
2016

Annual Review

A summary of our year

Royal Society Te Apārangi

EXPLORE | DISCOVER | SHARE



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Royal Society Te Apārangi

Supporting New Zealanders to explore, discover and share knowledge

Exploring our world, discovering knowledge and sharing that knowledge are central to the role of the Royal Society Te Apārangi. Discover what we were up to in 2016.

Introduction from the President

Kia ora koutou, ngā mihi,

In 2016 we prepared for renewal and planned for our refresh. We worked with our various communities to find out how best to present the Society to New Zealanders in a way that connects with and engages a broader range of people than we have before. We found that focussing on our differences wasn't helping and we needed to find our common goal, and to express that in a uniquely New Zealand way.

Our refresh has led us to launch a new brand in 2017. We now call ourselves Royal Society Te Apārangi and our logo is a koru representing new growth while recognising our valued past. To explain what it is that we all do, we can now say we are here to 'explore, discover and share knowledge'. Part of our refresh is to address our diversity and further develop our partnership with Māori. There is much to do.

During the year we have continued to support our work with New Zealanders from primary school to tertiary, from those researching in institutions to those implementing their knowledge in practice, and finally through to our valued experts at the top of their fields. We were pleased to welcome 19 new Fellows including 10 women in 2016, one of whom is our first female maths Fellow.

We were able to share the knowledge of people from NASA, on the journey to Mars, to our own climate experts talking about our reports on the *Implications of Climate Change for New Zealand* and the *Transition to a Low-Carbon Economy*. Fact sheets on Sugar and Health and Gene Editing were also popular in 2016.

We have emerged into our 150th year on a new path with a stronger connection to our New Zealand culture. I thank Chief Executive Dr Andrew Cleland, my colleagues on Council, our staff, members and all those supporters who so warmly and freely give up their time to help us promote and advance the cause of knowledge in New Zealand, Aotearoa.

Ngā mihi nui

Emeritus Professor Richard Bedford
QSO FRSNZ
President

Explore

We support New Zealanders of all ages to follow their curiosity and explore the world.

Increased funding allowed Marsden Fund to support more early-career researchers

The Marsden Fund, managed by us on behalf of the New Zealand Government, supports New Zealand researchers to explore their best ideas, including an understanding of how things work at a fundamental level. Two types of grants are offered: Fast-Start for early-career researchers and Standard for established researchers. The grants are distributed over three years, paying for salaries, students and postdoctoral positions, institutional overheads and research consumables and are offered for research in science, engineering, maths, social sciences and humanities. As of December 2016, we were managing 367 live research contracts.

In the 2016 Budget from government an additional \$66 million (excl.GST) was allocated to the Marsden Fund over four years. This allowed a higher overall success rate for applicants for the year's round (10.7% compared with 7.7% in the previous year) with 117 research projects selected.

The assessment panels were impressed with the quality of the Fast-Start proposals in 2016 and were able to use the extra money to support more of them: 49 compared with 29 in 2015. The Fast-Start grants are designed to allow early-career researchers to establish their independent research areas and create research momentum for these individuals. In 2016 we updated the criteria of who is eligible to apply for a Fast-Start grant to allow for time taken off for child care and other commitments as part of our commitment to embracing diversity across all of our activities.

Many of the Fast-Start grants awarded in 2016 were for exploring issues very much at the forefront of public interest today such as climate change, nitrogen run off, immigration and understanding New Zealand's native plants and animals.

Topics under investigation by those receiving a Standard grant also cover a range of topics of great interest to New Zealand, including slow moving landslides, ancient Māori social networks, and how melanin acts as a sunscreen.

Over time, the Marsden Fund helps to build a strong research base for New Zealand, which will benefit us all in the future.

Supporting established researchers to explore their area of expertise

Each year we award James Cook Research Fellowships, funded by government, to allow established researchers to explore their own research interests full time for two years. We awarded three fellowships in 2016:

Health Sciences | Professor Debbie Hay, University of Auckland, will work to improve the safety and efficiency of a new type of drug for chronic migraine sufferers that targets the neurotransmitter Calcitonin gene-related peptide. Her research shows that this neurotransmitter may induce pain by several pathways, not just one as commonly believed.

Physical Sciences | Professor Tim Naish FRSNZ, Victoria University of Wellington, seeks to improve predictions of sea level rise in New Zealand by better understanding how the Antarctic ice sheet will respond to warming temperatures and by creating better models of sea-level rise in different regions of New Zealand, based on interactions between tectonic, oceanic and climatic factors.

Engineering Sciences and Technologies | Professor Peter Smith, Victoria University of Wellington, will develop understanding of the fundamental properties of millimetre wave bands, the new technology hoped to allow a 100-fold increase in the rate of mobile data transfer in 5G (fifth generation wireless systems). He seeks to develop methods to both evaluate performance and optimise signal processing to achieve higher data rates.

Supporting early career researchers to become leaders

One of the ways we support early career researchers is by managing the Rutherford Discovery Fellowships programme on behalf of the government. Each year we award fellowships to approximately 10 outstanding early career researchers, which supports them for five years so that they can further build up their area of expertise and become research leaders. In 2016 we awarded ten Rutherford Discovery Fellowships (following). You can read more about this research on our website.

Dr Baptiste Auguié, Victoria University of Wellington, for research entitled: “Light chirality at the nanoscale”

Dr Federico Baltar, University of Otago, for research entitled: “What makes ‘normal’ normal? Alternative microbial carbon and energy acquisition mechanisms in the neglected high-nutrient low-chlorophyll (HNLC) areas of the ocean”

Dr Adam Hartland, University of Waikato, for research entitled: “Unlocking the karst record: quantitative proxies of past climates from speleothems”

Dr Huw Horgan, Victoria University of Wellington, for research entitled: “Accelerating ice – The role of water in the flow of ice sheets”

Dr Yoshihiro Kaneko, GNS Science, for research entitled: “Structural controls on earthquake behaviour in the Hikurangi subduction mega-thrust?”

Dr Jenny Malmstrom, University of Auckland, for research entitled: “Signals to cells when and where they are needed?”

