cellular and genomic complexity?	$960,000
Professor BA Lovelock	"Bad nature": The social dimensions of invasive alien species and their management in New Zealand	$682,000
Dr CM Brown	New ways of terminating bacterial gene expression	$960,000
Dr AM Jackson	Te whai wawewawe ā Māuitikitiki-ā-Taranga: Revitalisation of Māori string figure knowledge and practice	$842,000
Dr NTH Nghiem	Predicting risk of diabetes complications and costs using machine learning with equity analysis	$300,000
Professor GR Summerhayes	Crossing the divide from Asia to the Pacific: Understanding Austronesian colonisation gateways into the Pacific	$856,000
Dr JH Shaver	The longitudinal study of cohesion and conflict: Testing hypotheses of social and religious change in Fiji	$300,000
Dr J Watts	Cross-cultural patterns in theory of mind: Using text analytics to identify structure and variation in mental state attributions in the Pacific	$300,000
Dr SE Wardell	Online medical crowdfunding in New Zealand: Illness, giving, and moral emotion	$300,000
Professor DR Grattan	Why do males have prolactin?	$960,000
Dr CJ Collins	Piecing together Pacific prehistory using genomics and the commensal model	$300,000
Dr G Reid	From friend to foe: How do cancer cells convert the p53 tumour suppressor gene into an oncogene?	$945,000
Associate Professor N Kjærgaard	Reactive cold collisions in steerable optical tweezers	$891,000
Professor TR Merriman	Walking backwards into the future: An evolutionary investigation into the high rates of metabolic disease in Pacific populations	$3,000,000
Dr TL Candy	Global Behaviour of Nonlinear Dispersive Partial Differential Equations	$300,000
Professor MW Colombo	The code for visual objects in the avian brain: Advancing computer vision to rival a bird's eye view of the world	$648,000

Recipient	Research Project	Funds
Professor MCM Vissers	Exploring the epigenetic mechanisms by which maternal nutrition and metabolism influence prenatal development	$960,000
Dr TM Davies	A new generation of statistical models for spatial point process data	$705,000
Dr AJ High	Rape, passivity and permission: A comparative analysis of law on consent and reasonable belief	$300,000
Dr TJ Major	The role of epigenetics in the inappropriate activation of the innate immune system during gout flares	$300,000
Professor J Frauendiener	Gravitational waves from rotating black holes	$888,000
Professor PB Blakie	Binary magnetic gas – the next generation quantum-liquid	$891,000
Dr KJ Hards	Are quinones a novel mechanism for interspecies electron transfer?	$300,000
Dr SJ Miller	Development and assessment of a multi-spectroscopic fiber optic probe capable of disease diagnosis in the gastro-intestinal tract	$300,000
Dr AJM Sabadel	How to fit parasites in food webs? A compound-specific stable isotope approach	$300,00
Associate Professor BC Galland	Sleep loss in children: perchance to eat?	$852,000
Associate Professor DA Orlovich	Fruit body differentiation in mushrooms and truffle-like fungi	$960,000
Dr MJ Larcombe	The ecology diversification: do processes that promote and constrain diversification operate along different niche axes?	$300,000
Associate Professor CW Beck	With a little help from my friends: how do symbiotic microorganisms influence regenerative outcomes?	$957,000
Professor M Sellbom	Understanding the psychopathic personality: a neural motivation systems approach	$857,000
University of Waikato Te Whare Wānanga o Waikato		
Professor DJ Lowe	Earth-shaking insight from liquefied volcanic-ash layers in lakes: using geotechnical experiments, CT-scanned lake sediment cores, and tephrochronology to map and date prehistoric earthquakes	$960,000
Professor VL Arcus	Macromolecular Rate Theory (MMRT) and the temperature-dependence of the terrestrial biosphere over time and space	$3,000,00
Professor JK Gibson	Mis-counting China	$858,000
Professor MA Berryman	Languaculture within Te Ao Māori: Learning from infants, whānau and communities	$841,000
Victoria University of Wellington Te Herenga Waka		
Associate Professor NAN Bertler	Did the West Antarctic Ice Sheet Collapse during the Last Interglacial Warm Period?	$960,000
Dr M Preuss	Unravelling parasite evolution by tracking gene loss in plastid genomes of parasitic red algae	$300,000
Dr CA Seals	Creating a Model for Learning Multiple Languages	$300,000
Dr NJLK Davis	Photon multiplying light harvesting antenna systems for luminescent solar concentrators	$300,000
Associate Professor SR Brock	Religious and moral fictionalism	$660,000

Recipient	Research Project	Funds
Dr MD Hammond	How do relationship needs promote sexist idealization and aggression?	$300,000
Professor MJ Visser	Black holes beyond general relativity	$707,000
Professor KP Dew	Exceptional trajectories: transforming understandings of cancer survivorship	$842,000
Dr LM Connor	Deciphering the unspoken language between immune cells	$300,000
Professor DF Ackerley	Molecular contingency on a massive scale: how entirely new antibiotic resistance genes evolve	$960,000
Professor SK Davy	The language of success: Inter-kingdom communication in the coral-algal symbiosis and the adaptation of coral reefs to climate change	$960,000
Associate Professor SM Jackson	#MeToo; a cultural shift?: Young New Zealanders' exposure and responses to sexual harassment media	$842,000
Professor A Weatherall	Using talk and the body to prevent gender-based violence	$842,000
Dr DJ Sinclair	Drought or deluge? How did rainfall in the Tropical South Pacific respond to sudden climate change during the Glacial Period?	$960,000
Dr J Pitman	Saving the kākāpō: plant hormones to boost breeding	$960,000
Professor M Zhang	Genetic Programming for Symbolic Regression	$707,000
Professor JM Hodgkiss	Can enhanced exciton diffusion propel organic photovoltaic cells beyond the bulk heterojunction?	$891,000
Dr SV Chong	Next generation magneto-piezochromic composites for optically based intelligent magnetic field sensing	$837,000
Dr CJ Boulton	Healing and sealing earthquake faults: How fluids influence the seismic cycle	$300,000
Associate Professor B Xue	Evolutionary automated design of deep convolutional neural networks for image classification	$707,000

For the complete list of awarded Marsden Fund investigators including abstracts of all projects, visit:

bit.ly/2019MF8

Whakapā mai | Contact us

Marsden Fund Te Pūtea Rangahau a Marsden
Royal Society Te Apārangi

11 Turnbull Street
Wellington 6011
PO Box 598
Wellington 6140
New Zealand

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

Ngā tūhonohono | Connect with us

ISSN 1175-0073
Published 2020

MARSDEN FUND
TE PŪTEA RANGAHAU A MARSDEN

ROYAL SOCIETY TE APĀRANGI