Dr Jeremy Owen, Victoria University of Wellington, for research entitled: “Harnessing the biosynthetic potential of uncultivated microbes for the discovery of new antibiotics”

Assistant Professor Nicole Roughan, University of Auckland, for research entitled: “Jurisprudence without borders: A pluralist theory of law”

Dr Rachael Shaw, Victoria University of Wellington, for research entitled “Wild intelligence: Exploring the evolution, function and conservation applications of cognitive traits”

Dr Virginia Toy, University of Otago, for research entitled: “Weaving the Earth’s weak seams: Manifestations and mechanical consequences of rock fabric evolution in active faults and shear zones”

Supporting emerging researchers to develop their careers

In 2016 our Rutherford Foundation Trust awarded five postdoctoral fellowships and three PhD scholarships to outstanding emerging researchers with financial support from the Government.

2-year New Zealand Postdoctoral Fellowships to:

Dr Carolyn Boulton, Victoria University of Wellington, for research entitled: “Slipping fast and slow: How sediments influence Hikurangi subduction zone seismic hazard”

Dr Matthew Cowan, University of Canterbury, for research entitled: “Materials and process engineering for low-energy olefin/paraffin separations”

Dr Francis Hunter, University of Auckland, for research entitled “Using next-generation genetics to understand drug resistance in breast cancer”

Dr Benjamin Mallett, University of Auckland, for research entitled: “Shining a light on the interface: Spectroscopy of superconductor thin-film meta-materials”

Dr Nicholas Monahan, Victoria University of Wellington, for research entitled: “Does coherence make organic solar cells more efficient?”

3-year Cambridge Rutherford Memorial PhD Scholarship to:

Ms Efthimia Christoforou, University of Cambridge, for research entitled: “The role of placental endocrine function in determining the health of the mother and her offspring”

Ms Jessica Hiscox, University of Cambridge, for research entitled: “The impact of poverty focused initiatives on wildlife perception and human-wildlife conflict”

3-year International PhD Scholarships (a grant-in-aid) to:

Mr Maxim Jeffs, University of California, Berkeley, for research entitled: “Homological mirror symmetry”

ORCID Consortium will help close the loop on New Zealand’s research system

The New Zealand ORCID Consortium launched in October 2016, with the Society as the lead agency. ORCID is a global organisation that provides researchers with unique digital identifiers, which they link with their chosen professional activities. This removes ambiguity of who carried out research, especially for those who share the same name, or those who change their name. Research organisations and funders can build ORCID ID into their systems, which can then automatically source researcher information from ORCID and authoritatively confirm a connection with that researcher. The benefits of this include reduced data re-entry for researchers, better quality data and better tracking of research grant outcomes for organisations.

The role of the New Zealand ORCID Consortium is to support the adoption of ORCID by research organisations and funders in New Zealand with the assistance of the University of Auckland as the technology partner. As of December 2016, the consortium had 42 members, including universities, polytechnics, private and crown research organisations, health boards, government and research funders. This makes it the most diverse ORCID consortia yet and larger than the Australian ORCID Consortium. Overall, a wide adoption of ORCID ID in New Zealand will allow a better understanding of what drives discovery and innovation, closing the loop on New Zealand’s research system.

Powering Potential on climate change

Forty talented school students from around New Zealand were tasked to find answers to some of New Zealand's future problems around climate change, supported and guided by scientists and mentors, for Powering Potential in December 2016.

Organised by the Society and supported by Freemasons New Zealand, Powering Potential aims to excite the students about the future of science and technology and inspire them to want to contribute. 2016 was the second time it was run.

Working in small teams, the students addressed questions submitted by organisations. These questions included:

- How do New Zealand houses impact on climate change? What should we be doing to minimise this impact?
- How do we tackle emissions in the aviation sector given the current lack of alternative fuel sources?
- What greenhouse gas emissions might come from New Zealand agriculture in 2050?

The students researched, investigated and collaborated to provide recommendations to the submitted problems, which they presented to the organisations and a wider public audience.

Via written feedback, many students described the experience as 'life changing' and said it had taught them the importance of teamwork and had motivated them to pursue a career in science and technology. Staff from organisations that submitted questions also found it inspiring to meet and talk with such talented young people.

NZIFST/CREST Student Product Development Challenge

Dehydrated breakfasts, new and innovative vegetable dishes, protein enriched yogurt and spicy dried fish were some of the products developed by 72 secondary students and their teachers, from Dunedin to Auckland who participated in the 2016 NZIFST/CREST Student Product Development Challenge.

The Challenge gives senior secondary students the opportunity to experience, first hand, the innovative work done by scientists, technologists and engineers in New Zealand's food industry, and to raise the profile of a career in this industry. It also provides opportunities for professional development for teachers.

Teachers in Industry

Many employers are looking to employ students from their local schools but find that their skills and education don't add up to a suitable employee. Our Teachers in Industry programme, in the Franklin and Papakura education regions, connects local businesses, teachers, and career advice providers. Teachers visit local industry to see what it is they do and from that can consider how they might adapt their curriculum to include more practical skills or relevant skills for the workplace. Both teachers and businesses say they greatly value the programme. In 2016 there were 61 schools, 119 teachers, 29 businesses and 24 service agencies involved.

Science Teaching Leadership Programme

Changing how schools teach science requires both leadership from teachers and support from school management. Both elements are essential in this programme, and together they are resulting in better performance by students, and stronger connections between schools, science organisations in their areas and the community.

The Science Teaching Leadership Programme takes teachers out of school for two terms to experience working on research in a science organisation; and to do leadership training. The second part is essential because on returning to school, the teachers must work with their departments and management to ensure the best possible science programmes are implemented.

This year saw us reach more lower decile schools, increased Māori and Pasifika involvement, and improving student achievement in science. There are two intakes per year for this programme. In phase 1, placement with a science organisation, we had 16 and then 21 teachers; and for phase 2, implementation back at school, 57 and 55 teachers respectively.

Catalyst

The Catalyst Fund supports activities that initiate, develop and foster collaborations leveraging international science and innovation for New Zealand's benefit. It has four different sorts of funding, three of which are fully or partially managed by Royal Society Te Apārangi:

- Catalyst: Influence supports New Zealand science sector participation in, and membership of, key international science fora and targeted engagement
- Catalyst: Leaders supports targeted international fellowships for exceptional individuals
- Catalyst: Seeding to facilitate new small and medium pre-research strategic partnerships.

Catalyst: Seeding and Catalyst: Leaders have funded projects across all fields of research, science and technologies from chemical and physical sciences to law and psychology. In 2016, a total of 111 contracts have been funded with collaborators in 18 different countries. Project topics include ground water quality, Mt Ruapehu lahars, plastic and natural fibre composites and expectations infants have of robots.

The union delegates that were supported under Catalyst: Influence in 2016 are as follows:

Name	Union	Meeting Attended/ Date
Professor James Renwick	World Climate Research Programme (WCRP)	37th Session of World Climate Research Programme Joint Scientific Committee, Geneva, April 2016
Dr Philip Cowan	Pacific Science Association (PSA)	Council Meeting of the Pacific Science Association and the 23 rd Pacific Science Congress – Science towards Sustainability, Taipei, June 2016
Professor Bryan Storey	Scientific Committee on Antarctic Research (SCAR)	SCAR Delegates meeting and Open Science Conference 2016, Kuala Lumpur, August 2016
Professor Michael Roache	International Geographical Union (IGU)	33rd International Geographical Congress, Beijing, August 2016
Professor Rosalind Arche	International Union of Theoretical and Applied Mechanics (IUTAM)	24th International Congress of Theoretical and Applied Mechanics, Montreal, August 2016
Associate Professor Robin Peace	International Social Science Council (ISSC)	ISSC General Assembly Joint with International Council for Science (ICSU), Oslo, October 2016

Discover

We recognise the discoveries that New Zealanders make through their research, from school children through to researchers at the top of their field.

Diverse range of researchers and scholars elected as Fellows

Nineteen researchers and scholars with a range of research interests, backgrounds and places of work were elected as Fellows of our Academy in 2016. The new Fellows included a majority of females – ten out of nineteen – two Fellows from Crown Research Institutes, one Fellow from a private research organisation, two Fellows with Māori ethnicity and one with Asian ethnicity. The first female mathematician was also elected.

Prior to the selection round, we encouraged nominations from as broad a pool of candidates as possible. We also updated selection criteria and ran workshops on unconscious bias to ensure no one was disadvantaged. We are pleased that this approach resulted in a more diverse group of new Fellows – selected entirely on merit – which is more representative of our community of researchers and scholars.

The new Fellows are:

Professor Jacinta Ruru, University of Otago and Co-Director of Ngā Pae o te Māramatanga, New Zealand's Māori Centre of Research Excellence, whose work is at the forefront of defining the area of law on how the legal system of former colonies ought to recognise Indigenous peoples' interests in land and water.

Dr Judi Hewitt, Principal Scientist at NIWA whose interdisciplinary contributions have advanced fundamental knowledge of marine biology and advanced environmental science.

Professor Tony Merriman, University of Otago, who has made major contributions to the pre-clinical and clinical science of autoimmune diseases and gout in New Zealand, particularly amongst Māori and Pacific people.

Professor Donna Rose Addis, University of Auckland, who has pioneered the use of functional brain imaging to study how the brain stores and retrieves memories in healthy subjects and those suffering from disorders, such as amnesia, clinical depression, and dementia.

Professor Rod Dunbar, University of Auckland, whose studies of human cellular immunology, especially T cell responses to tumours arise and how these T cell responses can be stimulated in cancer therapy, have accelerated the advent of successful cancer immunotherapy.

Professor Hinke Osinga, University of Auckland, who is a specialist in dynamical systems theory, the mathematical analysis and prediction of behaviour that changes with time. She is at the forefront of developing and employing numerical methods for computing global objects known as invariant manifolds that are indicators of critical change or 'tipping points.'

Professor Hong Di, Lincoln University, who has led pioneering research into nitrate leaching and nitrous oxide emissions from intensive dairying systems, leading to mitigation technologies.

Professor David Crow, University of Otago, a geologist who has advanced knowledge of the relationship between plate tectonics and mineral deposits and latterly New Zealand fauna such as fresh water fish.

Professor Rosalind Hursthouse, University of Auckland, who has had a profound impact on the field of ethics in philosophy. She has been a leading figure in the development of the approach known as virtue ethics.

Professor Lynnette Ferguson, University of Auckland, who is a world leader in nutritional genomics with an international reputation in mutagenesis and in the causes and control of chronic disease.

Professor Stephen May, University of Auckland, who is regarded as a world authority on language rights and an international expert in the related fields of indigenous language and bilingual/immersion education and multilingualism.

Professor Peter Shepherd, University of Auckland, who has made important contributions to understanding how defects in a cell signalling pathway contribute to cancer and diabetes.

Professor Cris Shore, University of Auckland, who has developed new theoretical approaches and methodologies for analysing policy, power and organisations. He is internationally recognised for his work on the anthropology of policy, the EU and university reform.

Dr Skelte Anema, Fonterra Research and Development Centre, who is an expert in the interactions between milk proteins under different physical and chemical conditions. His work has led to solutions to difficult processing problems, new dairy products and six patents describing innovative dairy technologies.

Dr Jenny Juengel is an AgResearch scientist whose research effort has focussed primarily on understanding how genetic mutations in sheep have influenced their reproductive outcomes. A major outcome of her research is the identification of a major cell responsible for advancing or inhibiting fertility.

Professor Linda Tuhiwai Smith, University of Waikato, who is an outstanding Māori scholar in the social sciences whose research on 'decolonising' research methodologies has reshaped inquiry across many domains in the sciences and humanities.

Professor Parry Guilford, University of Otago, who has made international contributions to the fields of cancer biology and cancer genetics, identifying the first known gene for inherited gastric cancer and developing a biomedical device to test for bladder cancer in urine.

Professor Annie Goldson, University of Auckland, who is an acclaimed documentary film maker who has made a sustained contribution to humanities scholarship and film culture, forging a dialogue between these two domains.

Professor Kathleen Campbell, University of Auckland, who is at the forefront of unearthing evidence for past life in 'extreme' environments, thereby contributing to the search for life's origins and bio-signatures on other planets.

The Society also announced the election of two Honorary Fellows, aimed at encouraging strong ties with leading international scientists and scholars and New Zealand's research community.

Professor Grant Montgomery, University of Queensland, has pioneered genomic methods for production trait identification in farm animals and contributed to worldwide genome mapping for complex diseases, leading to breakthroughs in important diseases like endometriosis. He completed a PhD from Massey University, held appointments at AgResearch and University of Otago and continues to collaborate with research groups in New Zealand.

Professor Chris Simon, University of Connecticut, uses the tools of molecular biology to answer questions related to the origin, spread and conservation of biological diversity, using cicadas as a model organism. Her research has allowed better understanding of the family tree of cicadas and relationships with past climates and landforms and even the role of song.

CREST Team Gold: Keep it shut, then flush it out

This was the finding on how to minimise exposure to pollution when using indoor car parks from Team Gold CREST recipients Michelle Schneideman and Susie Kwon, from Epsom Girls Grammar School.

They researched whether differences in driver behaviour in regards to the ventilation settings of the car and the level the car was parked on, as well as the location of the ticket machine, affected the levels of carbon-monoxide exposure on the car-park user.

From the project the students learned they needed to have a practical mindset but also allow room for creativity. “We constantly asked ourselves questions to refine our method to meet our aim; Would a car park user really do this? How would we be able to keep this variable constant? What if we placed the ticket machine there instead of here? By constantly changing and refining our method, we also needed to learn to be flexible and be open minded,” said Susie Kwon.

Despite being overwhelmed by the topic at first Michelle Scheideman said research became a highlight of the project. “I thoroughly enjoyed reading and writing notes about how carbon monoxide is harmful to the human body and how, after being exposed to oxygen in the air, it binds and forms carbon dioxide which is harmful to the environment.”

Michelle and Susie were mentored by Associate Professor Kim Dirks (University of Auckland) and supported by Mr David Haylock (Aurecon) and were presented their medals by Royal Society Te Apārangi President, Professor Richard Bedford QSO FRSNZ at a special ceremony.

Celebrating New Zealand’s researchers

A highlight of our year is to recognise the outstanding discoveries and achievements of researchers working in the fields of sciences, social sciences, technology and the humanities at the New Zealand Research Honours Dinner. These researchers and scholars help us better understand the world we live in.

The medal winners’ research in 2016 covered some intriguing problems. How did human language evolve? How can school leaders best enable students to learn successfully, or teach literacy? How does light move in fibre optic cables? Can we mimic muscle movement using polymers? Is it possible to model a respiratory system? What impact have colonial ways of thinking had?

The **Rutherford Medal**, the Society’s premier award, was received by **Emeritus Professor Michael Corballis** ONZM FRSNZ of the University of Auckland for his research into the human mind. His work includes understanding the differences in the two hemispheres of the brain, the evolution of language and the human capacity for ‘mental time travel’ where we can think about both the past and future.

The **Pickering Medal** was awarded to **Associate Professor Iain Anderson** for commercialising electroactive polymer technology that can mimic muscle action. He directs the Biomimetics Lab at the Bioengineering Institute of the University of Auckland and launched the highly successful StretchSense company with two of his former students, which has commercialised this research.

The **Thomson Medal** for science leadership was awarded to **Dr Bruce Campbell** of Plant and Food for his contributions to agriculture and horticulture, which has led to innovations in grazing crop, wine, kiwifruit and avocado sectors. The awarding of the medal also recognises how he has fostered both new science talent and beneficial linkages between science, business and the wider community.

Professor Hamish Spencer FRSNZ, University of Otago, received the **Callaghan Medal** for science communication for his leadership of successful partnerships engaging public in scientific activities involving

the Allan Wilson Centre and both Uawa/Tolaga Bay and Ngai Tāmanuhiri. The awarding of the medal recognises these self-sustaining projects as exemplars of future public participatory partnerships.

Professor Merryn Tawhai, Deputy Director of the Auckland Bioengineering Institute at the University of Auckland, was awarded the **MacDiarmid Medal** for her research to create anatomically detailed models of the respiratory system. The medal is awarded for outstanding scientific research that has the potential for human benefit, and the models created by Professor Tawhai provide new tools for diagnosis, prognosis and treatment of lung disease.

The **Hector Medal** for an outstanding advancement in the physical sciences was awarded to **Associate Professor Stéphane Coen**, University of Auckland, for his research into optical phenomena in optical fibre. He has observed pulses of light, called temporal cavity solitons, that can self-organise to travel around a loop of fibre optic cable and linked understanding of these to optical frequency combs. Frequency combs, heralded through the 2005 Nobel Prize in Physics, are fundamental new tools for high-precision scientific measurement.

Research into seaweeds has earned **Professor Wendy Nelson** MNZM FRSNZ, of NIWA and University of Auckland, the **Hutton Medal** for plant sciences. She has significantly expanded knowledge of New Zealand seaweeds and the evolutionary relationships between seaweeds worldwide. She has also campaigned against seaweed pests and advanced understanding of the ecological importance of coral seaweeds and their vulnerability to climate change.

Professor Tony Ballantyne FRSNZ, University of Otago, was awarded the **Humanities Aronui Medal** for reshaping scholarly thought on British imperial history. His research on the history of the British empire during the nineteenth century has shown how ideas about cultural difference (race, religion, language and gender) structured colonial power, and how these ideas influenced and continue to influence both colonised and colonising people. His idea of the 'web of empire' draws attention to the importance of both direct connections between Britain and its colonies and connections between colonies.

The **Mason Durie Medal** for social sciences was awarded to **Distinguished Professor Viviane Robinson**, University of Auckland, for her research and development work on educational leadership. She identified that school leadership styles effected student outcomes and has designed and evaluated interventions to increase school leader's skills to improve student learning and well-being. Her resources are being used in New Zealand, Australia and Scandinavia under licence.

Professor Stuart McNaughton ONZM, University of Auckland, was awarded the **Dame Joan Metge Medal** for excellence in research and capacity building in the social sciences. Professor McNaughton has pioneered techniques that allow schools to improve teaching outcomes by monitoring their own results, and adjusting teaching approaches accordingly, particularly in literacy and language development. His research has had a large impact on education policy nationally and internationally.

Emeritus Professor Alastair Scott FRSNZ, University of Auckland, has sadly recently passed away. He was awarded the **Jones Medal** for his lifetime contribution to statistics. The medal recognised him as a world leader in the areas of survey sampling theory and analysis of case control studies. His methods are applied in a wide range of application areas and he also contributed substantially to research in public health.

Professor Rick Millane, University of Canterbury, was awarded the **T.K. Sidey Medal** for his research into using electromagnetic radiation to image biological material. His theoretical and computational methods for imaging biological molecules and tissue using x-rays and optical radiation allow their structures to be determined, which is key to understanding disease for drug design and for non-invasive medical imaging.

Professor Richard Beasley CNZM FRSNZ, Medical Research Institute of New Zealand and Capital & Coast District Health Board, was awarded the **Sir Charles Hercus Medal** for his wide ranging contributions to advancing respiratory medicine and health science research in New Zealand, which have had a major impact on clinical practice and public health.

Prime Minister's Science Prizes

The Society manages the Prime Minister's Science Prizes. The five prizes recognise the impact of science on New Zealanders' lives, celebrate the achievements of current scientists, teachers and science communicators and encourage those of the future. The award ceremony for the 2016 winners was held in February 2017.

The Prime Minister's 2016 Science Prize was awarded to the team of University of Otago researchers, led by **Professor Richie Poulton**, behind the **Dunedin Multidisciplinary Health and Development Study**, credited with providing the most detailed data on human development ever amassed.

The study, based on researching the lives of about 1,000 children born in Dunedin in 1972 and 1973, has enabled evidence-based health and social policy-making and changed the way policy makers, clinicians and practitioners think and act, both in New Zealand and overseas.

The raft of changes that have resulted from the 44-year-old Dunedin Study include the introduction of safety matting to prevent playground injuries, shortening the length of electric jug cords to reduce scalds and burns, influencing judicial practices by identifying antisocial behaviour stemming from childhood and understanding the later-life effects of adolescent cannabis use.

The Prime Minister's 2016 MacDiarmid Emerging Scientist Prize was awarded to **Professor Brendon Bradley** from the University of Canterbury, who is leading worldwide research into the effects of ground shaking caused by earthquakes. Dr Bradley's research is being used to set new building design codes internationally, putting emphasis on more robust designs for buildings and infrastructure of critical importance, such as hospitals, telecommunications headquarters and office blocks occupied by large numbers of workers. The Prize recognises Dr Bradley's sophisticated seismic hazard analysis and assessment modelling, and his pioneering ground motion simulation to identify and mitigate earthquake impacts.

The Prime Minister's 2016 Science Teacher Prize was, for the first time, won by a primary school teacher—Dianne Christenson, who is the curriculum leader for science at Koraunui School in Stokes Valley near Upper Hutt. Under Dianne's leadership, students at Koraunui School work in the garden, the river, the ocean and the kitchen, getting the opportunity to explore, take risks, get used to failure and have fun while they're doing it.

Among the projects initiated under Dianne's leadership are installing beehives at the school, making and selling natural balms and creams, students building a shed to store garden tools, supporting the establishment of a school taro patch and cleaning rubbish from local waterways. Dianne has been a participant of the Science Teaching Leadership Programme run by the Society.

The Prime Minister's 2016 Future Scientist Prize was won by former Onslow College student Catherine Pot who tackled a problem that no other New Zealand student competing in the 2016 International Young Physicists' Tournament wanted to take on. Catherine investigated the van der Pauw method, which is used in experimental semiconductor physics in many university labs, and came up with an experimentally-verified way of improving the technique so it can be more widely applied.

The Prime Minister's 2016 Science Media Communication Prize was presented to Dr Rebecca Priestley, who is committed to communicating science in a way that helps people make informed decisions about important issues facing society. Dr Priestley is a senior lecturer in the Science in Society Group at Victoria University of Wellington and author of books and articles about science. She says the role of science communication in democracy is crucial because people need to be able to understand, discuss and ask informed questions about issues such as climate change, water quality and emerging technologies to make decisions about their future. Rebecca's career in science communication spans more than 20 years and includes having written more than 200 science articles and features for the weekly magazine the *New Zealand Listener*.

Share

We support the sharing of new knowledge so that all New Zealanders have access to the latest information.

Focus on climate change and New Zealand

What will climate change mean for New Zealand and what can be done to reduce the risks? Providing the public answers to these questions was a strong focus of the Society in 2016 with the publication of two major reports and a number of public events and activities on this topic. The reports were unique in pulling together information from a wide range of fields for a New Zealand context.

The first panel identified six key areas of risk for New Zealand that could have significant implications for New Zealand's prosperity and well-being. These were:

- coastal margins
- flooding from rivers
- availability of and competition for freshwater
- changes to our surrounding oceans
- threats to our unique ecosystems
- flow on effects from climate change impacts and responses overseas.

Given that many New Zealanders live on the coast and two-thirds of us live in flood-prone areas, we are vulnerable to the expected rises in sea-level and extreme weather events. Freshwater resources will also be put under pressure, with decreasing annual average rainfall in eastern and northern regions of both islands, plus higher temperatures and increased demand from urban expansion and agriculture.

Fire danger is also predicted to increase in many parts of New Zealand.

Changes in the oceans, including water temperature, acidification and currents will have impacts on New Zealand's marine life, including aquaculture. On land, existing environmental stresses to New Zealand's unique species will likely be exacerbated, with increased ranges for animal pests and weeds predicted.

The Climate Change Implications for New Zealand panel members were Professor James Renwick (chair), Dr Barbara Anderson, Dr Alison Greenaway, Darren King, Dr Sara Mikaloff-Fletcher, Dr Andy Reisinger and Dr Helen Rouse.

The second panel identified the opportunities to mitigate climate change in sectors of heat and electricity supply, transport, buildings, industry, agriculture, and forest and other land-use. Mitigation is where we take action to either reduce greenhouse gas emissions or support their removal from the atmosphere.

The report *Transition to a Low-Carbon Economy for New Zealand* found there were good opportunities to mitigate climate change in all sectors, including:

- reducing fossil fuel use;
- increasing renewable electricity;
- using low carbon transport, eg electric cars, buses, rail

- managing energy use in buildings
- improving energy efficiency
- considering trade-offs in agriculture
- planting forests (may only be an interim solution)
- supporting low-carbon choices.

The report also considered the interactions between technology, policy and behaviour and the factors that either limit or provide opportunities for change, and gaps in our knowledge.

The Climate Change Mitigation Options for New Zealand panel members were Professor Ralph Sims (Chair), Professor Barry Barton, Dr Paul Bennett, Dr Nigel Isaacs, Dr Suzi Kerr, Associate Professor Jonathan Leaver, Dr Janet Stephenson and Dr Andy Reisinger.

Discover more at royalsociety.org.nz/climate

What we know about sugar and health

Sugar and health is a topic that is surrounded by mixed messages in the New Zealand community and media. In 2016 the Society set out to remove some of the confusion by providing a review of the latest research on sugar and health as well as an easy-to-understand animation and fact sheets published in English, Te Reo, Tongan and Samoan.

The review found that excessive consumption of sugar is harmful for health and hard for consumers to avoid because it is difficult to work out how much added sugar is in food and drink.

Current WHO guidelines put excessive consumption at over 12 teaspoons of added sugar per day for most people. To further promote health, the WHO recommends keeping sugar intake for adults and children to below 6 teaspoons per day, but the guidelines do not apply to sugars found in whole fruits, milk and vegetables.

Food labelling in New Zealand does not allow consumers to assess how much sugar has been added to food and drink, making it difficult to follow these recommendations.

With a typical can of sugar-sweetened fizzy drink containing 9 teaspoons of sugar, and sugar added to a wide range of food products in New Zealand, including items we think of as savoury, it is likely that many New Zealanders are exceeding these guidelines regularly, if not every day.

Research studies show that large intakes of sugar in the diet leads to weight gain and dental decay. High sugar intakes are also associated with metabolic diseases such as obesity, type-2 diabetes, heart disease and gout.

Research is looking at causes of high levels of fat in the blood, insulin resistance, fatty liver disease, abdominal fat gain and increased blood pressure and whether different sugars, such as fructose, may have different effects because they are processed differently in the body.

The following experts provided guidance on this review: Dr Helen Eyles, Dr Kim Mellor, Dr Lisa Te Morenga, Professor Paul Moughan FRSNZ, Professor Elaine Rush, and Professor Grant Schofield.

Discover more at royalsociety.org.nz/sugar

Revolution in gene editing

New gene-editing techniques are revolutionising the ease and accuracy of making changes to genetic material. They have huge potential benefits in many sectors including healthcare, agriculture and conservation but are not without risks.

To help us all understand the advances occurring in gene editing, we prepared a fact sheet, infographics and an animation in simple language, explaining current gene-editing technologies and what they are already being used for around the world.

The following people assisted in creating these resources: Professor Barry Scott FRSNZ, Professor Peter Dearden, Associate Professor Peter Fineran, Professor Neil Gemmell, Professor Emily Parker and Professor Andrew Allan.

The Society also convened a multidisciplinary panel to consider the implications of gene-editing technologies for New Zealand, including the research, ethical, social, legal, regulatory, environmental and economic considerations. The panel will release information on these different topics over the next year.

The panel members are Dr David Penman, Professor Barry Scott FRSNZ, Dr Jane Allison, Professor Peter Dearden, Professor Alexi Drummond FRSNZ, Professor Gary Hawke FRSNZ, Professor Mark Henaghan, Irene Kereama-Royal, Professor Lisa Matisoo-Smith FRSNZ, Associate Professor Susan Morton, Dr Richard Newcomb, Professor Joanna Putterill, Professor Stephen Robertson and Dr Phil Wilcox.

Discover more at royalsociety.org.nz/gene-editing

Cutting-edge research for MPs

The Speakers Science Forum, established in 2003, aims to present the latest research to MPs to inform the issues being addressed in Parliament. The events are held in partnership with Science New Zealand, Universities New Zealand, and the Independent Research Association of New Zealand. In 2016 the following expert presentations were presented at the Forum:

Protecting New Zealanders in an electrically connected world, by Dr Ryan Ko and Professor Craig Rodger.

Reducing the cost of delivering healthcare – challenging established practice, by Distinguished Professor Ian Reid FRSNZ and Professor Richard Beasley FRNSZ

How will New Zealand be impacted by the nanotechnology revolution?, by Dr Michelle Dickinson and Dr Murray McCurdy

What more can the primary sector deliver? by Dr Richard McDowell and Dr Warren Parker

Implications of Climate Change for New Zealand by Professor James Renwick and Dr Suzi Kerr.

Varied programme of events to interest all New Zealanders

Our events to share new knowledge with New Zealanders in 2016 included:

Talking Science – on how to present the big issues in science in New Zealand and internationally. Dr Guilio Selvaggi, Director, National Earthquake Centre, Italy; Associate Professor Maxwell Boykoff, University of

Colorado-Boulder, US; Professor Massimiano Bucchi, University of Trento, Italy; plus discussion panels involving four New Zealand researchers.

Dr Adam Rutherford, BCC who chaired **Gene Genie**, a series of five panel discussions on the topic of genetics involving 15 New Zealand researchers.

Professor Jean Palutikof, Griffith University, Australia on **managing climate change**.

Laureate Professor Ingrid Scheffer, paediatric neurologist at University of Melbourne on **epilepsy**.

Professor Jim Skea, Chair, IPCC Working Group 3 and President of UK Energy Institute on **scientific solutions to climate change**

Bill Oddie, comedian, author, conservationist and BBC wildlife presenter.

Journey to Mars – Dr Dava Newman, NASA Deputy Administrator on the research underway to get humans to Mars and back.

Dr Graham's Scientific Funomena – a family show with Dr Graham Walker from Australian National University who blasted, ignited and exploded his way through some astonishing experiments with families from harder-to-reach rural communities in central Otago.

UK Young Scientist of the Year 2016, Roxanne El-Hady, 18, shared her enthusiasm and experiences in science and work on climate change with young female students.

2016 Hamilton Lecture on the **possible origins of antibiotic resistance** from a biochemistry perspective with Dr Valerie Soo.

Cities of Tomorrow panel discussions chaired by Kim Hill with French and New Zealand and French experts looking at how we can make our burgeoning cities more sustainable.

UK science presenter and author Alok Jha on the extraordinary **history of water** on planet Earth.

Jim Flynn FRSNZ, internationally acclaimed expert on human intelligence and author of the Torchlight List on **books worth reading**.

Professors James Renwick and Tim Naish FRSNZ gave a lecture tour on '**Ten things you didn't know about climate change**', with additional venues added to the 10 planned centres due to popular demand.

Distinguished Professor Ian Reid FRSNZ gave 2016 Rutherford lecture 'Big Steps Forward' on research behind **treating bone diseases** such as osteoporosis.

Screening of film adapted from famous novel **Romanzo criminale** by Italian judge Giancarlo de Cataldo, including introductory discussion with public, scholars of film and Italian studies from Victoria University of Wellington.

Professor Konai Helu Thaman gave the 2016 New Zealand Aronui Lecture about the **importance of culture in teaching and learning**.

Society now a sponsor of Ockham New Zealand Book Awards

2016 saw the Society become the general non-fiction sponsor of the Ockham New Zealand Book Awards, reflecting our multi-disciplinary focus encompassing science, technology and humanities. We recognise the importance of national literature in sustaining and extending thinking about national issues. This involvement supersedes our Science Book Prize, which we ran in alternate years since 2009.

Guidelines to help researchers better engage with the public

In July 2016 we published public engagement guidelines for researchers, called for as part of the Government's plan *A Nation of Curious Minds He Whenua Hihiri I Te Mahara; A National Strategic Plan for Science in Society*.

Following consultation meetings around the country, the *Public Engagement Guidelines for Researchers, Scholars and Scientists* are based on three principles:

- that society benefits from being engaged and informed about new knowledge and its application
- that differing contexts of engagement bring different obligations
- that acting with professionalism and transparency are necessary to build and maintain public trust.

These guidelines complement our *Code of Professional Standards and Ethics*, which applies to our members. The guidelines will be reviewed after January 2018 with experience gained from their use and further engagement with Māori, business and non-profit communities. A particular focus will be on how specific knowledge systems such as mātauranga Māori enrich and add new dimensions to many fields of intellectual endeavour of value to society.

Wide ranging special issues published in journals: from grounding of the MV *Rena* to arachnids

To help researchers share their discoveries with other researchers, we publish seven peer-reviewed science journals and one peer-reviewed social science journal, of relevance to both New Zealand and international researchers, with a geographical scope of Australasia, the Pacific basin, Antarctica, and other countries with similar climates to New Zealand.

The journals seek to:

- enhance dissemination of research relevant to New Zealand
- provide opportunities for New Zealand authors to publish their research
- make the results of this research readily available.

Four issues are published for each journal a year, except for *Kōtuitui: New Zealand Journal of Social Sciences Online*, which is issued twice.

In March 2016 four special issues were published. The *Journal of the Royal Society of New Zealand* commemorated the life and work of Tony Whitaker, a prominent New Zealand herpetologist. The special issue was guest edited by Dr Don Newman formerly of the Department of Conservation and Dr Kelly Hare from Victoria University of Wellington. This issue hosted five papers by New Zealand researchers currently working in this area, building on Whitaker's work.

The New Zealand Journal of Geology and Geophysics published a special issue on advances in geodesy and active tectonic deformation. This issue was published in memory of Dr John Beavan, from GNS, who died in 2012. Sixteen papers were published, all building on John Beavan's work, giving insights into active plate boundary processes in New Zealand. This issue was guest edited by a team of researchers from GNS and from the University of Texas.

The New Zealand Journal of Zoology published a collection of writings in honour of Professor Robert Jackson, a prominent New Zealand arachnologist, marking his retirement. The articles reflect the ways in which his

work has influenced other arachnologists around the world, and include a biography and seven papers. This was guest edited by Dr Fiona Cross from the University of Canterbury and Dr Cor Vink of Canterbury Museum.

The New Zealand Journal of Marine and Freshwater Research published a special issue on the MV *Rena*: Cross Disciplinary Investigations into the Effects of Oil, Contaminants and Debris, guest edited by Dr Phil Ross, Professor Chris Battershill, Professor Conrad Pilditch, University of Waikato, and Distinguished Professor David Schiel, University of Canterbury. Eleven papers on the chemical, toxicological and ecological studies that took place after the grounding of the MV *Rena* were presented.

In June 2016 *The New Zealand Journal of Botany* published a special issue on the ecology and biogeography of south-temperate forests, guest edited by Dr Matt McGlone, formerly of Landcare Research, Dr Chris Lusk of University of Waikato and Dr Juan Armesto of Pontificia Universidad Católica, Chile. Eight papers covered a range of topics concerning the temperate forests of New Zealand, Australia and southern South America.

In July 2016 *Kōtuitui* published a special issue entitled “Social movements, resistance and social change in Aotearoa New Zealand”, which was guest edited by Dr Ozan Nadir Alakavuklar (Massey University) and Dr Andrew Dickson (Massey University). The issue comprised six articles by New Zealand researchers covering a range of topics related to society in New Zealand.

Science Media Centre: a trusted source of science-related information

Our Science Media Centre continued to adapt to the changing needs of the media and scientists in 2016 as it strives to improve the breadth and quality of science-related coverage and better engage New Zealanders with science.

They provided extensive expert commentary on three of the biggest stories of the year: the Zika virus and the Rio Olympics, the campylobacter outbreak in Havelock North and the Kaikoura earthquake.

They also launched a new product for journalists, the Expert Q&A series, which replace the SMC’s online briefings for journalists, reflecting the increasing unavailability of journalists to dial into press briefings. The Expert Q&As have been very well received and found their way into a wide range of publications.

New and more flexible formats for their Science Media SAVVY communication workshops saw them train more researchers than in any other period, which has heightened demand for their flagship two-day Science Media SAVVY workshop. Their partnership with Ngā Pae o te Māramatanga to offer media training workshops for Māori researchers resulted in 20 researchers completing the two day programme at workshops in Auckland and Dunedin as one example.

Sciblogs, the platform for science blogs hosted by the Science Media Centre, maintained its place in the top 10 list of most frequented New Zealand blogs, the only science-related blog in the list. New bloggers joined the stable, including conservation biologist, Dr Helen Taylor and natural hazards expert Associate Professor Julie Rowlands.

The increase in traffic to the Scimex website over 2016 also points to increased interest from the public as people search for reliable science-related information online.

Royal Society Te Apārangi

Supporting New Zealanders to explore, discover and share knowledge.

Our strategic goals

Our 2015–2018 strategic plan set out six objectives:

- An informed and educated New Zealand
- Relevant and influential expert advice
- Recognition of excellence across the breadth of research and scholarship
- Best practice in research and scholarship
- An engaged Academy and membership
- A progressive, smart and responsive organisation.

On top of these we have cross-cutting themes of diversity and international reach.

Embracing diversity in all that we do

One of our cross-cutting themes set out in our strategic plan 2015–2018 was embracing diversity in all we do. In 2016 the Society published a diversity statement, outlining our commitment to providing an inclusive and diverse environment throughout the Society and our processes.

We refined the eligibility criteria of many of our selection processes to ensure equal opportunity for all regardless of different characteristics, including gender, gender identity, sexual orientation, marital status, ethnic background, employment context, religion, culture, disability, economic background and education. Many selection panels received unconscious bias training to be aware of their unperceived biases.

The Society also contributed to a national working group for diversity and equity issues for the New Zealand research community.

Enhancing international reach and impact of New Zealand research and the Society

Our other cross-cutting theme in our strategic plan 2015–2018 was on extending international reach.

As part of the launch of our 150th celebrations in April 2017 we held an international symposium in Wellington with 17 different Academies from Europe, UK, China, Finland, Canada, Australia and the Pacific; international academies, and the Assistant Director General of UNESCO along with valued researchers from CRIs, universities, independent research organisations and government agencies. Topics discussed ranged over the challenges academies face today including staying relevant, supporting diversity, promoting research integrity and reaching out to developing nations.

We refreshed our own international strategy in 2016 which ensures we are:

- sharing good practice and collaborating with a broadening range of similar bodies
- developing opportunities for New Zealand researchers to undertake leadership roles in the global research community
- collaborating with Pacific Island Forum (PIF) nations in science, technology and the humanities.

MBIE requested the Society's feedback on their own draft International Science Strategic Action Plan.

Freedom and responsibility in the conduct of research

Royal Society Te Apārangi picked up responsibility for the role of Executive Secretary to the Committee on Freedom and Responsibility in the Conduct of Science (CFRS) in October 2016. CFRS is a committee of the International Council for Science (ICSU) – a non-governmental organisation with a global membership of national scientific bodies (122 members, representing 142 countries) and International Scientific Unions (31 members). The role provides an opportunity for the Society to promote good research practice and raise New Zealand's profile within the international research community.

CFRS serves as the guardian of ICSU's Principle of Universality of Science, adherence to which is a condition for ICSU membership. The committee's mission is to raise international awareness of, and promote, freedom and responsibility in the conduct of science. It does this by issuing advisory material, organising scientific meetings and by considering cases of individual scientists where the Principle of Universality of Science is violated.

Dr Roger Ridley, Director of Expert Advice and Practice at the Society, is currently filling the role and works with the ICSU secretariat in Paris in providing services to the committee. The New Zealand Government has committed to providing part-time funding support for five years.

Discover more at icsu.org/about-us

Early Career Researchers Forum

In March 2016 our Early Career Researcher (ECR) Forum was formed. The Forum Committee is made up of early career researchers, currently led by Dr Jane Allison, Massey University. It seeks to represent the national voice of New Zealand's ECR community and celebrate their achievements and contributions in the fields of physical, biological, and social sciences, as well as the humanities.

The Forum is dedicated to engaging New Zealand ECRs on the issues important to them and fostering a collaborative, communicative, and respected community under the auspices of Royal Society Te Apārangi.

In its first year the forum has held a number of events and activities including issuing media releases on issues of concern, encouraging members to take part in training activities to better communicate their research and keeping all forum members up to date on current news and opportunities.

Survey on how we can best support the research community

In early 2016 we ran a survey to gather ideas and feedback about how we can best support the professional needs of the research community. We are grateful to the 1,000-plus researchers who responded (thank you if you were amongst them).

Almost 80% of the respondents had interacted with the Society and most said their experience had been positive. There was mixed knowledge of our activities, with respondents either not knowing about some of our long-running programmes or thinking we run activities that we don't. Although most respondents view us as largely independent, there was an almost universal desire for us to be more independent and to advocate for the research community. This last issue is a slight misinterpretation of our role, which is to advocate for the public interest.

There was a strong appetite for more services from the Society, especially from early career researchers. The most popular requests were for networking opportunities, input into expert advice, and recognition as a competent researcher. Women were particularly interested in mentor support, guidelines for applying for research funding and opportunities for professional development. The two terms most strongly associated with the Society were 'well meaning' followed by 'knowledgeable'.

New membership structure and online portal

In 2016 we began work to update our membership structure. We added the category of Friend for those who wish to join with us to support the work we do and our Member categories are now for those who are engaged in the knowledge sector in New Zealand.

Our 47 Constituent Organisations help us identify and address issues relevant to the research, knowledge and innovation sectors, and link into the research information and activities that we undertake.

Our 10 Affiliate Organisations cover a diversity of disciplines, including policy, science education and the museum sector.

We have 10 regional branches located from Auckland to Otago.

In 2016 we launched a new online membership portal, called MyPortal, which allows our Fellows, Companions, Members and Member Organisations to easily and securely update contact details and their professional profile, view current and previous fee invoices, pay annual subscription fees, and more.

Looking forward: Celebrating 150 years

During 2017 we are celebrating 150 years of discovery, and supporting the pursuit of knowledge. A six-month programme of events was kicked off with an international symposium in April and will end on 10 October 2017 which marks 150 years from the day that legislation was signed, establishing the New Zealand Institute, as the Society was previously called.

Our new branding, involving a stronger connection to New Zealand culture with our new name Royal Society Te Apārangi, and a new website with improved accessibility and functionality are part of our 150th refresh.

To discover more and celebrate with us visit: royalsociety.org.nz/150

Our people

During 2016 our Chief Executive was Dr Andrew Cleland FRSNZ and our members of council were:

Emeritus Professor Richard Bedford QSO FRSNZ, President

Professor Gaven Martin FRSNZ, Vice President – Physical Sciences, Mathematical Sciences, Technology and Engineering

Professor Dame Anne Salmond CBE FRSNZ FNZAH – Humanities and Social Sciences

Professor Barry Scott FRSNZ, Vice President – Biological and Life Sciences

Dr John Caradus FRSNZ, Councillor

Dr Liz Gordon, Constituent Organisation Representative

Associate Professor Christine Jasoni, Branches' Representative

Professor Tahu Kukutai, Co-opted Councillor

Professor Caroline Saunders ONZM, Councillor

Professor Margaret Tennant FRSNZ, Co-opted Councillor

Professor Linda Tuhiwai Smith CNZM, Co-opted Councillor

Dr Siouxsie Wiles, Councillor

Financial information

Our audited 2016 Financial Statements are available online. Visit royalsociety.org.nz/financial.